

# Research statement

I carry out research in the field of computer networks and distributed systems with a special focus on the transport, network and data link layers of the OSI stack.

I believe that the general practice in the present Internet (one-size-fits-all TCP and IP, no matter which application and infrastructure) is far from being optimal:

- Due to the introduction of Network Address Translators and Firewalls, the Internet has moved from having a slim connecting IP layer (the hourglass model) to running everything over TCP/IP or UDP/IP, which is not what was originally intended. This evolution is now making it extremely hard to introduce new transport protocols for special purposes. Ironically, since the transport layer does not involve intermediate nodes, it should theoretically be easy to introduce new technology at this layer – but this is no longer the case.
- Layering led to detrimental technology combinations such as TCP over wireless links, where TCP strives to reduce congestion (instead of wireless collisions) based on an entirely wrong model of the underlying media (a router queue).

These problems are partially due to a lack of communication between layers that exists today; IP does not incorporate enough knowledge of the layers above and below, nor does it communicate enough information to them. Similarly, the standard socket interface does not allow applications to properly specify their requirements and traffic profile, often leaving programmers with the need to implement optimized network mechanisms inside their applications.

This architectural mismatch is one of my main interests. I have been focusing on tailoring network technology to perform better in various scenarios (across high-speed links or noisy links, in mobile environments, ..) and support all kinds of applications (streaming media, the Grid, ..). This naturally leads to an interest in network mechanisms which are affected by the layering problem outlined above, such as Congestion Control and Quality of Service (QoS), as well as short-term cross-layer solutions (adaptive multimedia, etc.). Having lost belief in the notion that strict layering is good design, I am generally interested in new network architectures that should one day bring us a better Internet, as well as from-scratch designs of distributed systems which are overlaid onto the network, and how they interact with the infrastructure below.

I particularly enjoy crossing boundaries, as I have done for Grid computing (where the network has now become a resource to be considered within the parallel systems world) and Networks on Chips (NoCs), where I have applied my Internet background for the design of a new on-chip protocol. Finally, mobile networks are a field that I would like to get deeper into.