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Beamforming Optimization rApp

Rimedo Labs: Beamforming Optimization rApp

The **Ericsson Intelligent Automation Platform (EIAP)** provides Service Management and Orchestration (SMO) for Open RAN and further enhances openness, network management, and automation by supporting multi-vendor and multi-technology RAN environments. EIAP is supported by open interfaces and the industry's leading Software Development Kit (SDK) to enable an ecosystem of developers with all the capabilities needed to innovate, build, validate, share and operate rApps

Brief introduction

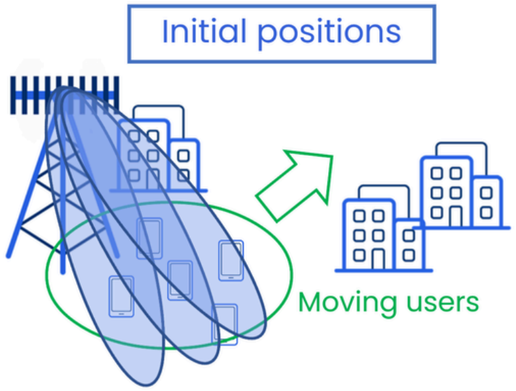
The Rimedo Labs Beamforming Optimization rApp is an intelligent O-RAN application that maximizes 5G network performance. Operating within the Non-RT RIC, it utilizes machine learning to adaptively align Massive MIMO Grid-of-Beams patterns with actual user distributions, ensuring optimal coverage and spectral efficiency without manual intervention

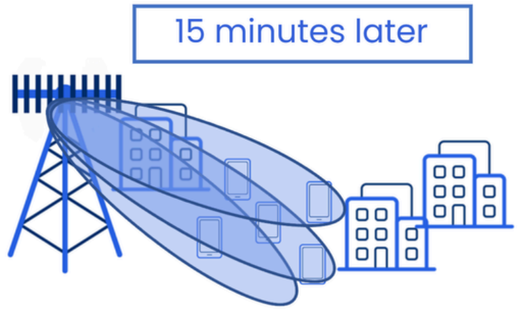
Setting the scene

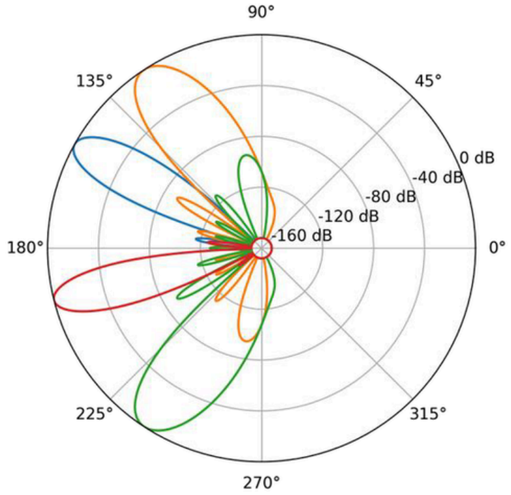
Massive MIMO is the engine of 5G capacity, relying on "Grid-of-Beams" (GoB) technology to direct energy toward users. However, standard GoB configurations are static and rigid. They do not account for the dynamic nature of user behavior—crowds shifting from office districts to residential areas or stadiums. A misaligned grid results in users falling into the "nulls" between beams or being served by weak side-lobes. This leads to degraded SINR, poor cell-edge performance, and wasted radiated energy. Operators struggle to optimize these parameters manually, as physical antenna adjustments are costly and slow.

Introduction to solution

The BO-rApp transforms the static GoB into a dynamic, software-defined asset. By leveraging the O1 interface, the rApp continuously aggregates long-term Performance Management (PM) data, including SINR distributions and beam reporting statistics. It constructs a "User Center of Gravity" map to visualize where capacity is truly needed. An integrated AI model then calculates the optimal azimuth and digital tilt for the beam grid. This solution automatically rotates the coverage pattern to align high-gain main lobes with user clusters, maximizing signal quality and capacity while utilizing standard O-RAN interfaces.







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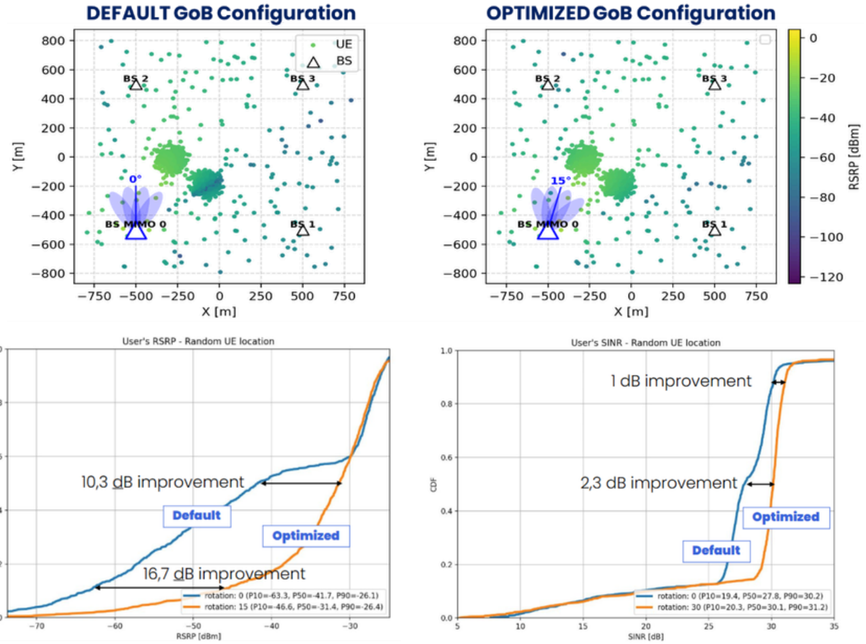
Explanation of the solution

The Rimedo Labs BO-rApp operates as a sophisticated closed-loop control system within the Service Management and Orchestration (SMO) layer. It is designed to solve the "static grid" problem in Massive MIMO deployments.
The process begins with data ingestion. The rApp subscribes to O1 Performance Management (PM) counters from the O-DU and O-CU, specifically focusing on UE feedback loops such as CSI-RS reports and SINR histograms. Unlike real-time xApps that manage millisecond-level scheduling, the BO-rApp focuses on "Slow-Time" optimization. It aggregates data over minutes or hours to identify persistent inefficiencies in the spatial domain.
Using an internal Machine Learning agent, the rApp analyzes this data to detect misalignments between the current Grid-of-Beams configuration and the actual user distribution. For example, it might detect that 40% of users are located at the cell edge, currently served by the weak crossover point between two beams.
The optimization engine then simulates various configuration shifts—such as adjusting the digital azimuth or modifying the beamwidth—to find a Global Optimum. Once identified, the rApp commands the network via the O1 Configuration Management (CM) interface to update the antenna weight vectors or digital tilt parameters. This aligns the peak gain of the beams directly with the user clusters. The solution is fully compliant with O-RAN specifications, supporting both legacy 4G and modern 5G NR, and is particularly effective in high-density urban environments where user locations are highly variable.

Key benefits

- **Maximized Spectral Efficiency:** By aligning beam peaks with users, the rApp significantly increases the average SINR. Higher SINR allows the scheduler to select higher Modulation and Coding Schemes (MCS), directly increasing cell throughput and spectral efficiency (bits/Hz).
- **Enhanced Cell-Edge Performance:** The algorithm specifically targets the 10th percentile of users (cell-edge). By optimizing the grid to cover these "blind spots," the rApp reduces connection drops and improves the consistency of service quality across the cell.
- **Zero-Touch Automation:** The solution eliminates the need for manual drive tests and expensive site visits to adjust antenna tilts. Optimization is continuous, autonomous, and software-defined.
- **Adaptive to Traffic Dynamics:** Unlike one-time manual optimizations, the BO-rApp adapts to long-term changes in the environment, such as new building construction or seasonal crowd shifts, ensuring the network is always tuned to the current reality.
- **ML-Ready Architecture:** The rApp is built with a modular AI engine, allowing operators to plug in custom optimization policies (e.g., maximizing throughput vs. maximizing fairness) based on their specific business intent.



rApp characteristics

- **Supported technologies:** 4G, 5G, O-RAN
- **RAN technology:** O-RAN
- **RAN vendor:** multi-vendor
- **Interfaces:** O1 (CM/PM), A1 (Policy)
- **Deployment:** Non-RT RIC (SMO)
- **Algorithm:** Statistical Analysis & Machine Learning
- **Application:** Radio Resource Management, Coverage & Capacity Optimization

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