

PhD in Computer and Control Engineering

Research Title: Orchestrating Edge Computing Solutions with Efficient Data Planes (Automazione di soluzioni di Edge Computing)

Titolo abbreviato: Edge Computing Orchestration

Funded by	TIM
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Context of the research activity	<p>Network operators and telcos are increasingly relying on softwarized network functions (NFs) to replace dedicated network appliances. While bringing evident advantages in terms of agility, the drawback is in the performance of the current software, which sits well below the corresponding dedicated appliances counterpart.</p> <p>The current PhD is oriented to investigate the above problem, focusing on telco-relevant (e.g., 5G) network services, with the ambitious objective of reaching terabit speed on common off-the-shelf hardware (e.g., commodity server), which corresponds to an improvement of one order of magnitude compared to current state of the art. In addition, this activity will explore also the problem of the orchestration of the above technologies in a cloud-native infrastructure.</p> <p>This PhD proposal will be developed in collaboration with Telecom Italia Mobile (TIM SpA).</p>
Objectives	The candidate could pursue one (or more) of the following directions to reach the objective, while maintaining the "agile" properties of current software models and the capability to run the software on common

	<p>virtualization platforms (no dedicated servers):</p> <ul style="list-style-type: none"> • Exploit recent hardware accelerators such as SmartNICs or GPU cards; • Novel hardware-aware algorithms (e.g., to consider the CPU cache structure) that can improve the efficiency of current hardware pipelines (e.g., CPU); • Novel software techniques that can optimize the executed program at run-time, exploiting information such as the current configuration (e.g., rules configured in a firewall) and the current traffic (e.g., which rules are hit most frequently with the current traffic), while reducing the overhead across multiple network functions (e.g., header parsing shared across multiple network functions); • Novel parallelization approaches that can allow to scale horizontally (multiple CPU cores exploited in parallel) and vertically (split the software across multiple software modules executed in sequence, on different servers). • Define the impact of such novel data plane techniques on the orchestration of network components in distributed data centres (e.g., in edge data centers located also in customer's premises). <p>Finally, a use case will be selected to validate the developed algorithms in realistic conditions. Among the possible choices, a 5G mobile gateway serving a set of customers, running on a server cluster with non-dedicated servers (e.g., the cluster can deliver both NFV and other generic services at the same time).</p>
<p>Skills and competencies for the development of the activity</p>	<ul style="list-style-type: none"> • Operating Systems • Linux Kernel • Computing architectures • Computer Networks • Computing Virtualization • Cloud computing