



TECHNISCHE  
UNIVERSITÄT  
DARMSTADT

**A VERY COOL TOPIC**

vom Fachbereich Informatik  
der Technische Universität Darmstadt  
genehmigte Dissertation  
zur Erlangung des akademischen Grades  
Doktor-Ingenieur (Dr.-Ing.)

VON NAME OF THE STUDENT, M. SC.

geboren am 1. Januar 1970 in Darmstadt, Deutschland.

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Tag der Einreichung: 24. April 1337  
Tag der Disputation: 24. April 1337

Darmstadt 1337  
Hochschulkennziffer D17



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*Ohana* means family.  
Family means nobody gets left behind, or forgotten.  
— Lilo & Stitch

Dedicated to the loving memory of Rudolf Miede.  
1939–2005



## ABSTRACT

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Short summary of the contents in English...a great guide by Kent Beck how to write good abstracts can be found here:

<https://plg.uwaterloo.ca/~migod/research/beck00PSLA.html>

## ZUSAMMENFASSUNG

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Kurze Zusammenfassung des Inhaltes in deutscher Sprache...



## ACKNOWLEDGMENTS

---

*I would like to express my deepest gratitude to my parents and my family for supporting me in all the years of my studies and also while writing this thesis.*

*Special thanks for giving helpful advice while writing this thesis goes to Prof. Matthias Hollick and Adrian Loch.*

*Furthermore, I especially thank Sandrine Adélaïde and Adrian Loch for proofreading my thesis.*





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## LISTINGS

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## ACRONYMS

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SNR    signal-to-noise ratio

## PREVIOUSLY PUBLISHED MATERIAL

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This thesis includes material of previously published conference papers and articles. Following the regulations of the Department of Computer Science at Technische Universität Darmstadt, I list below the affected parts that include verbatim and rephrased fragments from these publications.

### CHAPTER 1

- Section [1.1](#) revises Section 1 of all papers ...



## COLLABORATIONS

---

Systematically investigating a technical research topic and engineering the required tools is a demanding and interdisciplinary process. Most achievements could never evolve without collaborations in which colleagues and international partners integrated their intellectual forces. When working in teams, accounting particular contributions and components of the resulting publications to individual collaborators becomes almost impossible. This situation also applies to several contents of this thesis, which arise from collaborations, thus, cover joint contributions. Many of these collaborations persisted even longer than the research projects and became a long-term strategic partnership. In our previous publications, all authors contributed by discussing ideas and debating on results throughout the whole project duration. Each of them has particular strengths that sometimes appear invisible. For this reason, I explicitly state and acknowledge—where possible—the contributions of my collaborators in the following.



## Part I

### INTRODUCTION

The first chapter of this part gives an introduction and a motivation to this thesis, followed by a presentation of related work found in the area of physical layer security. In the third chapter, we present some definitions and background information to make it easier for the reader to quickly understand the subsequent parts of this thesis.





## INTRODUCTION

---

Start a chapter with text and not with a section header. Open the *classicthesis-config.tex* file to insert the title of your thesis, the names of your supervisors and the hand-in date of your thesis.

### 1.1 FIRST SECTION

After a section there should always be text before the next section. The first paragraph is always without indentation. Starting from the second paragraph, there is an indentation.

Here is an equation without numbers for referencing:

$$\underbrace{\begin{pmatrix} \mathcal{B}_1 \\ \mathcal{B}_2 \\ \vdots \\ \mathcal{B}_R \end{pmatrix}}_{\mathcal{B}} = \underbrace{\begin{pmatrix} H_{1,1} & H_{1,2} & \dots & H_{1,T} \\ H_{2,1} & H_{2,2} & \dots & H_{2,T} \\ \vdots & \vdots & \ddots & \vdots \\ H_{R,1} & H_{R,2} & \dots & H_{R,T} \end{pmatrix}}_{H_{\mathcal{A} \rightarrow \mathcal{B}}} \cdot \underbrace{\begin{pmatrix} \mathcal{A}_1 \\ \mathcal{A}_2 \\ \vdots \\ \mathcal{A}_T \end{pmatrix}}_{\mathcal{A}}$$

Here is an equation that you can reference:

$$\underbrace{\begin{pmatrix} \mathcal{B}_1 \\ \mathcal{B}_2 \\ \vdots \\ \mathcal{B}_R \end{pmatrix}}_{\mathcal{B}} = \underbrace{\begin{pmatrix} H_{1,1} & H_{1,2} & \dots & H_{1,T} \\ H_{2,1} & H_{2,2} & \dots & H_{2,T} \\ \vdots & \vdots & \ddots & \vdots \\ H_{R,1} & H_{R,2} & \dots & H_{R,T} \end{pmatrix}}_{H_{\mathcal{A} \rightarrow \mathcal{B}}} \cdot \underbrace{\begin{pmatrix} \mathcal{A}_1 \\ \mathcal{A}_2 \\ \vdots \\ \mathcal{A}_T \end{pmatrix}}_{\mathcal{A}} \quad (1.1)$$

#### 1.1.1 Referencing

Take a look in the following list to reference sections, figures and equations:

- Section [1.1](#)
- Figure [1.1](#)
- Equation ([1.1](#))

#### 1.1.2 Acronyms

For acronyms you should use the *glossaries* package and put your acronyms in the *FrontBackmatter/acronyms.tex* file. The first acronym is

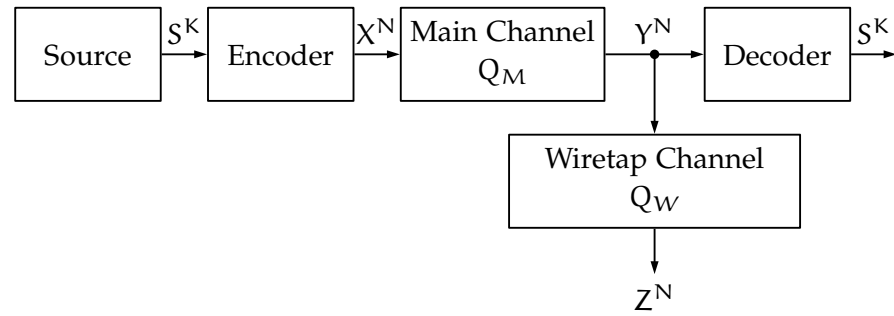


Figure 1.1: The wiretap channel (source: [1])

always written in it's long form, the following occurrences are abbreviated: first occurrence signal-to-noise ratio (SNR), second occurrence SNR, plural SNRs.

### 1.1.3 Examples on Figures

When using figures, use vector graphics whenever possible. In Figures 1.1 and 1.2 are some examples to generate vector graphics directly from L<sup>A</sup>T<sub>E</sub>Xcode. The second example is based on the *matlab2tikz* script for matlab. You find an example in the *gfx/matlab/create\_example\_graph.m* file. TikZ is used to generate the graphics. As it takes some time and memory to recompile a graphic, pdf<sub>l</sub>atex caches generated figures when the `--enable-write18` switch is set when calling pdf<sub>l</sub>atex. Graphics are only recompiled when you uncomment the `\tikzset{external/remember next}` command. Figures should always appear after the first reference in the text or at the top of the same page as the reference, but never before the reference. Prefer placing figures on separate pages. Try to always have figures and text on each page. Or place enough figures to fill a page only with figures.

### 1.1.4 Examples on Tables

You can find an example table in Table 1.1 using the *tabular* environment. Note the use of horizontal lines from the *booktabs* package (`\toprule`, `\midrule`, and `\bottomrule`) and removed whitespace at both sides of the table (`@{}`) as proposed by Markus Püschel.<sup>1</sup>

## 1.2 MARGIN NOTES

Especially in the standard SEEMOO template with wide margins, you are encouraged to insert text into the margins. If you decide to do so,

Here you can add  
text to the margin.

For example, to  
summarize the  
section next to it.

<sup>1</sup> <https://www.inf.ethz.ch/personal/markusp/teaching/guides/guide-tables.pdf>

Table 1.1: Large-scale natural disasters in the last ten years

DISASTER	YEAR	COUNTRY	AREA (km <sup>2</sup> )
Nepal earthquake	2015	Nepal	3 610
Cyclone Pam	2015	Vanuatu	12 190
Ludian earthquake	2014	China	1 487
Typhoon Haiyan	2013	Philippines	71 503
Christchurch earthquake	2011	New Zealand	1 426
East Africa drought	2011	East Africa	2 346 466
Tropical storm Washi	2011	Philippines	104 530
Tohoku earthquake	2011	Japan	83 955
Haiti earthquake	2010	Haiti	27 750
Afghanistan blizzard	2008	Afghanistan	652 864
Sichuan earthquake	2008	China	485 000
Cyclone Nargis	2008	Myanmar	676 578

plan to have at least one margin note per double page.

### 1.3 SOME EXAMPLE TEXT

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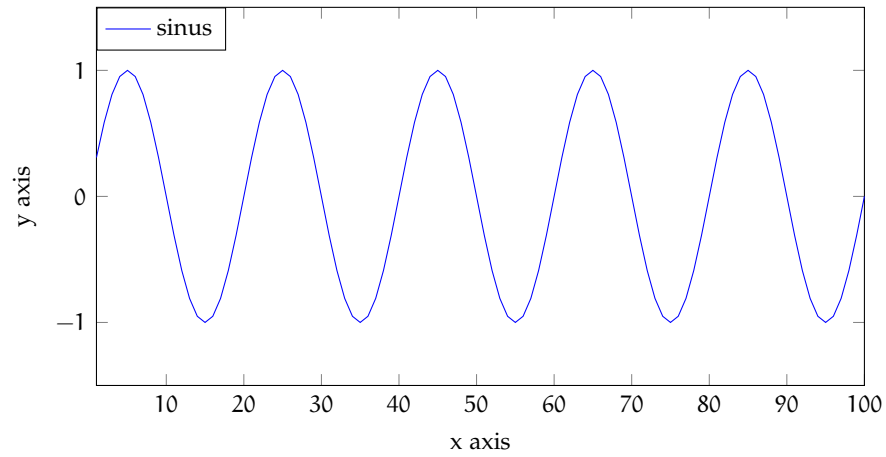


Figure 1.2: Caption of figure

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RELATED WORK

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## Part II

### CONTRIBUTION

The contribution starts with a design chapter, where we mathematically describe the design of the physical layer security system, as well as the adaptive filter of the attacker. After the design follows the implementation on WARP nodes. Here we give an insight into the challenges of implementing the designed MIMO communication system. The last chapter concentrates on evaluating the performance of our proposed attack in simulation and practice.



DESIGN

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## IMPLEMENTATION

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EVALUATION

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### Part III

## DISCUSSION AND CONCLUSIONS

After the evaluation, we further discuss the results and give an outlook. In addition, we finish this work with conclusions.



## DISCUSSION

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## CONCLUSIONS

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Part IV

APPENDIX







## SOME PROOF

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amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer  
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ultrices a, dui.



## BIBLIOGRAPHY

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- [1] A. D. Wyner. "The Wire-tap Channel." In: *Bell Systems Technical Journal* 54.8 (1975), pp. 1355–1387.



## AUTHOR'S PUBLICATIONS

---

This might come in handy for PhD theses: some ideas and figures have appeared previously in the following publications:

- [1] Tobias Isenberg, André Miede, and Sheelagh Carpendale. "A Buffer Framework for Supporting Responsive Interaction in Information Visualization Interfaces." In: *Proceedings of the Fourth International Conference on Creating, Connecting, and Collaborating through Computing (C<sup>5</sup> 2006)*. IEEE, 2006, pp. 262–269. ISBN: 978-0-7695-2563-1.
- [2] Ulrich Lampe, Markus Kieselmann, André Miede, Sebastian Zöller, and Ralf Steinmetz. "A Tale of Millis and Nanos: On the Accuracy of Time Measurements in Virtual Machines." In: *Proceedings of the Second European Conference on Service-Oriented and Cloud Computing (ESOCC 2013)*. Springer, 2013, pp. 172–179. ISBN: 978-3-642-40650-8.
- [3] Ulrich Lampe, Qiong Wu, Ronny Hans, André Miede, and Ralf Steinmetz. "To Frag Or To Be Fraggd – An Empirical Assessment of Latency in Cloud Gaming." In: *Proceedings of the Third International Conference on Cloud Computing and Services Science (CLOSER 2013)*. 2013, pp. 5–12. ISBN: 978-898-8565-52-5.
- [4] André Miede. "Theses and other Beautiful Documents with classicthesis." In: *TUGboat – The Communications of the T<sub>E</sub>X Users Group* 31.1 (2010), pp. 18–20. ISSN: 0896-3207.
- [5] André Miede, Gökhan Şimşek, Stefan Schulte, Daniel F. Abawi, Julian Eckert, and Ralf Steinmetz. "Revealing Business Relationships – Eavesdropping Cross-organizational Collaboration in the Internet of Services." In: *Proceedings of the Tenth International Conference Wirtschaftsinformatik (WI 2011)*. Vol. 2. 2011, pp. 1083–1092. ISBN: 978-1-4467-9236-0.
- [6] Hsin-Yi Tsai, Melanie Siebenhaar, André Miede, Yu-Lun Huang, and Ralf Steinmetz. "Threat as a Service? Virtualization's Impact on Cloud Security." In: *IEEE IT Professional* 14.1 (2012), pp. 32–37. ISSN: 1520-9202.

*Attention:* This requires a separate run of bibtex for your refsection, e.g., `ClassicThesis1-btx` for this file. You might also use biber as the backend for biblatex. See also <http://tex.stackexchange.com/questions/128196/problem-with-refsection>.



## CURRICULUM VITÆ

---

### PERSONAL INFORMATION

*Name*            Name of the Student  
*Date of Birth*   January 1, 1970  
*Place of Birth*   Darmstadt, Deutschland  
*Nationality*     German

### EDUCATION

*since 2018*      **Doctoral Candidate**  
Computer Science, Technische Universität Darmstadt,  
Darmstadt, Germany  
*2016–2018*      **Master of Science**  
Computer Science, Technische Universität Darmstadt,  
Darmstadt, Germany  
*2013–2016*      **Bachelor of Science**  
Computer Science, Technische Universität Darmstadt,  
Darmstadt, Germany

### WORK EXPERIENCE

*since 2012*      **Research Associate**  
Secure Mobile Networking Lab, Technische Universität  
Darmstadt, Darmstadt, Germany.

### AWARDS

*Publication*    **Best Community Paper Award at ACM MobiCom '18**  
Paper: "One Billion Apples' Secret Sauce: Recipe for  
the Apple Wireless Direct Link Ad hoc Protocol".

### SUPERVISED STUDENT THESES

*B. Sc. Thesis*    **Another Student**, "A Very Cool Topic", 2018.  
*M. Sc. Thesis*   **Milan Schmittner**, "Scalable and Secure Multicast  
Routing for Mobile Ad-hoc Networks", 2014.

Darmstadt, April 24, 1337





## ERKLÄRUNG ZUR DISSERTATIONSSCHRIFT

---

*gemäß § 9 der Allgemeinen Bestimmungen der Promotionsordnung der  
Technische Universität Darmstadt vom 12. Januar 1990 (ABl. 1990, S. 658)  
in der Fassung der 8. Novelle vom 1. März 2018*

Hiermit versichere ich, Name of the Student, die vorliegende Dissertationsschrift ohne Hilfe Dritter und nur mit den angegebenen Quellen und Hilfsmitteln angefertigt zu haben. Alle Stellen, die Quellen entnommen wurden, sind als solche kenntlich gemacht worden. Eigenzitate aus vorausgehenden wissenschaftlichen Veröffentlichungen werden in Anlehnung an die Hinweise des Promotionsausschusses Fachbereich Informatik zum Thema „Eigenzitate in wissenschaftlichen Arbeiten“ (EZ-2014/10) in Kapitel „Previously Published Material“ auf Seiten xi bis xi gelistet. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen. In der abgegebenen Dissertationsschrift stimmen die schriftliche und die elektronische Fassung überein.

*Darmstadt, 24. April 1337*

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Name of the Student