Special Session on "Links-on-the-fly Technology for Robust, Efficient and Smart Communication in Unpredictable Environments"

1. Dr Hicham Khalife
"RESCUE project general view, goals-and-objectives, and current status"

Abstract:
As current communication systems are planned using accurate link budget allocation in order to keep service outage in an acceptable range, the whole communication chain (coding, signalling chain, as well as higher layer protocols) is optimized accordingly. Therefore, communication services perform poorly or fail completely in unpredictable and harsh radio environments. It is particularly the case in serious disaster scenarios such as earthquakes or tsunamis and in scenarios with an unmanaged infrastructure as in vehicle-to-vehicle (V2V) communications. RESCUE establishes the basis for communication in uninterrupted communications in unpredictable environments through a paradigm shift to lossy based link design, referred to as “links on the fly”.
In this presentation, we give a general overview of the RESCUE project. We emphasize on the studied public safety and the V2V use cases and on the followed approach in the project. Indeed, the project aims to propose breakthroughs in information theoretical basis, protocol design and testbed implementations of the proposed “links on the fly” paradigm.

The lecturer biography:
Dr. Hicham Khalifé is the ICT-FP7 RESCUE project coordinator. He received his M.Sc. degree from the University Pierre et Marie Curie (Paris 6) in 2005 then his PhD from the same university in 2008. From 2009 to 2011 he served as an associate professor in the computer engineering department of IPB ENSEIRB-MATMECA in Bordeaux France and a member of the LaBRI research laboratory enrolled in the COMET Networking team. He joined Thales Communications & Security in December 2011. His main research contributions are essentially in the area of wireless networks and multi-hop cognitive radio networks. He has been involved in several collaborative projects at National (ANR LiCoRNe project coordinator) and European levels (FP7 DUPLO and MOTO). He has served as PC member of many international conferences and published and reviewed for international journals and conferences.

2. Prof. Tadashi Matsumoto
"Tutorial on backbone theories and experiments of RESCUE"

Abstract:
A goal of this talk is to provide audience with the knowledge about the relationship between the relay systems and the Distributed Coding techniques for correlated sources.

This talk will be started by briefly reviewing the historical background and progress of Information Theory and Signal Processing for Wireless Communications. Especially, how and why iterative (turbo) decoding can achieve asymptotically the close-limit performance will be addressed.

Then, the focus of this talk is shifted to cooperative communications. It is shown that performance of the conventional decode-and-forward system can significantly be improved by performing another interleaving at the relay, with which the resulting network structure is equivalent to distributed turbo code. Furthermore, since the knowledge about the bit error probability of the source-relay node can be used as the correlation between the two frames, one from the source, and the other from the relay, we can well exploit the Slepian-Wolf theorem; With the utilization of the theorem, the relay can forward the frame even though it detects errors in the information part, and the destination can recover the data losslessly.

Then, this talk further expands the idea, from lossless-link-design-based to lossy-based. In this part, we assume that none of the relays at the final stage has no errors in the information parts of the frames. This category of the problems belongs to *Distributed Lossy Coding*, represented by the *Chief Executive Officer* (CEO) *problem*, in Network Information Theory. Even in this situation, still the destination can recover the data with the distortion level lower than specified.

This talk introduces conceptual bases of the lossless (Slepian Wolf) and lossy-link-design –based network design, and provides basic ideas for signal detection algorithms for the both cases based on the *turbo principle*. Results of initial simulations conducted to evaluate the performances of the detection/decoding techniques for several simple network models are also presented. The major applications of the system concept introduced in this keynote speech are Wireless Mesh Networks, Wireless Sensor Networks, Wireless Machine-to-Machine networks, Wireless Internet-of-Things, and Densely Populated Wireless Networks, as well as Rapid Construction of Monitoring Systems in Devastated Public Facilities, such as Fukushima.

Finally, this talk briefly introduces "Links-on-the-fly Technology for Robust, Efficient and Smart Communication in Unpredictable Environments (RESCUE) a EU FP7 ICT-2013 project, of which concept was motivated by the technological bases described above. The objective of the project is to create energy- and spectrally-efficient communication systems which are robust against unpredictable network topology changes. The origin of the project proposal is that massive earthquakes including series of aftershock hit the Tohoku and Kanto areas in Japan on March 11, 2011, followed by unprecedentedly huge Tsunami waves of up to 40 m height. After the huge devastative/disastrous event clearly indicated several limitations in operability of the conventional wireless communication systems based on the accurate link budget allocation concept and communication chain design (coding, signaling chain, as well as also higher layer protocols), and the continuation of the communication is supported by a proper handover algorithm. The systems, which are expected to keep its operability in unpredicted network damages, have to be robust against the network topology change.

The results are expected to be applicable to machine-to-machine and vehicle-to-vehicle communications as well as communication for internet-of-things since they should also require the robustness against the network topology change, and have to be highly energy-efficient. This talk provides the participants with the knowledge of technological bases towards achieving this goal, performance limit/outage derivations, and some practical coding/decoding algorithms. The issues described above are explained mainly from the viewpoint of lossless/lossy distributed correlated source coding theorems in network information theory.

The lecturer biography:

Tad Matsumoto received his B.S., M.S., and Ph.D. degrees from Keio University, Yokohama, Japan, in 1978, 1980, and 1991, respectively, all in electrical engineering. He joined Nippon Telegraph and Telephone Corporation (NTT) in April 1980. Since he engaged in NTT, he was involved in a lot of research and development projects, all for mobile wireless communications systems. In July 1992, he transferred to NTT DoCoMo, where he researched Code-Division Multiple-Access techniques for Mobile Communication Systems. In April 1994, he transferred to NTT America, where he served as a Senior Technical Advisor of a joint project between NTT and NEXTEL Communications. In March 1996, he returned to NTT DoCoMo, where he served as a Head of the Radio Signal Processing Laboratory until August of 2001; He worked on adaptive signal processing, multiple-input multiple-output turbo signal detection, interference cancellation, and space-time coding techniques for broadband mobile communications. In March 2002, he moved to University of Oulu, Finland, where he served as a Professor at Centre for Wireless Communications. In 2006, he served as a Visiting Professor at Ilmenau University of Technology, Ilmenau, Germany, funded by the German MERCATOR Visiting Professorship Program. Since April 2007, he has been serving as a Professor at Japan Advanced Institute of Science and Technology (JAIST), Japan, while also keeping the position at University of Oulu.
Prof. Matsumoto has been appointed as a Finland Distinguished Professor for a period from January 2008 to December 2012, funded by the Finnish National Technology Agency (Tekes) and Finnish Academy, under which he preserves the rights to participate in and apply to European and Finnish national projects. Prof. Matsumoto is a recipient of IEEE VTS Outstanding Service Award (2001), Nokia Foundation Visiting Fellow Scholarship Award (2002), IEEE Japan Council Award for Distinguished Service to the Society (2006), IEEE Vehicular Technology Society James R. Evans Avant Garde Award (2006), and Thuringen State Research Award for Advanced Applied Science (2006), 2007 Best Paper Award of Institute of Electrical, Communication, and Information Engineers of Japan (2008), Telecom System Technology Award by the Telecommunications Advancement Foundation (2009), IEEE Communication Letters Exemplifying Reviewer Award (2011), and Nikkei Wireless Japan Award (2012). He is a Fellow of IEEE and a Member of IEICE. He is serving as an IEEE Vehicular Technology Distinguished Lecturer during the term July 2011-June 2015.

3. Christian Schneider
"Tutorial on OTA and Field Measurement based performance verification techniques"

Abstract:
While researching new wireless system designs the evaluation under realistic conditions is an essential task to ensure the functionality and performance targeted. In particular with increasing exploitation of the given wireless propagation channel parameter domain (e.g. as space and time) this plays an important role.
The talk will give an introduction into performance evaluation of MIMO systems based on channel sounding data sets. Multi-dimensional channel sounding will be briefly introduced which is the basis for different performance verification strategies. The different strategies

will be discussed and validated wrt. their pro and con's. Within the RESCUE project realistic performance verifications will be done for the V2V use cases current work status and next steps will be discussed.

The lecturer biography:

Dipl.-Ing. Christian Schneider received his Dipl.-Ing. (M.S.E.E.), from the Ilmenau University of Technology, Ilmenau, Germany in 2001. He is currently finalizing his Dr.-Ing. degree (Ph.D.E.E.) with the Institute for Information Technology at the Ilmenau University of Technology. The research focus comprises channel sounding, geometric stochastic channel modelling and validation of measurement based performance evaluation methods for wireless systems. He was strongly involved into the channel modelling research work within the EU projects WINNER I and WINNER II. Christian Schneider led the extensive Multi-Cell/Multi-User MIMO channel sounding campaign and joint research work with RWTH Aachen performed at the TUIL within an exclusive research partner program at the UMIC research cluster (established under the German Federal and State Government Excellence Initiative at the RWTH Aachen). Currently he is focusing at directional channel modelling for V2X communications to be applied for realistic validation within an OTA test facility. In 2007 he received together with Prof. R. Thomä (TU Ilmenau, Germany), Prof. T. Matsumoto (JAIST, Japan) the Thuringian State Research Award for Applied Research for contributions to high-resolution multidimensional channel sounding. Furthermore in 2013 he received the best paper award at the European Wireless conference.