

# Modelling and Verification of Wireless Mesh Network Routing Protocols

(Internship @ Data61, CSIRO, Sydney, Australia)

## Background

Wireless Mesh Networks (WMNs) are a promising technology that is currently being used in a wide range of application areas, including Public Safety, Transportation, Mining, etc. Typically, these networks do not have a central component (router), but each node in the network acts as an independent router, regardless of whether it is connected to another node or not. They allow reconfiguration around broken or blocked paths by “hopping” from node to node until the destination is reached. Unfortunately, the performance of current systems often does not live up to the expectations of end users in terms of performance and reliability, as well as ease of deployment and management.

We explore and develop adaptive network protocols and mechanisms for WMNs that can overcome the major performance and reliability limitations of current systems. To support the development of these new protocols, the project also aims at new Formal Methods based techniques, which can provide powerful new tools for the design and evaluation of protocols and can provide critical assurance about protocol correctness and performance.

## Research Questions and Tasks

Routing protocol specifications are usually written in plain English. Often this yields ambiguities, inaccuracies or even contradictions. Moreover no formal guarantees can be given based on such a description. The use of Formal Methods such as process algebra avoids these problems, leading not only to a precise description of protocols, but also allowing formal reasoning. The project’s work will be in this area; it can include

**Modelling Routing Protocols** So far we have modelled one of the standard protocols using process algebra, namely AODV, as well as a draft successor protocol that is currently being discussed by the Internet Engineering Task Force (IETF). The project’s work could include the formalisation of a second standard protocol such as OSLR ([http://en.wikipedia.org/wiki/Optimized\\_Link\\_State\\_Routing\\_Protocol](http://en.wikipedia.org/wiki/Optimized_Link_State_Routing_Protocol)) or HWMP ([http://en.wikipedia.org/wiki/IEEE\\_802.11s](http://en.wikipedia.org/wiki/IEEE_802.11s)).

**Verifying Routing Protocols** Based on a faithful specification that has been given, the work could include the verification of basic properties of the routing protocol: packet delivery for example guarantees that a packet, which is injected into a network, is finally delivered at the destination (if the destination can be reached).

**Tool Support** The generation of tools for (semi)automatic reasoning is of high interest. For our work we have used the interactive theorem prover Isabelle and the model checker Uppaal. The project’s work could aim at more automation: this can be automatic translation software from a process algebra language to a language that supports automatic tools; examples are FDR, nuXmv, or CADP. The development of proof-tactics for Isabelle is also an option.

The concrete topic is set according to the applicant’s interests and strengths.

## General Information

Data61 is Australia's leading digital research powerhouse, offering the research capabilities, IP and collaboration programs to unleash the country's digital and data-driven potential, with a global context. By driving collaboration across industry, academia, government and the startup space, Data61 is able to help existing industries transform, and act as a catalyst in the creation of new technology-based industries.

The intern will be part of *Concurrency and Protocol Verification* (<http://ts.data61.csiro.au/projects/concurrency/home.pml>), a highly motivated group with different backgrounds (e.g., formal methods and network engineers), working at different institutes (Data61, UNSW, UQ, and Macquarie University). The successful applicant will work together with Prof. Rob van Glabbeek and Dr. Peter Höfner.

Sydney is the largest and most populous city in Australia. It is located on Australia's south-east coast of the Tasman Sea. With an approximate population of 5 million in the Sydney metropolitan area the city is the largest in Oceania. Sydney also ranks among the top 10 most liveable cities in the world according to Mercer Human Resource Consulting and The Economist.

## Contact Information

If you have any questions concerning the internship, please do not hesitate to contact **Peter Höfner**.

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### FOR FURTHER INFORMATION

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