Ph.D. in Information Technology
Thesis Defense

February 19th, 2026
At 09:00 a.m.
Room Alpha - Building 24

Paolo FIORE – XXXVII Cycle

IMPACT CHARACTERIZATION OF SMART RADIO ACCESS NETWORK DEVICES IN A NETWORK-WIDE CONTEXT
Supervisor: Prof. Ilario Filippini

Abstract:

The deployment of next-generation wireless networks faces a fundamental challenge: how to cost-effectively provide ubiquitous coverage and high-precision services in environments where traditional approaches reach their limits. As mobile networks evolve toward 6G, millimeter-wave frequencies promise unprecedented data rates but introduce severe propagation limitations that demand innovative infrastructure solutions. Meanwhile, the growing importance of location-based services requires positioning capabilities that extend far beyond what conventional cellular networks can deliver. This thesis investigates Smart Radio Devices as a transformative technology for addressing both challenges through a comprehensive system-level analysis. Rather than treating communication and sensing as separate problems, we examine how emerging technologies like Reconfigurable Intelligent Surfaces and Network-Controlled Repeaters can reshape network deployment strategies while simultaneously enabling new service capabilities. Our first and second contributions develop rigorous optimization frameworks for Smart Radio Device deployment in millimeter-wave networks, revealing the practical boundaries of these technologies in communication scenarios. Through extensive analysis comparing different device types and optimization objectives, we demonstrate that while Smart Radio Devices offer valuable coverage enhancements, their role is mostly complementary to traditional infrastructure rather than substitutional. Our third contribution explores how the same infrastructure can be opportunistically leveraged for high-precision positioning without additional dedicated sensing equipment. We show that Reconfigurable Intelligent Surfaces create controllable propagation environments that enable sub-meter positioning accuracy where traditional methods fail, effectively transforming communication infrastructure into a sensing platform. The convergence of these perspectives reveals Smart Radio Devices as enablers of infrastructure flexibility, where single deployments serve multiple purposes. This research provides the foundation for understanding how emerging wireless technologies can address the dual challenges of coverage and sensing in next-generation networks.

PhD Committee

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