

# PhD in Electrical, Electronics and Communications Engineering

## Research Title: Physical layer techniques for TV broadcasting in 5G New Radio

Funded by	Rai Centro Ricerche e Innovazione Tecnologica (Italy)
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Context of the research activity	<p>3GPP has defined in Release 14 the new 4G feMBMS (further enhanced Multimedia Broadcast Multicast Service) system, whose characteristics are well aligned to the technical requirements coming from the broadcast sector for TV services, to deliver regular “mobile-TV” services, characterized by high quality HD video content at guaranteed QoS (without buffering time), covering permanently wide territories (countries, regions). In particular, the following important features are introduced in the eMBMS standard:</p> <ul style="list-style-type: none"><li>• free-to-air and receive-only mode, i.e. free-to-air reception without SIM Card and without contractual obligation with a network operator</li><li>• the possibility to dedicate 100% of the available radio resources to broadcast (standalone mode)</li><li>• The definition of a framing structure to cover inter site distances up to about 60 km in a Single Frequency Network (SFN) scenario.</li></ul> <p>In Release 15, 3GPP has started to define the new 5G system, which is being designed to fit the diverse range of services that future networks will have to provide: enhanced mobile broadband (eMBB), massive machine-type communications (mMTC) and ultra-reliable low-latency communications (URLLC).</p> <p>To meet the complex and sometimes contradictory requirements of these diverse use cases, 5G will encompass both an evolution of today’s 4G networks and the addition of a new, globally standardized radio access technology known as New Radio (NR).</p>
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	<p>The NR physical layer is being specified according to a flexible and scalable design to support diverse use cases as well as a wide range of frequencies and deployment options. The key technology components 3GPP is working on are modulation schemes, waveform, frame structure, reference signals, multi-antenna transmission and channel coding.</p> <p>Taking into account the above international framework, this project is performed in collaboration with Rai Centro Ricerche e Innovazione Tecnologica, and has the objective to investigate new physical layer technologies for 5G New Radio, that are best suited to the broadcast TV use case.</p>
<b>Objectives</b>	<p>The objective of this PhD project is to study the physical layer technologies for 5G New Radio, with a special attention to the broadcast TV scenario, investigating one or more of the following aspects:</p> <ul style="list-style-type: none"> <li>• Multiple access and new waveforms in alternative to conventional cyclic prefix- OFDM, such as windowed-OFDM, filtered-OFDM, and the newly proposed Orthogonal Time Frequency Space (OTFS) modulation, to support the variety of mobility cases (e.g. fixed/portable/mobile UEs)</li> <li>• New modulation and coding techniques to cover the wide range of 5G use cases, from high protection to high capacity</li> <li>• Multi-antenna transmission to improve network coverage</li> </ul>
<b>Skills and competencies for the development of the activity</b>	<p>Suitable candidates should have the following skills:</p> <ul style="list-style-type: none"> <li>• Very good programming skills in Matlab and C/C++ languages</li> <li>• A strong communication and information theory background</li> </ul>