**1. AI-Driven RRM and O-RAN+ Optimization on CU/DU Platforms**

**Research Challenge & Goal:** The challenge is to intelligently manage radio resources in a complex 6G RAN using AI/ML for real-time optimization. Traditional RRM (Radio Resource Management) algorithms struggle to meet 6G demands for ultra-low latency, high spectral efficiency, and multi-service adaptability. The innovation goal is to develop an AI-native RAN control framework where machine learning agents embedded at the Central Unit (CU) and Distributed Unit (DU) continuously optimize scheduling, interference coordination, and load balancing. This concept extends the O-RAN architecture by integrating AI-driven RRM at multiple layers – for example, using the RAN Intelligent Controller (RIC) for policy guidance and on-board AI in DUs for fast decisions.

**Consortium Structure (Radisys’ Role):** A balanced consortium would include: *Radisys* as the primary RAN platform provider (delivering O-RAN compliant CU/DU and near-RT RIC platforms where custom AI control loops can be implemented). One or two *academic partners* (experts in AI/ML and wireless) will develop advanced algorithms – e.g. deep reinforcement learning for dynamic spectrum allocation or neural networks for traffic prediction. A *mobile network operator* partner can provide real network data and define scenarios (e.g. dense urban cell deployment or multi-slice networks) to ensure the solution is realistic and meets operator needs. An *IT/Telco hardware partner* (for example, an edge compute or accelerator vendor) might contribute AI acceleration technology to efficiently run learning/inference on CU/DU. Radisys’s role is to integrate these innovations into a disaggregated RAN prototype – for instance, implementing an O-RAN xApp/rApp that interfaces with the CU scheduler to adjust resource allocation in real-time based on AI insights.

**2. 6G/Wi-Fi Multi-Access Coordination (Leveraging N3IWF and ATSSS)**

**Research Challenge & Goal**: Future 6G networks are expected to be a “network of networks”, seamlessly integrating cellular, Wi-Fi, and other access technologies​. The challenge is achieving truly seamless multi-access connectivity – allowing devices to aggregate or switch between 5G/6G and Wi-Fi networks for improved throughput, reliability, or low latency. Past approaches to 3GPP–Wi-Fi convergence (UMA, ANDSF, LWA, N3IWF, ATSSS) have existed but saw limited commercial uptake​. The innovation goal is to develop a limited-scope ATSSS (Access Traffic Steering, Switching & Splitting) implementation on a 5G core that can steer and aggregate traffic across 5G and Wi-Fi in a flexible, policy-driven manner. An N3IWF– which connects untrusted Wi-Fi into the 5G Core – will be used with Radisys 3GPP RAN, along-with a simplified ATSSS function to enable multi-access PDU sessions. This project will prototype seamless handover and flow-level splitting between 5G and Wi-Fi, demonstrating, for example, a video stream or industrial control signal that remains uninterrupted even if the connection dynamically moves between cellular and Wi-Fi.

**Consortium Structure (Radisys’ Role):** Key players would include: *Radisys* providing a 5G core network and a 5G RAN for the testbed. Radisys will implement the ATSSS logic (traffic rules engine, multipath scheduler) within its core functions (UPF/SMF). A *mobile operator* partner is to supply real-world requirements and possibly test facilities (e.g. an operator’s campus with 5G and Wi-Fi coverage to trial seamless handover). A *device or chipset partner(or simulator in worst case)* (e.g. a smartphone modem manufacturer or Wi-Fi chip vendor) can implement the UE-side support for multipath (such as the MP-TCP proxy or policy client) and ensure the solution works end-to-end. Additionally, an *academic/research partner* can contribute algorithms for intelligent traffic steering (e.g. deciding in real time which flows should go over 5G vs Wi-Fi based on QoS, or how to do fast switching when one link degrades). Radisys’s role is as the systems integrator and core/RAN/ supplier – it will host the prototype in a lab environment, integrate the device and network sides, and lead interoperability testing of this multi-vendor solution.

**3. Non-Terrestrial Network (NTN) Integration into 6G RAN Architecture**

**Research Challenge & Goal**: Non-terrestrial networks – satellites (LEO/MEO/GEO), high-altitude platforms (HAPS) are poised to play a much larger role in 6G to enable global coverage and resilience. The challenge is integrating these NTN components seamlessly into the 6G RAN, rather than treating them as standalone systems. In current 5G standards, NTN integration is in early stages (Release 17 added satellite NR support), but it mostly handles NTN in transparent payload deployment with minimal adaptation on the NR air interface. However, for improved performance adapting to radio link to the UT and services like UE-to-UE communication, regenerative payload solutions, with different functional splits, are being preferred with fully regenerative payload support getting defined in Rel-19 but partial regenerative payload architectures remaining un-addressed. For 6G, a native integration is envisioned: satellites and terrestrial base stations cooperating under one unified architecture​.Technical hurdles include very different latency and channel characteristics (e.g. a LEO satellite link has ~2-10 ms one-way delay and high Doppler shifts) that can break typical RAN protocols designed for terrestrial use. Also, handovers between terrestrial cells and satellite beams, or using them concurrently, require new RRM approaches. The innovation goal of this project is to design and prototype a 6G RAN architecture where NTN is an intrinsic component. This could mean developing a variant of a gNodeB that serves both terrestrial and satellite links, or an interworking function at the RAN level (lower than the core) to coordinate NTN. Additionally, defining a partial regenerative architecture which could interface efficiently with TN cellular infrastructure, to maintain the service UX as subscriber transitions from TN to NTN coverage.. The project will address features like multi-link connectivity (devices using a terrestrial cell and a satellite simultaneously), smart traffic steering between Earth and sky based on network conditions and per-device policies and handling the long round-trip time in scheduling algorithms. It may also prototype a scenario such as emergency communication where if terrestrial infrastructure is down, a satellite backhaul or access node seamlessly fills in. The end goal is a working proof-of-concept of a unified TN-NTN RAN, demonstrating key capabilities at TRL 4–5 (e.g. a live system with a satellite emulator or actual satellite link integrated with a 5G/6G base station).

**Consortium Structure (Radisys’ Role):** This project requires a mix of terrestrial and space expertise. *Radisys* will contribute its Open RAN platform (CU/DU and potentially RIC). Radisys’s software can be extended for NTN support – for example, adapting the MAC/RLC layers to handle long delays or implementing the O-RAN interfaces towards an NTN node and adapting the CU-DU F1C/F1U interfaces to support partial regenerative payload architecture. A key partner would be a *satellite communications company* or agency (e.g. an operator of LEO satellites or a tech company specializing in satcom). They can provide access to satellite testbeds or at least detailed simulators, and ensure the design is realistic for space deployment. An *academia or research institute* with focus on NTN/5G could lead work on new algorithms (like predictive scheduling to counter delay, or synchronization techniques for Doppler). A *mobile network operator* could be involved, especially one interested in extending coverage via satellite (for instance, operators already trialling satellite-to-phone services). They would guide the use cases (like rural coverage, disaster recovery, IoT via satellite) and help evaluate performance requirements. Additionally, an *industry partner* focusing on network orchestration or core network might help integrate the NTN-capable RAN with 5G core networks (ensuring authentication, mobility management, etc., work seamlessly with satellites in the mix).

**4. Advanced mMIMO Control in Open RAN with AI-Enhanced Operations**

**Research Challenge & Goal:** Massive MIMO (mMIMO) antenna technology is a cornerstone of 5G, and 6G is expected to push it to new extremes with perhaps hundreds or even thousands of antenna elements​. This will enable unprecedented capacity and coverage (especially in higher frequency bands where more elements compensate for propagation loss). The challenge is that controlling these large-scale antenna arrays – forming beams, scheduling many users, and dynamically adapting to channel conditions – becomes extraordinarily complex. In a disaggregated/open RAN architecture, additional hurdles arise: the fronthaul interface (between distributed unit and radio unit) must carry large volumes of channel state information and beamforming coefficients, and multiple vendors’ components must interoperate for calibration and feedback. Moreover, new modes like cell-free massive MIMO (where many distributed radios cooperate as one giant array) could be introduced, requiring tight coordination. The innovation goal is to develop advanced control techniques for mMIMO in 6G RAN, making it efficient and AI-enhanced. This includes improving the O-RAN interfaces and protocols to handle large antenna arrays (ensuring *high-performance open fronthaul* for mMIMO as identified by O-RAN Alliance​) and developing intelligent algorithms to manage beams and spatial resources. For example, the project might create an AI-driven beamforming engine that learns the environment to fine-tune multi-user precoding, or a coordinated algorithm to link multiple mMIMO sites for joint transmission. It will also consider near-field effects that come into play with very large arrays – 6G’s bigger antennas will enable near-field beam focusing which can be used for high-precision positioning and sensing in addition to communication​. A key outcome will be a proof-of-concept demonstration of a 6G base station (or a simulated equivalent) with an advanced mMIMO subsystem under open RAN control, operating at TRL 3–4. This POC might show, for instance, a 6G NR prototype using a 256-antenna array that adapts in real-time via an xApp on the RIC to serve users with different mobility and QoS requirements, achieving better spectral efficiency than fixed algorithms.

**Consortium Structure (Radisys’ Role):** This project leans heavily on wireless communications research and advanced prototyping. *Radisys* will provide the Open RAN hardware/software framework – possibly contributing a reference RU (Radio Unit) with a massive MIMO array (or cooperating smaller RUs to emulate a cell-free array) and a DU/CU stack that can be modified. Radisys’s open fronthaul implementation will be a starting point for enhancements (e.g. exploring compression of CSI feedback, or new control messages for RIS if applicable). One or more *universities* with strong wireless signal processing groups would lead the development of novel mMIMO algorithms: for example, a team to design an energy-efficient precoding method or an adaptive feedback scheme that reduces overhead while maintaining performance. An *AI specialist* partner (could be a research lab or an industry AI team) would work on incorporating machine learning – e.g. using deep learning to predict channel conditions or to perform anomaly detection on the massive data coming from antennas (helping fault management and self-optimization). A *telecom equipment or semiconductor partner* might contribute by providing FPGA/ASIC technology or test equipment to implement the massive MIMO. A *mobile operator* is to be included to guide requirements (for instance, how an operator would deploy 384-antenna panels on towers, and what O&M capabilities they need to manage such systems). Radisys will act as the integrator and testbed host, assembling the pieces into a working system in its labs (e.g., integrating the university’s algorithm into the RIC platform and the hardware, then demonstrating multi-user performance gains).