

## *Publications between 2005 and 2006*

Girija Deo, Maximillian Zuend, Mirko Naumann, Markus Ludwig, „Realizing Peer-to-Peer Location-Based Services in Mobile Networks”, *In Joint 2nd IEEE Workshop on Positioning, Navigation and Communication 2005 (WPNC'05) & 1st Ultra-Wideband Expert Talk (UET'05)*, **Hannover**, March, 2005

Girija Deo, Maximillian Zuend, Mirko Naumann, Markus Ludwig, „De-centralized Location Management: Minimizing Privacy Concerns for Location Based Services”, *In 3rd International IEEE Conference on Information Technology, Research and Education (ITRE'05)*, **Hsinchu, Taiwan**, June, 2005

Tansir Ahmed, Kyandoghene Kyamakya, and Markus Ludwig, “Context-Aware Decision Model for Vertical Handover in Heterogeneous Networks”, *Proc. of the 1<sup>st</sup> IEEE International Conference on Next-Generation Wireless Systems (ICNEWS 2006)*, **Dhaka, Bangladesh**, pp. **103-107**, ISBN. **984-32-2914-2**, January 2-4, 2006

**Abstract:** Present day mobile networks are evolving towards heterogeneous overlaying infrastructure. Traditional handover decisions that are mainly based on signal strength are not sufficient to provide ubiquitous and seamless mobility across heterogeneous networks. Intelligent handover decision is needed so that users can select the best option available from diverse networks and services as per their requirements. The decision mechanism is also needed to realize multimode functionality in current and future multimode mobile devices that will enable user applications to use multiple radio interfaces simultaneously and to switch between active interfaces based on application requirements and interface capabilities. This paper introduces a context-aware vertical handover decision model suitable for heterogeneous networks environment based on the *Analytic Hierarchy Process (AHP)* method. It illustrates the whole mechanism starting from grouping and matching of relevant contexts in the AHP model to the application management based on the handover decision.

**Award:** *Outstanding Paper Award in ICNEWS 2006.*

Tansir Ahmed, Kyandoghene Kyamakya, and Markus Ludwig, “Scenarios and Vertical Handover Strategies in Heterogeneous Networks Environment”, *Proc. of the 1<sup>st</sup> IEEE International Conference on Next-Generation Wireless Systems (ICNEWS 2006)*, **Dhaka, Bangladesh**. Pp. **98-102**, ISBN. **984-32-2914-2**, January 2-4, 2006

**Abstract:** In the future era of communication, realizing ubiquitous and seamless mobility in heterogeneous networks environment is of prime importance. Users will need to select the best option available from diverse networks and service scenarios. New strategies need to be introduced in order to handle complex scenarios that would enable support of context-awareness. This paper investigates different communication and vertical handover scenarios in heterogeneous networks environment and, with respect to those, analyzes possible strategies and mechanisms that would need to be taken into account for realizing ubiquitous mobility. It also identifies a context model for the terminal as well as for the network side.

Tansir Ahmed, Kyandoghere Kyamakya, and Markus Ludwig, "A Context-Aware Vertical Handover Decision Algorithm for Multimode Mobile Terminals and Its Performance", *Proc. of the IEEE/ACM Euro American Conference on Telematics and Information Systems (EATIS 2006)*, **Santa Marta, Colombia**, February 7-10, 2006

**Abstract:** Traditional handover decision algorithms for mobile devices mainly depend on signal strength. In the very near future, these will be obsolete for wireless networks and mobile terminals that are rapidly evolving towards being heterogeneous and multimodal, respectively, in response to the huge market potential. In the given circumstances, more sophisticated and intelligent handover decision algorithm is needed so that terminals can select the best option available from diverse networks and services as per user requirements. The algorithm has to provide user applications the flexibility to switch automatically between active interfaces that best suit them based on application requirements and interface capabilities, as well as to use multiple radio interfaces simultaneously ensuring the optimum usage of the network resources available to the terminal. In order to realize the above requirements, this paper illustrates a novel context-aware vertical handover decision algorithm suitable for multimode mobile devices in heterogeneous wireless networks based on the Analytic Hierarchy Process (AHP) and evaluates its performance through simulation.

Tansir Ahmed, Kyandoghere Kyamakya, Markus Ludwig, Michael Schielein, Stephen McCann, Eleanor Hepworth, and Abigail Surtees, "Location-Assisted Handover for Multimode Mobile Terminals", *Proc. of the IEEE/ACM Euro American Conference on Telematics and Information Systems (EATIS 2006)*, **Santa Marta, Colombia**, 7-10 February 2006

**Abstract:** Present day mobile networks and terminals are rapidly evolving. Wireless networks are evolving towards heterogeneous overlaying infrastructure, while the mobile terminals towards having multimode functionality. Traditional horizontal handover decision mechanisms that mainly depend on signal strength for decision making are unable to realize ubiquitous and seamless mobility across heterogeneous networks as well as true multimode functionality in mobile terminals. Use of location information in decision making would certainly enhance intra and inter technology handover mechanisms by supporting optimized handover management and enhanced terminal operation. As terminals evolve and adopt further wireless technologies for their interfaces, these issues become more important to the early concept and design of such terminals. This paper proposes and describes a novel multimode mobile terminal architecture suitable for realizing location-assisted handover.

Tansir Ahmed, Kyandoghere Kyamakya, and Markus Ludwig, "Design and Implementation of a Context-Aware Decision Algorithm for Heterogeneous Networks", *Proc. of the 21<sup>st</sup> ACM Symposium on Applied Computing (SAC 2006)*, **Dijon, France**, April 23-27 2006

**Abstract:** Wireless networks and mobile terminals are evolving towards being heterogeneous. In this environment, intelligent handover decision, beyond traditional ones that are based on only signal strength, is needed so that terminals can select the best option available from diverse networks and services as per user requirements. In the process, it would enable user applications to switch automatically between active interfaces that best suit them based on application requirements and interface capabilities and to use multiple radio interfaces simultaneously ensuring the optimum usage of the network resources available to the terminal. To fulfill the above requirements, this paper proposes the design and implementation of a context-aware vertical handover decision algorithm suitable for multimode mobile devices in heterogeneous networks based on the *Analytic Hierarchy Process (AHP)*.

Tansir Ahmed, Kyandoghere Kyamakya, and Markus Ludwig, “Architecture of a Context-Aware Vertical Handover Decision Model and Its Performance Analysis for GPRS – WiFi Handover”, *Proc. of the 11th*

*IEEE Symposium on Computers and Communications (ISCC 2006)*, **Pula-Cagliari, Sardinia, Italy**, June 26-29, 2006

**Abstract:** The common desire to be connected “anytime, anywhere, anyway, and to anything” leads to explosive growth of mobile computing and speedy emergence of new wireless technologies, applications, and devices in recent years. In this array of heterogeneous systems, intelligent handover (HO) decision,

beyond traditional ones that are based on only signal strength, is needed so that terminals can select the best option available from diverse networks and services as per user requirements. In the process, it would enable user applications to switch automatically between active interfaces that best suit them based on application requirements and interface capabilities, and to use multiple radio interfaces simultaneously. To fulfill the above requirements, this paper describes the architecture of a context-aware vertical HO decision model suitable for multimode mobile devices in heterogeneous networks and evaluates its performance for vertical HO between GPRS and WiFi.

Tansir Ahmed, Kyandoghere Kyamakya, and Markus Ludwig, “Vertical Handover Support for Multimode Mobile Terminal Using Multi-Homed MIPv4”, *ISCIT 2006*

**Abstract:** Basic Mobile IPv4 (MIPv4) operation constraints applications bound to the same Home Address (HoA) to use the same physical interface because traffic is only tunneled towards a single Care-of-Address (CoA) by the Home Agent (HA). This prevents the different applications from using different physical interfaces. Solutions to address this problem have been proposed that require configuration of filters in the HA to tunnel traffic towards different CoAs but these require modifications to the network, and additional signaling between the mobile terminal (MT) and the network. This paper describes enhancements to current MIPv4 enabled MTs to support multimode operation with no changes to the network, as well as the multimode MT architecture supporting such MIPv4 operation.