Aira's High Fidelity Channel Estimation and Prediction

Boosting MU-MIMO Performance by Running Aira's xApp on VMware Distributed RIC

PARTNER SOLUTION AT A GLANCE

Aira's Channel Prediction xApp running on VMware Distributed RIC increases the effectiveness of MU-MIMO by predicting the evolution of the channel between base station and user, allowing the base station to direct energy effectively, even to highly mobile users at the edge of the cell.

MWC rAppathon PARTICIPANT

Aira's xApp was one of seven applications demonstrated during the rAppathon RIC developer's competition hosted by VMware and Intel at MWC Barcelona 2023.

COMPANY OVERVIEW

Aira Technologies is a pioneer in the application of machine learning (ML) to radically improve wireless telecommunications. Aira's vision is to harness ML to make every wireless connection, in every transport, better. Aira's base station software improves wireless performance by using proprietary ML models to process contextual information already present in the data flowing through mobile networks. This innovation allows mobile network operators to improve coverage and capacity, two key elements affecting total cost of ownership. A higher performing network offers more monetization opportunities with a stable end-user experience, even in high variability environments. See

https://www.aira-technology.com/

MU-MIMO Efficiency Requires Accurate Channel Knowledge

MU-MIMO is a technology that communications service providers (CSPs) are adopting to improve RAN performance without changes to devices or radios. However, in order to beamform efficiently, MU-MIMO requires accurate knowledge of the channel between the user and the base station. Current channel estimation techniques fail to incorporate user mobility and evolution of the RF environment into their calculations, resulting in inaccurate estimates that eliminate the advantage of MU-MIMO.

Aira's Uplink Channel Prediction xApp

Aira's High Fidelity Channel Estimation and Prediction xApp can allow operators with existing networks to achieve more than double the throughput and gain up to 3dB of Signal to Interference Noise Ratio (SINR). This excess throughput can either service more subscribers or furnish existing ones with higher levels of data rates for high-fidelity applications like VR and gaming, helping operators improve topline revenue. With these gains in SINR, operators can extend cell ranges and plan new network deployments with fewer base stations, which can reduce TCO, CapEx, and OpEx.

Channel Estimation is a key processing block in the Distributed Unit (DU) of the radio access network (RAN) software stack. In traditional implementations, the algorithm used for channel estimation relies solely on the reference signals (such as SRS and DMRS) defined by 3GPP. Aira, however, uses a more custom approach. Aira's machine learning (ML) module uses the reference signals to establish and continuously update a network profile and user profile. These profiles accurately
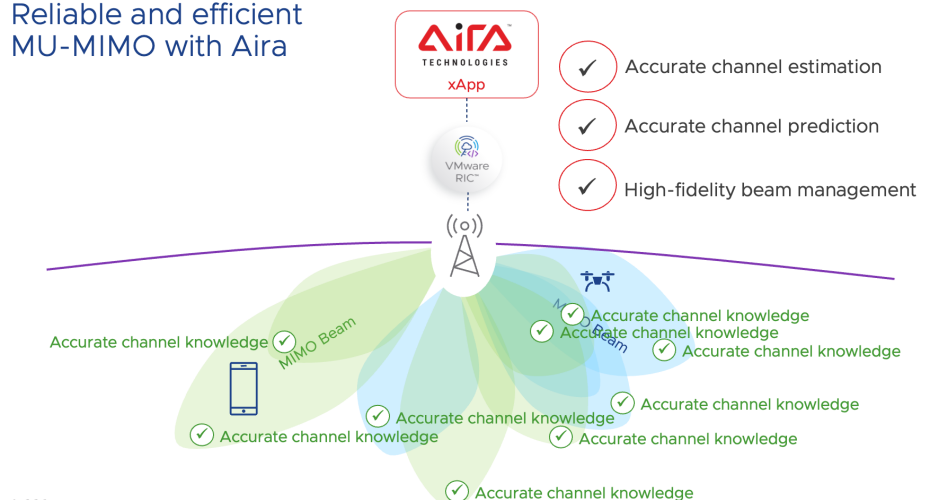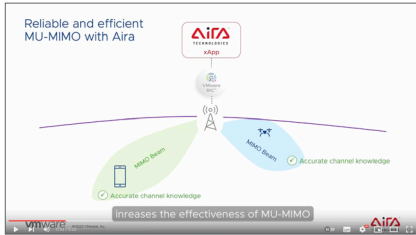
Reliable and efficient MU-MIMO with Aira

✓ Accurate channel estimation

✓ Accurate channel prediction

✓ High-fidelity beam management

FIGURE 1: The Aira Technologies xApp works with VMware RIC to deliver efficient MU-MIMO.

*Boosting MU-MIMO Performance with Aira's xApp on VMware Distributed RIC*

RAN PROGRAMMABILITY

The RAN intelligent controller gives applications from different vendors access to the functions running in the control and management planes of your radio access network, empowering you to program and optimize your RAN by using methods like artificial intelligence and machine learning.
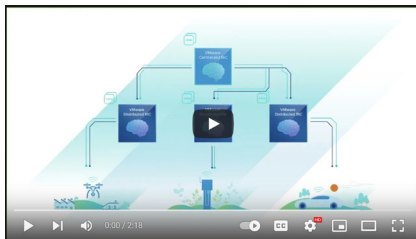
Demo Video: Activating Network Programmability with VMware RIC
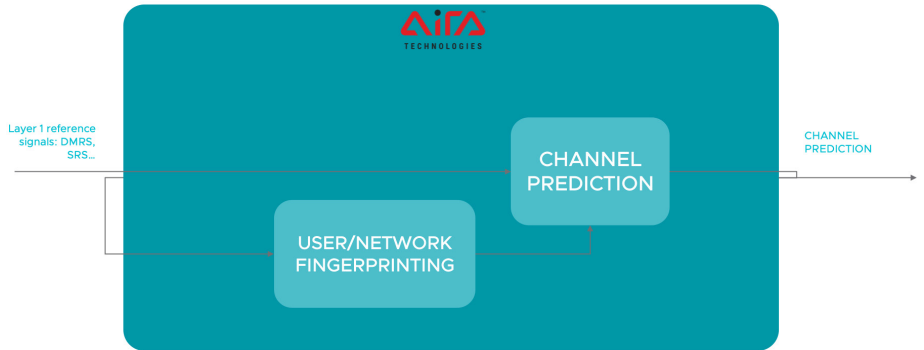
FIGURE 2: The xAPP from Aira uses machine learning to estimate user mobility and channel conditions to predict the evolution of the channel.

estimate and classify various network parameters and user characteristics. A different machine learning block then uses these profiles to hyper-localize the channel estimation and prediction algorithm to the network and user scenario. Aira calls this data-driven process "fingerprinting." This process allows Aira's xApp to predict the evolution of a channel more accurately than current state-of-art algorithms deployed in the DU.

How it Works

Cellular networks behave differently depending on whether you are in a city, suburb or rural area, and are a function of what the users in those areas are doing at a point in time. The characteristics of the serving network and user behavior are finger-printed by Aria using proprietary machine learning algorithms that can predict future changes in the channels between a user and their serving network. Aira's Channel Prediction xApp uses available L1 reference signals (SRS, DMRS, etc.) to first estimate and classify the user status, including their speed and distance from the base station, and the network environment, especially the most likely channel model and multipath delays. The xApp then uses this information with the reference signals to predict the evolution of the user channel. This process increases the effectiveness of MU-MIMO compared to simple channel estimation, and it can result in huge SINR gains.

Details of the xApp

The xApp is composed of:

• An ML-powered fingerprinting module that uses the existing reference signals in the network to accurately generate two profiles.

• A User Profile that estimates characteristics like the speed of the user and distance from base station on a per-user basis.

Network Profile estimates that classify characteristics like number of reflectors in the network and rural versus urban network setting. These profiles, along with the standard reference signals, are then processed by an MLpowered channel prediction module that accurately predicts the evolution of the channel. Accurate prediction of the channel has uses beyond the primary use case of MU-MIMO beamforming. It can improve rate adaptation, scheduling, and reduce the overall energy consumption of the base station.

Benefits

The Aira Channel Prediction xApp supported by VMware Distributed RIC provides network operators with a range of options to increase throughput, expand their cell coverage and reduce power consumption. These options drive OpEx and CapEx reductions, bringing real value to a CSP's business.

VMWARE RIC AT A GLANCE

VMware RIC lets you programmatically manage and control your radio access network (RAN). The RAN intelligent controllers from VMware enable third-party application developers to tap into network data, process it, and use it to modify RAN behavior.

VMware Distributed RIC hosts near-real-time applications (xApps), and VMware Centralized RIC runs non-real-time applications (rApps). These apps introduce new use cases — automation, optimization, and service customization — that fuel innovation across a telecommunications network.

KEY BENEFITS

• **Multi-vendor interoperability and a vibrant partner ecosystem** – use a vendor- and technology-agnostic platform and tap pioneering solutions.

• **Network optimization** – gain network-wide observability and automate optimization with AI/ML.

• **Efficiency** – reduce energy consumption and improve spectrum utilization by using applications from various partners.

RIC SDK PARTNER PROGRAM

A rich developer ecosystem is critical to the successful adoption of open RAN technology. The VMware RIC SDK Partner Program expands access to and simplifies the development of RIC applications. The program gives partners access to RIC SDKs as well as training videos and application developer support. To find out more, visit
https://techpartnerhub.vmware.com/programs/vmware-ric

LEARN MORE

For more information about the VMware Telco Cloud or VMware RIC, call 1-877-VMWARE (outside North America, dial +1-650-427-5000) or visit
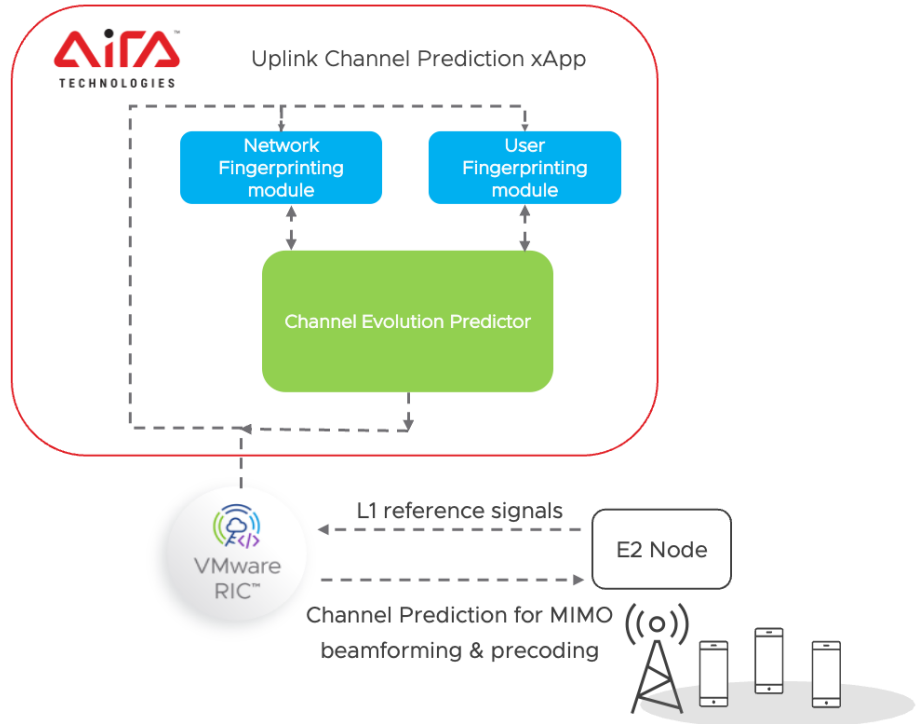*https://telco.vmware.com/*

FIGURE 3: The high-level architecture of the Aira xApp running on VMware Distributed RIC.

VMware and the Path to a Disaggregated, Programmable RAN

For the past five years, VMware has been methodically introducing new telco cloud solutions and changing expectations in the service provider industry about modernization. With an established footprint in telco cloud deployments globally, VMware has been expanding its capabilities to address the challenges in the disaggregation of the RAN.

With a horizontal platform that enables workload consistency from the core and the RAN to the public cloud, we've revealed what is possible—simplicity, speed, agility, and far-reaching automation. The objective is to enable our customers to modernize their entire networks, simplify their operations with end-to-end consistency, and further disaggregate their RAN.