

Application for a KHYS Research Travel Grant (post)doctoral researcher

(delete where inapplicable)

1 APPLICANT CONTACT DETAILS

Surname:	Kaushik
First name:	Ankit
Academic degree:	Master of Science
Campus North/Campus South/External Institution/ Company:	South Campus
Institute/Building:	Communication Engineering Lab
Division:	Nachrichtentechnik
Faculty/Department:	Faculty of Electrical Engineering
Telephone:	(+49) 721 608 46748
Email:	Ankit.kaushik@kit.edu
Start of doctoral (planned) end of doctoral research	01.04.2012 30.09.2016
Resp. date of defense:	01.10.2016

2 SUPERVISOR CONTACT DETAILS

Surname:	Jondral
First name:	Friedrich K.
Academic degree:	Univ.-Prof. Dr. rer.nat.
Campus North/Campus South /External Institution/ Company:	South Campus
Institute:	Communications Engineering Lab
Division:	Nachrichtentechnik
Faculty/Department:	Faculty of Electrical Engineering
Telephone:	(+49) 721 608 43345
Email:	Friedrich.jondral@kit.edu

3 DESTINATION AND CONTACT DETAILS OF THE COOPERATION PARTNER/SUPERVISOR ABROAD

Country:	Luxembourg
Institution/Company	University of Luxembourg
Institute/Division:	Interdisciplinary Centre for Security, Reliability and Trust
Surname:	Ottersten
First name:	Björn
Academic degree:	Professor
Telephone:	(+352) 46 66 44 5665
Email:	Bjorn.ottersten@uni.lu

4 TRAVEL PERIOD

From:	01.10.2015
Until:	29.12.2015
Length of stay:	90 Days

5 RESEARCH WORK

5.1 Title/Topic

Deployment of Cognitive Small Cells

5.2 Abstract ($\frac{1}{4}$ page, in layman's terms)

The upcoming decade is about to witness a tremendous growth in the popularity of smart devices. The integration of these enormous number of devices in the network is the biggest challenge currently faced by the wireless community. To encounter this, ultra-densification and spectrum extension are envisioned as the paramount solutions. Given the constraints in deployment costs and the available spectrum, these solutions appear to be indomitable. In order to breakthrough these bottlenecks, we propose a deployment-centric viewpoint to the concept of cognitive small cell that jointly resolves the issues with small cell and spectrum scarcity. In the research project, we highlight the significant steps necessary for the deployment of this notion in (Fifth-Generation) 5G networks. Another interesting element in our research is the introduction of novel models that facilitate the feasibility of the opportunistic access for the cognitive small cell. Based on this model, we characterize the true performance of interweave and underlay cognitive systems.

5.3 Current Progress of the research project (1 page, in layman's terms)

We are currently in the phase of conceptualizing the requirements of the fifth-generation of the wireless standards. One of the major requirements includes the improvement in the areal capacity bits/s/m² by a factor of 1000. A large contribution of this demand is procured by means of an extension to the existing spectrum. Due to the static allocation of the spectrum specially below 6 GHz, which is appropriate for mobile communications, it is on the verge of scarcity. Given that the spectrum is utilized efficiently, it is possible to overcome this scarcity. In this perspective, cognitive radio is foreseen as one of the viable solutions that addresses the problem of spectrum scarcity. Secondary access to the licensed spectrum is viable only if the interference is avoided at the primary system. In this regard, different paradigms have been conceptualized. This makes performance characterization of a cognitive radio system critical, hence, an interesting research problem.

An access to the primary user spectrum is an outcome to the paradigm employed by the secondary user. Based on the paradigms described in the literature, all cognitive radio systems that consider dynamic access to the spectrum fall mainly under three categories, namely, interweave, underlay and overlay systems. As interweave systems, the secondary users render an interference-free access to the primary user by exploiting spectral holes in different domains such as time, frequency, space and polarization existing in the licensed spectrum, whereas

underlay systems enable an interference-tolerant access under which the secondary users are allowed to use the licensed spectrum as long as they respect the interference constraints of the primary receivers. Besides that, overlay systems consider participation of higher layers for enabling spectral coexistence between two or more wireless networks.

Following the previous discussion, it is evident that spectrum extension and small cells are key-enablers for the 5G system. Motivated by this fact, we establish a concept of cognitive small cell, a promising approach that jointly enhances the small cell deployment and the efficient usage of the spectrum below 6 GHz. In particular, we motivate that cognitive small cell entails the credibility of overcoming the requirements for the next generation wireless systems. In this context, we have introduced a novel model that facilitates the deployment of opportunistic access within cognitive small cell. For the proposed model, we have specified the key-issues, posed several challenges and discussed their possible solutions. As an outcome of the analysis, we have emphasized that the existing models, illustrating an ideal scenario, do not characterize the true performance of the cognitive radio paradigms.

In this view, the existing work provides a deployment-centric viewpoint to ensure a successful integration of cognitive small cells in the 5G network. Consequently, we consider underlay and interweave paradigms to enable secondary usage of the licensed spectrum, we illustrate a deeper comprehension of the concept. The feasibility of the respective paradigms has been supported with hardware implementations. In future, we would like to investigate performance of hybrid systems that operate jointly as interweave and underlay systems.

5.4 Schedule of the research project

Period	Workflow
August 2015 - September 2015	Preliminary investigation of the hybrid technique (Problem formulation)
October 2015 - December 2015	Development of mathematical model, thereby characterizing the performance of hybrid systems. Publish the significant results and analysis performed during this period.
January 2016 - May 2016	Summarize the existing and new results into the dissertation.
June 2016	Submit the first version of the dissertation

6 STAY ABROAD

6.1 Purpose for the Time Spent Abroad ($\frac{1}{4}$ page, in layman's terms)

The major contribution of the research has been conducted at CEL, KIT. The research stay at SnT headed by Dr. Ottersten would

- enhance and/or stimulate the existing contribution,

- exercise cooperative research
- facilitate rapid exchange of ideas,
- provide extensive feedback leading to fruitful discussions.

During the stay, the mathematical model that will incorporate channel estimation will be proposed. Based on this model, performance of hybrid systems, that operate jointly as interweave and underlay systems, will be evaluated. The scientific contribution of the analysis performed during the stay will be published in renowned journal or conference.

6.2 Benefit of the Research Period Abroad for the KIT (Post)doctoral Researcher (1/4page)

(Value added to your research and your personal development)

At personal level, a research stay at a foreign country would

- enhance research skills
- procure experience in a different environment
- social competence

6.3 Benefit of the Research Period Abroad for the KIT Working Group (1/4 page)

6.4 Are any publications planned as a result of your stay abroad?

Yes, we plan to publish the results of the research conducted.

1 PUBLIKATIONEN AND PROCEEDINGS

Please ensure mind correct and complete quotation! Only properly-cited publications and proceedings are counted; authors (applicant bold highlight), title, journal, page numbers etc.

6.5 Publications (peer-reviewed)

[1] A. Kaushik, S.K. Sharma, S. Chatzinotas, B. Ottersten, F. K. Jondral: [Estimation-Throughput Tradeoff for Underlay Cognitive Radio Systems](#) Proceedings of IEEE International Conference on Communications (ICC) - Cognitive Radio and Networks Symposium, Proceedings of IEEE Wireless Communications & Networking Conference (WCNC), pp. 9304 – 9309, June 2015, London, UK

[2] A. Kaushik, S.K. Sharma, S. Chatzinotas, B. Ottersten, F. K. Jondral: [Sensing-Throughput Tradeoff for Cognitive Radio Systems with Unknown Received Power](#) Proceedings of 10th International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM), pp. 1 – 12, April 2015, Doha, Qatar

[3] Ankit Kaushik, Ralph Tanbourgi, Friedrich K. Jondral: [Operating Characteristics of Underlay Cognitive Relay Networks](#) Proceedings of 25th IEEE International Symposium on Personal, Indoor and Mobile Communications (PIMRC), pp. 1206 – 1210, Sept 2014, Washington D.C., USA

[4] Ankit Kaushik, M. Rehan Raza, Friedrich K. Jondral:
[On the Deployment of Cognitive Relay as Underlay Systems](#)
Proceedings of 9th International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM), pp. 329 – 334, June 2014, Oulu, Finland

[5] Ankit Kaushik, Friedrich K. Jondral:
[On the Estimation of Channel State Transitions for Cognitive Radio Systems](#)
Proceedings of IEEE Wireless Communications & Networking Conference (WCNC), pp. 2037 – 2042, April 2014, Istanbul, Turkey

[6] Ankit Kaushik, Marcus Mueller, Friedrich K. Jondral:
[Cognitive Relay: Detecting Spectrum Holes in a Dynamic Scenario](#)
Proceedings of IEEE International Symposium on Wireless Communication Systems (ISWCS), pp. 679 – 680, August 2013, Ilmenau, Germany

8 CONGRESSES/CONFERENCES

8.1 Oral presentations

The oral presentations were conducted in the conferences [1 - 5] mentioned above.

8.2 Poster

The poster presentation was conducted in the conferences [6] mentioned above.

9 INTERDISCIPLINARY ACTIVITIES (e.g. KHYS courses or trainings)

10 AWARDS SO FAR (e.g. prices, scholarships)

MERIT / ERASMUS MUNDUS SCHOLARSHIP FOR MASTER STUDIES
([HTTP://WWW.MERITMASTER.ORG/](http://www.meritmaster.org/),
[HTTPS://WWW.IHE.KIT.EDU/MERIT.PHP](https://www.ihe.kit.edu/merit.php))

11 DECLARATION

With my signature I accept the Research Travel Grant guidelines. In addition I declare that the details provided are correct and that I have declared all other funding that I receive for the project in question. Should I receive any further funding once I have send in my application, I will notify KHYS immediately.

Karlsruhe, 26.07.2015

Place, date



ANKIT KAUSHIK (Applicant signature)

Attachments

- **Information on financing during the stay abroad**
- **Reference letter from the applicant's KIT supervisor**
- **Letter of invitation from the applicant's cooperation partner**
- **CV**
- **Copy of most recent university certificate**
- **Letter of acceptance as a doctoral researcher from the applicant's department/faculty**

Financing

for the Funding of a Research Stay Abroad by the Karlsruhe House of Young Scientists (KHYS)

Applicant name: Ankit Kaushik

Institute: Communication Engineering Lab

The applicant will finance his/her research stay abroad with:

- ☒ a full-time E13 job, i.e. 40 hours per week
- ☐ a part-time E13 job, i.e. 30 hours per week
- ☐ a half-time E13 job, i.e. 20 hours per week
- ☐ a _____ scholarship
- ☐ a student assistant position for _____ hours
- ☐ other (please specify)

The applicant currently has a scholarship

- ☒ no
- ☐ yes (please specify)

Will the applicant receive additional funding from third parties (e.g. an institution abroad)?:

- ☒ no
- ☐ yes

Sponsoring body:

Amount:

I confirm that the information that I have provided is correct.

Karlsruhe, 25/07/2015
.....
Place, date

Ankit Kaushik
.....
Signature

Karlsruhe, 14. Juli 2015

Gutachten über Herrn Ankit Kaushik,

geboren am 7. Juni 1984 in Delhi (Indien), bezüglich eines KHYS-Doktorandenstipendiums für einen Aufenthalt an der Université du Luxembourg für den Zeitraum Oktober bis Dezember 2015.

Eignung des Bewerbers

Herr Kaushik kam zum Wintersemester 2005/2006 mit einem Bachelorgrad der Guru Gobind Singh Indraprastha University, Delhi (Indien), im Rahmen des MERIT-Programms an die Universität Karlsruhe (TH) und erlangte mit dem Ende des Sommersemesters 2007 den Grad eines Master of Science mit der Gesamtnote 1,4 (sehr gut). Seine Masterarbeit „Performance of MAC Protocol in OFDM based Overlay Systems in Ad hoc Mode“ verfasste er unter meiner Anleitung am Institut für Nachrichtentechnik (Communications Engineering Lab, CEL).

Vom 1. September 2007 bis zum 31. März 2012 arbeitete Herr Kaushik als Entwicklungsingenieur bei der Leica Camera AG in Solms. Als zum 1. April 2012 im Rahmen des BMBF-Verbundprojekts *Cognitive Mobile Radio (CoMoRa)* am CEL die Stelle eines Wissenschaftlichen Mitarbeiters zu besetzen war, kam er, natürlich mit der Absicht zu promovieren, zurück an das Karlsruhe Institut für Technologie (KIT). Im Rahmen von CoMoRa bearbeitete Herr Kaushik das Teilprojekt *Spektrumsmanagement und Kognitive Indoorversorgung* (BMBF-Förderkennzeichen 16BU1205). Dieses Teilprojekt konnte er, nicht nur aufgrund seiner Industrieerfahrung sondern auch wegen seiner zielstrebigem, kommunikativen Art zu arbeiten, weitgehend eigenständig und auch sehr erfolgreich abschließen.

Neben seiner erfolgreichen Forschungs- und Projektarbeit engagiert sich Herr Kaushik stark in der Lehre. Neben der Betreuung des *Praktikums Nachrichtentechnik* hält er die Übungen zu den von Herrn AOR Dr.-Ing. Holger Jäkel gehaltenen Vorlesungen *Nachrichtentechnik II* und *Angewandte Informationstheorie*. Darüber hinaus betreut Herr Kaushik überdurchschnittlich viele Abschlussarbeiten.

Persönlich schätze ich an Herrn Kaushik sein offenes sympathisches Auftreten. Als gebürtiger Inder ist er bestens in Deutschland integriert und beherrscht die deutsche Sprache verhandlungssicher.

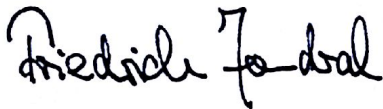
Qualität des Vorhabens

Das Promotionsthema von Herrn Kaushik beschäftigt sich mit dem Einsatz kognitiver Relais zur Erhöhung der Kapazität von Mobilfunknetzen. Statistiken zeigen, dass etwa achtzig Prozent des Mobilfunkaufkommens in Deutschland innerhalb von Gebäuden stattfindet. Bringt man diese Zahl mit der stetig wachsenden (und berechtigten) Nachfrage nach Mobilfunkfrequenzen zusammen, liegt aufgrund der Tatsache, dass eigentlich nur Frequenzen unterhalb von 6 GHz für den Mobilfunk geeignet sind, der Schluss nahe, dass ein großer Beitrag zur Effizienzsteigerung durch die Herausnahme des Indoorverkehrs aus dem Mobilfunk erreicht werden kann. Der Funk in Gebäuden könnte dann entweder durch Wiederverwendung von Frequenzen oder durch den Einsatz höherer (28, 38, 60, 90 GHz) Frequenzen abgewickelt werden. Als Mittel zur Einbindung des Indoorverkehrs in das Netz bieten sich kognitive Relais an, die für einen räumlich begrenzten Bereich, eigenständig das Frequenzmanagement übernehmen.

Das Promotionsthema von Herrn Kaushik ist aktuell und international von großem Interesse, was auch durch seine auf mehreren international wichtigen Tagungen (IEEE-ICC 2015 in London, CROWNCOM 2015 in Qatar, IEEE-PIMRC 2014 in Washington, CROWNCOM 2014 in Oulu, IEEE-WCNC 2014 in

Istanbul) gehaltenen wissenschaftlichen Vorträge unterstreichen. Seit etwa einem Jahr hat sich auf dem Gebiet des Spektrumsmanagements und des Einsatzes kognitiver Relais eine Zusammenarbeit zwischen Herrn Kaushik und seinem Landsmann Shree Krishna Sharma, der an der Universität du Luxembourg bei Herrn Kollegen Björn Ottersten arbeitet, entwickelt. Aus dieser Kooperation ist bereits ein gemeinsamer Tagungsbeitrag entstanden. Ich bin mir daher sicher, dass der von Herrn Kaushik geplante Aufenthalt an der Universität du Luxembourg ihm deutliche Impulse für seine Forschung geben wird. Den dafür vorgesehenen Zeitraum Oktober bis Dezember 2015 erachte ich für äußerst günstig. Ich habe keinen Zweifel daran, dass Herr Kaushik in der Arbeitsgruppe von Herrn Kollegen Ottersten an der Universität du Luxembourg gern aufgenommen und er auch seinen Teil zum Erfolg dieses Vorhabens beitragen wird.

Ich befürworte eine Förderung des Aufenthalts von Herrn Kaushik an der Universität du Luxembourg durch das KHYS mit Nachdruck.

A handwritten signature in black ink, reading 'Friedrich Jondral'. The signature is written in a cursive style with a large, stylized 'F' and 'J'.

Univ.-Prof. Dr.rer.nat. Friedrich Jondral



securityandtrust.lu

Interdisciplinary Centre for Security,
Reliability and Trust

Luxembourg, July 13, 2015

Dear Mr. Ankit Kaushik,

As the director of SnT, it is my pleasure to invite you at our Interdisciplinary Centre for Security, Reliability and Trust (SnT), University of Luxembourg.

We would like to share knowledge on your ongoing research that concerns, "Deployment Perspectives of Cognitive Radio", conducted at Communications Engineering Lab, KIT. During your research stay, we will be pleased to assist you with necessary feedback and hope that this will open new aspects and strengthen your work.

We are informed that your stay will last for a duration of 90 days and your intended start and end dates are 01.10.2015 and 29.12.2015, respectively.

Kindly note that we will assist you with a suitable working condition, thereby providing you with a workstation, access to the internet, literature and university library.

Please be informed that although we are glad to facilitate your ongoing work, however, we cannot offer you any kind of financial assistance during your stay.

We look forward to welcoming you at SnT, Luxembourg.

With best regards,

Prof. Dr. Björn Ottersten
Director SnT

CURRICULUM VITAE

ANKIT KAUSHIK

CONTACT DETAILS

Luise Riegger Strasse 58
76137 Karlsruhe, Germany
Mobile: +49 (0)176 23645733
E-Mail: Ankit.Kaushik@kit.edu



PERSONAL DETAILS

Date of birth: 07.06.1984
Place of birth: Delhi, India
Nationality: Indian
Marital Status: Married

EDUCATION

- | | |
|-----------------|--|
| Since 04.2012 | Pursuing Ph.D , Karlsruhe Institute of Technology, Karlsruhe, Germany |
| 10.2005–07.2007 | Master's Degree:
<i>Information and Communication Engineering</i>
<i>University of Karlsruhe, Germany and Politecnico di Torino, Italy</i>
<i>Qualification: M.Sc. (Master of Science, European Master of Research on Information and Communications Technologies (MERIT))</i>
Final Grade: 1,4 (German Standards) 110/110 with Honours (Italian Standards) |
| 08.2001–06.2005 | Bachelor's Degree:
<i>Electronics and Communication Engineering</i>
<i>Qualification: B.Tech. (Bachelor of Technology, Guru Gobind Singh Indraprastha University), Delhi</i>
Final Grade: 75% |
-

SCHOOLING

04.1999–03.2001 Visited *Oxford Senior Secondary School*, Delhi, India
Qualification: CBSE 12th
Final Grade: 76%

WORK EXPERIENCE

09.2007–03.2012 **Design Engineer**, Leica Camera AG

- **Accomplishment:** Devised an algorithm of lossless image compression for RAW image inside camera using context adaptive Huffman codes.

LANGUAGES KNOWN

Hindi	Mother tongue
English	Written and spoken
German	Conversational

Ankit Kaushik

Ankit Kaushik
Karlsruhe, July 27, 2015



Universität Karlsruhe (TH)
Forschungsuniversität • gegründet 1825

Fakultät für Elektrotechnik und
Informationstechnik

Certificate of the Master Examination

Ankit Kaushik

born on June 7, 1984 in Dehli (India)

has passed the Master Examination in

**European Master of Research on Information and
Communications Technologies (MERIT)**

of the English postgraduate master programme

Electrical Engineering and Information Technologies

Field of Specialisation
Information and Communications Engineering

with the overall score

„VERY GOOD“ (1,4)

and the individual scores specified on the insides.

Karlsruhe, July 9, 2007



Dean

G. Trummer

MASTER THESIS:

Topic: „Performance Analysis of Mac Protocol for OFDM based Overlay Systems in Ad Hoc Mode“

Referent: Marina Mondì
Politecnico di Torino, Italy

Submission date: July 9, 2007
Politecnico di Torino, Italy

Grade: 30 L
Politecnico di Torino, Italy

Examination courses	University, where the examination has been passed	Grade, assigned by the university	ECTS-Credit Points of the respective university
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Compulsory core courses:

Materials and Devices in Electrical Engineering	Universität Karlsruhe (TH)	2,0	3
Electromagnetics and Numerical Calculation of Fields	Universität Karlsruhe (TH)	3,0	3
Integrated Systems of Signal Processing	Universität Karlsruhe (TH)	2,0	3
System Dynamics and Control Engineering	Universität Karlsruhe (TH)	2,0	6
Advanced Radio Communications I	Universität Karlsruhe (TH)	1,7	4,5
Advanced Radio Communications II	Universität Karlsruhe (TH)	1,0	4,5

Compulsory concentration courses:

Digital Spectral Analysis	Universität Karlsruhe (TH)	1,0	3
Optical Communications - Components	Universität Karlsruhe (TH)	1,0	4,5
Smart Antennas	Universität Karlsruhe (TH)	1,0	3
Systems and Software Engineering	Universität Karlsruhe (TH)	2,3	4,5
Management Systems for Communication Networks	Universität Karlsruhe (TH)	1,3	3

Elective concentration courses:

Introduction to Microstrip Antennas	Universität Karlsruhe (TH)	1,0	3
Student Research Project in Radio Frequency Engineering	Universität Karlsruhe (TH)	1,0	12
Optical Communications Systems	Universität Karlsruhe (TH)	1,0	3
Radar Systems Engineering	Universität Karlsruhe (TH)	1,3	3

Examination courses	University, where the examination has been passed	Grade, assigned by the university	ECTS-Credit Points of the respective university
Computer-aided design of wireless communication systems	Politecnico di Torino, Italy	30 L	6
Information theory and codes	Politecnico di Torino, Italy	30 L	5
Spaceborne SAR Remote Sensing	Universität Karlsruhe (TH)	1,7	4,5
Operating systems	Politecnico di Torino, Italy	27	4
Language model courses:			
Deutsch als Fremdsprache intensiv 1	Sprachenzentrum, Universität Karlsruhe (TH)	1,5	9
Additional courses:			
Video communications	Politecnico di Torino, Italy	26	5

Overall score of the examinations, passed at Universität Karlsruhe (TH): 1,48

Overall score of the examinations, passed at Politecnico di Torino, Italy: 29,73 – converting to the grading system of the Universität Karlsruhe (TH): 1,29

Overall score of the Universität Karlsruhe (TH): 1,4

The examinations have been taken at the universities Politecnico di Torino, Italy and Universität Karlsruhe (TH), Germany.

The Bachelor-Examination passed at the Guru Gobind Singh Indraprastha University - Maharaja Surajmal Institute of Technology (Indien) has been acknowledged by the Universität Karlsruhe (TH).

Chairman of Examination Board
Department of Electrical Engineering
and Information Technologies
at Universität Karlsruhe (TH)



individual grade

very good	= 1,0 - 1,3
good	= 1,7 - 2,0 - 2,3
satisfactory	= 2,7 - 3,0 - 3,3
sufficient	= 3,7 - 4,0

course grade

very good	= in case of an average up to 1,5
good	= in case of an average above 1,5 to 2,5
satisfactory	= in case of an average above 2,5 to 3,5
sufficient	= in case of an average above 3,5 to 4,0

overall score

with distinction	= in case of an average from 1,0 up to 1,1*
very good	= in case of an average above 1,1 to 1,5
good	= in case of an average above 1,5 to 2,5
satisfactory	= in case of an average above 2,5 to 3,5
sufficient	= in case of an average above 3,5 to 4,0

*) master thesis must be evaluated with „very good“

KIT-Campus Süd | Dekanat ETIT | 76128 Karlsruhe

Herrn
M. Sc. Ankit Kaushik
Institut für Nachrichtentechnik
(CEL) Hauspost

Fakultät für Elektrotechnik und
Informationstechnik

Dekan: Prof. Dr.rer.nat. Olaf Dössel

Kaiserstraße 12
76131 Karlsruhe

Telefon: 0721-608-42468
Fax: 0721-608-46105
E-Mail: dekanat@etit.kit.edu
Web: www.etit.kit.edu

Bearbeiter/in: Silvia Probst
Unser Zeichen:
Datum: 14.2.2013

Annahme als Doktorand

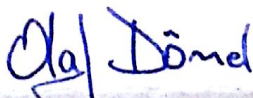
Sehr geehrter Herr Kaushik,

auf Ihren Antrag vom 1.2.2013 teile ich Ihnen mit, dass Sie hiermit gemäß § 3 der Promotionsordnung als Doktorand der Fakultät für Elektrotechnik und Informationstechnik angenommen werden.

Herr Prof. Dr.rer.nat. Friedrich Jondral hat sich bereit erklärt, Sie bei der Anfertigung der Dissertation auf dem beabsichtigten Arbeitsgebiet „Cognitive Relays in mobile communications networks“ zu betreuen.

Mit dieser Bestätigung ist keine Garantie eines erfolgreichen Abschlusses Ihrer Promotion verbunden.

Mit freundlichen Grüßen



Prof. Dr. rer.nat. Olaf Dössel

Kopie an Herr Prof. Dr.rer.nat. Friedrich Jondral, Institut für Nachrichtentechnik (CEL)