

ERCIM “Alain Bensoussan” Fellowship Scientific Report

Fellow: Anwar Al Hamra
Visited Location : University of Oslo, Norway
Duration of Visit: 9 months, 14th October 2005 – 13th July 2006

I - Scientific activity

My research work during my staying at the University of Oslo has covered many aspects related to wireless networking and can be divided into three parts:

In the first part, I continued the work that I started with my colleagues at INRIA, Sophia Antipolis, France. In this work, we studied network coding, a new transmission paradigm that has proved its strength in optimizing the usage of network resources in two main scenarios: file sharing applications and wireless mesh networks. File sharing is the application allowing a certain number of users to collaborate together in order to share a certain content. A wireless mesh network is the application where any two hosts can communicate directly over wireless, if their transmission powers allow, otherwise indirectly via the other hosts.

In this work, we strived to answer the question of how network coding performs when these two scenarios are combined together. Our contribution is thus a study in which we investigated the benefit that we can achieve from using network coding for file sharing applications over wireless mesh networks.

In the second part of my research work, I addressed the area of wireless sensor networks. These networks represent a very promising technology that finds applications in many areas. Their power lies in their ability to deploy a large number of nodes that assemble and configure themselves. They also have the ability to dynamically adapt to changing environments. In addition, through advanced mesh networking protocols, data can be transmitted over the network in a multi-hop fashion without the need of any infrastructure.

My research work in this area started with a deep study of the state-of-art. After reviewing existing work at the routing and application levels, I tackled the “target tracking” service using wireless sensor networks. Such a service has attracted a lot of attention in the recent few years and many research papers have appeared on this subject. Thus, our contribution consists of a survey and classification of existing solutions for this service that have been proposed over the period 2002–2005. Our survey provides researchers with a consistent material on the recent advances in this emerging and exciting area of research.

In addition, I was able to identify a new application of wireless sensor networks, which is the subject of an ongoing work.

In the third and final part, I addressed the publish/subscribe service in mobile ad-hoc networks. Such a service is becoming popular as it is ideal for critical scenarios like rescue and emergency operations. One main design parameter that guides the performance of publish/subscribe systems is the mobility scenario characterized by the mobility of nodes and their density. Unfortunately, existing solutions are designed to optimize a given metric under a specific mobility scenario, e.g., low delivery delay under low density and high mobility. In this context, our “in progress” work aims at designing a new architecture that can perform

efficiently under all mobility scenarios. Moreover, we are targeting a very flexible architecture that can be easily adjusted to optimize different metrics.

II- Publication(s) during your fellowship

Please insert the title(s), author(s) and abstract(s) of the published paper(s). You may also mention the paper(s) which were prepared during your fellowship period and are under reviewing.

- Title: Network Coding for Wireless Mesh Networks: A Case Study
- Authors: Anwar AL Hamra, Chadi Barakat, and Thierry Turletti.
- **Abstract:** Network coding is a new transmission paradigm that proved its In this paper, we evaluate the gain from using network coding for file sharing applications running on top of wireless mesh networks. With extensive simulations carried out on a simulator we developed specifically for this study, we confirm that network coding can improve the performance of the file sharing application, but not as in wired networks. The main reason is that nodes over wireless cannot listen to different neighbors simultaneously. Nevertheless, one can get more from network coding if the information transmission is made more diverse inside the network. We support this argument by varying the loss rate over wireless links and adding more sources.

One paper under submission:

- Title: Strategies for Target Tracking in Wireless Sensor Networks: A Survey
- Authors: Anwar AL Hamra, Thomas Plagemann, and Vera Goebel
- **Abstract:** Wireless sensor networks have been identified as one of the most promising technologies for the 21st century. One of the most important applications of wireless sensor networks is the target tracking. Such an application is already used in many domains such as, battlefield surveillance, wildlife monitoring, and border security. In this paper, we survey the literature on target tracking over the period 2002-2005. We aim at providing researchers with consistent material on the latest advances in this exiting and hot area of research.

Outgoing work:

III -Attended Seminars, Workshops, and Conferences

Please identify the name(s), date(s) and place(s) of the events in which you participated during your fellowship period.

- Conference name: The 7th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WOWMOM).
- Place: Niagara Falls, NY, USA.
- Date: 26-29 June, 2006.