

Final Program for M2NM

Wednesday, October 17, 2007

2:00 PM - 3:45 PM

W4D – (M2NM I) Host Identity Protocol—A Tutorial

Chair: Jochen Eisl (Nokia Siemens Networks, DE)

Speakers— Patrik Salmela (Ericsson Research NomadicLab, FI) and Kristian Slavov (Ericsson, FI)

Abstract— In the current Internet, hosts are identified using IP addresses that also describe the topological location of the hosts. In other words, the IP addresses are semantically overloaded since they both identify hosts and represent their topological locations. The Host Identity Protocol (HIP) introduces a way of separating the location and host identity information. It introduces a new namespace, cryptographic in nature, for host identities. Hosts are assigned an identity from this new namespace while the IP addresses continue to be used for packet routing. The cryptographic host identities can be used for host authentication and for establishing security associations between hosts for information security. The identifier/locator split introduced by HIP facilitates for an intuitive mobility solution; connections are bound to the static identifiers and thus connections don't break when the IP addresses are changed.

The Host Identity Protocol is being standardized at the IETF, and the architecture draft has reached experimental RFC status (RFC 4423). Furthermore, many research topics on future internetworking architectures are considering techniques and ideas brought up by the Host Identity Protocol. In the Ambient Networks project HIP has played a major role in the prototyping work in security and mobility contexts.

This tutorial will cover the basic functionality of HIP, including the reasoning for it. It will present the basic concepts of the protocol, such as the base exchange and the update exchange, and also the extensions such as HIP rendezvous and moving networks. The current implementation and standardization status will also be presented.

4:00 PM - 5:45 PM

W5D – (M2NM II) Applications and Security

Chair: Eranga Perera (National ICT Australia, AU)

HIP Based Network Access Protocol in Operator Network Deployments

Authors— Jouni Korhonen (TeliaSonera, FI); Antti Mäkelä (TeliaSonera, FI); Teemu Rinta-aho (Ericsson Research, FI)

Abstract— Wireless mobile operators are expanding their IP networking services outside cellular networks and are increasingly becoming multi-access operators. Increased security requirements, dynamically bootstrapping various IP services and the need for seamless handovers for realtime IP services have become an important problem area to solve in a feasible way. Recent developments on IEEE 802 wireless technologies have addressed most security and management concerns of mobile operators. However, this has been done at a cost of more complex base stations and link layers, and increased control plane signaling between networking nodes. Typically the design is based on the traditional layered networking model, which has caused each networking layer to perform overlapping authentication, authorization and configuration procedures on their own. Clearly, this is inefficient. In this paper we propose a Host Identity Protocol based Network Attachment Protocol and present its prototype implementation, which moves all security features to IP layer, supports bootstrapping of IP configuration as part of the access authentication and supports creation of security associations for authenticating to third party services. Furthermore, the proposed solution has an access technology independent centralized deployment model with minimal requirements on the access network and thus allows deployment of simple lightweight base station.

Secure Identification and Authentication of Legacy Hosts in Ambient Networks

Authors— Patrik Salmela (Ericsson Research NomadicLab, FI); Tony Jokikyyny (Ericsson, FI); Kristian Slavov (Ericsson, FI)

Abstract— In host identity-aware networks, e.g. Ambient Networks, each host has one or more identities. The security principles designed in Ambient Networks mandate that these identities are cryptographic. Like with most new

architectures, a migration path is required for a global deployment. For legacy hosts to be able to participate in Ambient Networks, an ordinary proxy is not enough from the security point-of-view. We present a mechanism that allows legacy hosts to communicate in host identity-aware networks without requiring them to support the used algorithms or protocols.

The Multimedia Capacity of 802.11 Networks

Authors— **Nghia Dao** (University of New South Wales, AU); Robert Malaney (University of New South Wales, AU)

Abstract— The use of 802.11 WLANs as a means to deliver multimedia traffic, such a voice and video, is likely to grow over the next few years. In this work, we propose a modified analytical model to predict the multimedia capacity of 802.11 networks. By capacity we will mean the upper bound on the number of voice or video calls that an 802.11 network can support. Specifically, we predict the voice capacity using the G.711 codec, and the video capacity using the H.264 codec. Our analysis is carried out for three types of 802.11 networks, namely 802.11a, 802.11b and 802.11g. The analytical results are validated by detailed network simulations. The results reported here provide new insights into the multimedia capacity of 802.11 WLANs. Our results are important not only for network planning, but also for QoS guarantees and admission control.

User-Level QoS Assessment of Audio-Video IP Transmission over Link Quality-Based Ad Hoc Networks

Authors— **Toshiro Nunome** (Nagoya Institute of Technology, JP); Shuji Tasaka (Nagoya Institute of Technology, JP)

Abstract— This paper assesses user-level QoS (perceptual QoS) of audio-video streaming over wireless ad hoc networks. We employ the method of successive categories, which is a psychometric method, for the user-level QoS assessment. In order to achieve high user-level QoS, we employ link quality-based routing, which takes account of link quality such as signal strength and link utilization level for route selection. We adopt three link quality-based routing protocols: OLSR-SS (Signal Strength), AODV-SS, and LQHR (Link Quality-Based Hybrid Routing). OLSR-SS is a proactive routing protocol, while AODV-SS is a reactive one. LQHR is a hybrid protocol, which is a combination of proactive and reactive routing protocols. We also employ media synchronization control in the application layer. We performed computer simulation with ns-2 by assuming an IEEE 802.11b mesh topology network with 24 nodes. We then assessed user-level QoS by a subjective experiment with 30 assessors. From the assessment results, we found that AODV-SS achieves the best user-level QoS and that LQHR is effective in networks with short inter-node distances.

Tree Cache Based Context Coordinator for Ambient Networks

Authors— Michal Jakobczyk (University of Science and Technology, PL); **Krzysztof Zielinski** (AGH-University of Science and Technology, PL)

Abstract— This paper presents Context Coordinator (ConCoord) for Ambient Networks. ConCoord is serving as a gateway responsible for indexing, registering and resolving context names into location addresses. The goal of presented study is to design and create the ConCoord service implementation with Distributed Objects Caching technology. The implementation provided by JBoss under TreeCache project is used for this purpose. The proposed ConCoord system architecture consists of a cluster of ConCoord Servers, realized as standalone applications running on separate nodes in the network cooperating with each other and exhibiting certain services. Core functionality of the ConCoord system is data management – registration, retrieval and eviction. Three different data consistency protocols have been proposed: Synchronous Replication, Asynchronous Replication, and Lazy-update. These protocols are characterized by different communication and replicas update overhead. Their features have been evaluated by experimental study performed with prototype implementation. The obtained results fully confirmed that constructed ConCoord implementation satisfies all requirements of Ambient Networks applications. It proves that the Distributed Objects Caching technology provides very interesting alternative to DHT already used for ConCoord implementation.

Thursday, October 18, 2007

09:15 AM - 11:00 AM

T2A – (M2NM III) Mobility and Multiaccess I

Chair: Roksana Boreli (National ICT Australia, AU)

A Generic Signaling Framework for Seamless Mobility in Heterogeneous Wireless Networks

Authors— **Oliver Blume** (Alcatel-Lucent Deutschland AG, DE); Abigail Surtees (Roke Manor Research, UK); Ramon Aguero (University of Cantabria, ES); Eranga Perera (National ICT Australia, AU); Kostas Pentikousis (VTT Technical Research Centre of Finland, FI)

Abstract— Many wireless communication standards have been developed and are still appearing, each with different scope and strength. Heterogeneous networks combine multiple of these radio interfaces both in network infrastructure and in user equipment. This requires a new multi-radio framework, enabling mobility and handover management. This paper analyzes the functional architecture for such multi-radio management and proposes a generic signaling sequence applicable for a range of different handover protocols.

RAT Selection in Wireless Multi-Access Systems

Authors— Jordi Perez-Romero (Universitat Politècnica de Catalunya, ES); **Oriol Sallent** (Universitat Politècnica de Catalunya, ES); Anna Umbert (Univ. Politecnica of Catalunya, ES); Andrea Barbaresi (Telecom Italia, IT); Rickard Ljung (TeliaSonera, SE); Ricardo Azevedo (Portugal Telecom Inovação, PT)

Abstract— This paper discusses the problem of selecting the Radio Access Technology (RAT) to attach to a given connection request among a variety of available RATs. To this end, the need and relevance of this functionality in the context of heterogeneous wireless access networks is firstly described. Secondly, and given the complexity of the problem to be tackled, three different and complementary methodological approaches to gain insight into the problem are presented together with some specific examples. Finally, the need to devise a generic RAT selection framework is identified and a solution, based on a novel metric named fittingness factor, is developed and assessed. The fittingness factor reflects the suitability of allocating a given Radio Access Technology (RAT) and cell to a user depending on the specific context in terms of requested service and on the terminal and network capabilities at each instant. Results obtained indicate that the fittingness factor solution achieves better performance than other approaches.

Ambient Network Advertisements

Authors— **Teemu Rinta-aho** (Ericsson Research, FI); Olav Queseth (KTH, SE); Joachim Sachs (Ericsson Research, Aachen, Germany, DE); Nadeem Akhtar (University of Surrey, UK)

Abstract— One of the main goals of the Ambient Networks project is to develop mechanisms to enhance the probability of a user to have connectivity, independently of the network access technology. As networks and terminals are supporting multiple access technologies, it becomes increasingly important to quickly select the most optimal access depending on the status of the networks, users and applications, without adding extra burden of manual network configuration on the client or the network side. In this paper the advertising and attachment procedure of Ambient Networks is outlined, focusing on the exchange of Ambient Information Elements. In addition, an example of the whole process is described using WLAN as the underlying access technology. It is shown that the framework provides a multitude of options and that it can be used in networks utilizing a multitude of legacy technologies.

The Ambient Networks Heterogeneous Access Selection Architecture

Authors— **Kostas Pentikousis** (VTT Technical Research Centre of Finland, FI); Ramon Aguero (University of Cantabria, ES); Jens Gebert (Alcatel Lucent, DE); Jose Galache (University of Cantabria, ES); Oliver Blume (Alcatel-Lucent Deutschland AG, DE); Pekka Pääkkönen (VTT Technical Research Centre of Finland, FI)

Abstract— Forthcoming wireless communications will be characterized by the ubiquity of multiaccess. Despite the inherently increased complexity, end-users should be able to take advantage of the most suitable access network. Thus, access selection in an environment with different overlapping radio technologies is of central interest and an architecture is needed that performs equally well on single- and multi-operator scenarios, considers several parameters, and respects the principle of layering. In this paper, we introduce the Ambient Networks heterogeneous access selection architecture explaining how it meets such requirements. We present the essential architectural components and explain their interactions. We illustrate how the proposed architecture works in practice and discuss recent results from our prototype-based validation.

11:15 AM - 1:00 PM

T3A – (M2NM IV) Mobility and Multiaccess II

Chair: Tony Jokikyyny (Ericsson, FI)

A Resource Management Framework for IP-based Radio Access Networks

Authors— Ramon Ferrús (Universitat Politècnica de Catalunya, ES); Joan Olmos (Universitat Politècnica de Catalunya, ES); **Oriol Sallent** (Universitat Politècnica de Catalunya, ES); Jordi Perez-Romero (Universitat Politècnica de Catalunya, ES); Ferran Casadevall (Universitat Politècnica de Catalunya, ES)

Abstract— As 3G traffic grows and radio technologies enhancements like HSPA come online, more effective traffic handling mechanisms along with new resource management approaches are becoming imperative in the transmission networks used for mobile backhauling. In this regard, there is a clear migration towards the usage of IP/MPLS packet-based technologies in the mobile transport networks and, as a result, new challenges are faced in the field of efficient resource management and QoS provisioning. In this context, this paper focuses on the development of a resource management framework targeted to exploit the coordination of radio and transport resource usage. To this end, a set of functions traditionally driven by an efficient usage of the air interface is enhanced so that transport resource information is also taken into account.

On capacity/load-based and availability-based resource abstractions for multi-access networks

Authors— Francesco Meago (Nokia Siemens Networks, IT); Jens Gebert (Alcatel Lucent, DE); Joachim Sachs (Ericsson Research, Aachen, Germany, DE); Johnny Choque (University of Cantabria, ES); Ramon Aguero (University of Cantabria, ES); **Oliver Blume** (Alcatel-Lucent Deutschland AG, DE)

Abstract— The Ambient Networks project designs a future networking environment where today's and tomorrow's networks (cellular, wireless and fixed) seamlessly integrate offering a richer and smarter networking experience to applications and users. The future networking vision of Ambient Networks encompasses dynamic composition and establishment of inter-network agreements, multi-access, multi-operator and multi-hop operations, mobility and security support. In particular, multi-access resource management methods need to deal with heterogeneous access technologies, requiring a suitable abstraction of the diverse access resources to be devised carefully. This implies comparison of different resource abstractions, together with the definition of related algorithms for the respective abstraction layers and access selection modules. This paper presents and compares three different options for the multi-access resource abstraction, including emulation results and performance figures for GSM.

Handover Decision for Heterogeneous Access Networks

Authors— **Matthias Lott** (Nokia Siemens Networks, DE); Jochen Eisl (Nokia Siemens Networks, DE); Jin Liu (Nokia Siemens Networks Beijing, CN)

Abstract— In future mobile networks, a common challenge will be the enabling of mobility management, respectively handover. To perform a handover several measurements including the link characteristics are preceded. In heterogeneous networks, e.g., those comprising legacy 3G systems, LTE / SAE, and WLAN, the measurement reports (MRs) of the serving network and the target network(s) could be quite different. An interpretation of the MRs would be quite difficult since the MRs of a different network need to be differently interpreted, not to mention the different types of measurement values that are available. In this paper a solution for the optimized handover decision based on different MRs in a heterogeneous mobile network environment is introduced. The radio conditions in the serving and the potential target system(s) are taken into account though they might be based on different air-interface technologies. Besides the description of the concept for distributed collection and analysis of the necessary MRs, a concrete example for the vertical handover between UMTS and SAE/LTE as well as the benefits of the new approach are presented.

Management of multiple mobility protocols and tools in dynamically configurable networks

Authors— Jochen Eisl (Nokia Siemens Networks, DE); Michael Georgiades (University of Surrey, UK); Tony Jokikyyny (Ericsson, FI); **Roksana Boreli** (National ICT Australia, AU); Eranga Perera (National ICT Australia, AU); Kostas Pentikousis (VTT Technical Research Centre of Finland, FI)

Abstract— Solutions for mobility management in wireless networks have been investigated and proposed in various research projects and standardization bodies. With the continuing deployment of different access networks, the wider range of applications tailored for a mobile environment, and a larger diversity of wireless end systems, it emerged that a single mobility protocol (such as Mobile IP) is not sufficient to handle the different requirements adequately. Thus a solution is needed to manage multiple mobility protocols in end systems and network nodes, to detect and select the required protocols, versions and optional features and enable control on running daemons. For this purpose a mobility toolbox has been developed as part of the EU funded Ambient Networks project. In this paper we describe this modular

management approach and illustrate the additional benefits a mobility protocol can gain by using context transfer as an example.

Specification Framework for Ambient Network Interface

Authors— **Abed Ellatif Samhat** (France Telecom R&D, FR); Di Zhou (Siemens, AT); Francesco Meago (Nokia Siemens Networks, IT)

Abstract— The Ambient Network Interface (ANI) is defined in the Ambient Networks project to facilitate communications between the control spaces of different networks, enabling advanced internetworking capabilities. To ensure flexible messaging across network boundaries, a specification framework satisfying existing and eventually future requirements over ANI is proposed. In this paper, we present the ANI specification framework developed for the main functional entities including negotiation for composition agreement, triggering for mobility management, transfer of context information during handover and management of internetworking flows.

2:00 PM - 3:45 PM

T4A – (M2NM V) Ambient Networks—Business Models, Services, and Migration

Chair: Kostas Pentikousis (VTT Technical Research Centre of Finland, FI)

Business models and feasibility with Ambient access, mobility and composition functionality

Invited Talk

Speaker—**Ove Strandberg** (Nokia Siemens Networks, FI)

Abstract— One of the key views of Ambient Networks project is to provide architecture and functionality for heterogeneous networks to co-operate and co-ordinate network utilization. Both the operator and end user are challenged to control connectivity and service access in multiple network types. Ambient Networks extend traditional functionality for interaction over network boundaries, and propose the Network Composition function to support co-operations with dynamic agreements between heterogeneous networks. These functional developments enable new alternatives to the vertically tight bundling of traditional mobile operators; there is room for specialization and combination of roles to more efficiently provide the network service. The unbundling of the business model introduces new potential actors like access providers, service providers, different brokers (access, aggregate and service), and identity control providers. The technical design principles are available and the feasibility has been shown, the uncertainty is can a sustainable business model be proved for co-operating networks? Will there be a compelling business trend or is it the regulator that will open up the possibilities for new business actors in an unbundled network?

Dynamic Adaptable Overlay Networks for Personalised Service Delivery

Authors— Markus Kampmann (Ericsson Research, DE); Bertrand Mathieu (France Telecom R&D, FR); Martin Stiemerling (NEC Europe Ltd., DE); Mirko Cano (Telefónica I+D, ES); Alex Galis (University College London, UK); Kerry Jean (University College London, UK); Roel Ocampo (University College London, UK); Kazimierz Balos (University of Science and Technology, PL); Muhammad Adnan Tariq (Ericsson, DE); Kamal Ahmed (Netherlands Organisation for Applied Scientific Research, NL); Mark Prins (TNO Information and Communication Technology, NL); Bryan Busropan (TNO, NL), **Teemu Rinta-aho** (Ericsson Research, FI)

Abstract— In the Ambient Networks (ANs) project, the objectives are to study the composition and decomposition of services, the multi-radio interfaces, the user and network mobility and all the features that should address the networks dynamic, variability, change and so on. In this project, the concept of overlay networks has been selected as the means to deliver services that should be adapted to end-users' context, regarding the access network, the location, the used device and the user's preferences. Obviously, since ANs are very dynamic, variable, the overlay network should be adaptable to fit the new environment. In this paper we present the architecture of this overlay network as well as the dynamic and secure deployment mechanisms which aim at improving the delivery of adapted services. The overlay network being created upon service providers request, an interface allowing this creation request and further configuration requests has been defined and is presented in this paper, the so-called Ambient Service Interface (ASI). Finally to prove the interest of our solution, an implementation of an IPTV services use-case is described.

Context Dissemination for Ambient Networks Composition and Decomposition

Authors— Tomasz Szydło (AGH-University of Science and Technology, PL); Robert Szymacha (AGH-University of Science and Technology, PL); Kazimierz Balos (University of Science and Technology, PL); **Krzysztof Zielinski** (AGH-University of Science and Technology, PL)

Abstract— Composition of networks is an essential capability of Ambient Networks (ANs). The paper refers to a well-established ContextWare architecture, which is a framework that manages context in AN. It elaborates a concept of

context acquisition in case of Ambient Networks composition and decomposition. A design and implementation of the infrastructure supporting the composition process regarding the context-related Functional Entities (FEs) is presented. Access to AN context using Ambient Service Interface (ASI) and its role during the process of composition and decomposition of ANs is also described. Overhead of the proposed solution is practically evaluated in a simple scenario. Advantages and disadvantages of the proposed solution are briefly summarized.

Unbiased approach to Ambient Control Space Migration

Authors—Nabil Charkani (France Telecom RD, FR); Eleanor Hepworth (Roke Manor Research,); Martin Johnsson (Ericsson AB, SE); Mirko Cano (Telefónica I+D, ES); **Jochen Eisl** (Nokia Siemens Networks, DE)

Abstract—The Ambient Networks project introduces the concept of a converged network control layer to support novel advanced communication services. To enable successful deployment of provided solutions, it is essential that any functionality developed within the project is compatible with current network implementations and supports scalable deployment and interworking. This paper presents the migration approach developed within Ambient Networks to support the above goals. This approach, the "unbiased approach", subdivides Ambient Network functionality into a number of packages that can be deployed incrementally within a network to provide new capabilities. The packages are defined in a way that is independent of (unbiased by) constraints imposed by current network value chains. The paper begins by introducing the unbiased approach to migration concept, argues on its adaptation to the project objectives and illustrates how it could apply to control layer architecture developed in the project.