

Wireless sensor networks demystified

The technological advances in micro-electro-mechanical systems (MEMS) and wireless communications have enabled the deployment of the small intelligent sensor nodes at homes, in workplaces, supermarkets, plantations, oceans, streets, and highways to monitor the environment. The realisation of smart environments to improve the efficiency of nearly every aspect of our daily lives by enhancing the human-to-physical world interaction is one of the most exciting potential sensor network applications utilising these intelligent sensor nodes.

Professor Ian Akyildiz of the Georgia Institute of Technology (USA) recently presented a day-long tutorial on wireless sensor networks at the University of Pretoria. He explained that the above objective necessitates the efficient and application-specific communication protocols to assure the reliable communication of the sensed event features and hence enable the required actions to be taken by the actors in the smart environment.

In his tutorial, Prof Akyildiz presented the challenges and the existing solutions for the design and development of sensor/actor network communication protocols. More specifically, application layer, transport layer, network layer, data link layer, in particular, error control and MAC protocols, and physical layer issues as well as the localisation protocols and the time synchronisation algorithms were explained in detail. Open research issues for the realisation of sensor and actor networks were also discussed. The overall objective of the tutorial was to provide a global and detailed view at the current state-of-the-art in WSNs/WSANs and present the still-open research issues in this field.

The topics covered included Wireless Sensor Network (WSN), Architecture and Protocol Stack, Factors Influencing WSN Applications, Application Layer, Transport Layer, Routing Algorithms, Medium Access Control, Error Control, Physical Layer, Wireless Sensor and Actor Networks (WSANs), Coordination and Communication Problems in WASNs, Underwater Sensor Networks: Challenges, Routing and MAC Solutions, Underground Sensor Networks: Research Challenges, and Grand Challenges for Wireless Sensor Networks. Prof Akyildiz is the Ken Byers Distinguished Chair Professor in Telecommunications at Georgia Institute of Technology. [📧](#)

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→ **Professor Ian Akyildiz** of the Georgia Institute of Technology (2nd from right) presented a day-long tutorial on wireless sensor networks at the University of Pretoria. In attendance at the tutorial were, from left: Prof Wilhelm Leuschner (Head of the Department of Electrical, Electronic and Computer Engineering), Prof Robin Crewe (Vice-Principal), Prof Gerhard Hancke (Department of Electrical, Electronic and Computer Engineering), and right, Prof Calie Pistorius (Vice-Chancellor and Principal of the University of Pretoria).



University of Pretoria research group wins THRIP award

The research group of Prof Gerhard Hancke of the Department of Electrical, Electronic and Computer Engineering was recently honoured by the Department of Trade and Industry (DTI) for research that benefits small, medium and micro enterprises (SMMEs).

The Technology and Human Resources for Industry Programme (THRIP) – an initiative of the DTI – presented the award at a function in Port Elizabeth on 18 September 2007. Prof Hancke and his team won the award in the SMME development category.

Prof Hancke is head of the Distributed Sensor Networks (DSN) research group in the department that has, over the past three years, researched and developed several systems that have assisted SMMEs. "One example is the wireless sensor networks we developed for coal mines where the presence of explosive gasses is measured over a wireless mesh network. This network is essentially an early warning system (measuring the presence of gasses) and also acts as an emergency voice communication system," says Prof Hancke. The benefits of such a network are obvious and many lives might be saved through the application of this mesh network.

"Another example of our research is a system we're building for a production plant that manufactures dairy products. In the past, this company installed a system using wires to measure the throughput on their machines. It took them one month to install this system. Now, using wireless technology, they are able to install the system in less than a day and measure such things as product output, whether machines are broken, operator problems and so forth," says Prof Hancke.

Prof Hancke says that using wireless technology and through the research of this group, the process of evaluating output is quicker and cheaper. There are around 40 students and four staff members who form part of the DSN research group and, according to Prof Hancke, their research has a real application in South Africa and can, possibly, even be exported.

He says that the THRIP award is significant for the researchers. "I think it's important that we are getting acknowledgement for the work we are doing and the way we approach our work in terms of our collaboration with industry. The award recognises that we can contribute to South African industry, which is important for us," explains Prof Hancke.

The research of the DSN research group is done in collaboration with a consortium of seven companies known as a South African Sensor Net Initiative (aSASNi). The vision of aSASNi is for South Africa to become a global wireless sensor/actor network (WSAN) player and that the technology developed locally is maximally deployed to service needs in southern Africa. "aSASNi is interested in technology transfer in South Africa – not necessarily only for the companies who are directly involved, but for the general benefit of the country. These companies are happy to fund research that may not have a particular bearing on their own business because at the end of the day they are getting good engineers and top quality people," says Prof Hancke.

The DSN research group received a further accolade with the involvement of Dr Ian Akyildiz in the group's activities. Dr Akyildiz is the Ken Byers Distinguished Chair Professor in Telecommunications at Georgia Institute of Technology in Atlanta, USA. Dr Akyildiz is rated as the number one professor of telecommunications in the world and is, consequently, highly respected. "He is a world leader in this field and is very keen to collaborate with us. We are going to be sending our PhD students to him for six months to a year and I am also hoping to spend my sabbatical in 2008 working with him," says Prof Hancke.

Prof Hancke adds that it is important for the University of Pretoria to be associated with someone of Dr Akyildiz's quality, not only for his academic input, but also because of the practical approach he brings to research initiatives. "He really has a pragmatic approach to research. He asks important questions about the application of research and how any ideas can be sold or used to make money. That's important because everything one researches needs to have a financial benefit as well," says Prof Hancke.

Dr Akyildiz is very involved in a new field of research known as wireless multimedia sensor networks and believes that this will play an important part in dealing with physical security problems – a burning issue in South Africa. "One of my main visions is to tackle the physical security problem in the country – such as hijackings. One of my students is working on gesture recognition, for instance, where someone who is being hijacked simply lifts his arms in a specific way and this will send a signal to a security company," says Dr Akyildiz.

Since receiving the THRIP award, Prof Hancke was approached to speak at the Net-atHome conference in Nice, France, on 14 November 2007. The conference focused on the connected home domain and brought together leading minds from around the world to discuss home networking solutions. The conference covered topics such as today's home of the future, ten technological breakthroughs for the connected home and ten key issues for the future. Prof Hancke was the guest speaker from Africa at the conference and spoke on the topic of one connected home world. 📍