

INTERVIEW

INTRACOM TELECOM GROUP NEWSLETTER | ISSUE 35

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INTRACOM
TELECOM



INTERVIEW

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SUPPLY OF WIRELESS SYSTEMS FOR OPEN MINING OPERATIONS IN THE AFRICAN CONTINENT

Intracom Telecom announced the supply and deployment of its Fixed Wireless Access ecosystem, the WiBAS™ Point-to-MultiPoint (PtMP) and the uniMS™ platform, by the operating company of one of the largest mines in the world, located in sub-Saharan Africa.

The use of high-frequency PtMP technology over the vast area of the mine is one of the many uses for this technology. Mining companies take advantage of the latest technology which ensures not only high capacity but also long range to cover large areas and connect with lightweight network assets the remote points to a central hub. The use of high frequencies is not any more constrained within the perimeter of urban areas.

Intracom Telecom has been pioneering the use of its PtMP technology for open excavation mines in the African continent, foreseeing the need of a transmission technology that can transport bidirectional digital traffic at ultra-high speeds. In the harsh environment of the mines, the state-of-the-art WiBAS™ technology is being used to provide high quality broadband services, and avoiding the cost and trouble from the use of cables. The WiBAS™ systems can be easily installed at any facility and be scaled to support larger coverage areas, with more devices and higher capacity when required.

Moreover, through uniMS™ management platform, the mines make efficient utilization of their communication infrastructure. The sophisticated alarm flow coupled with key performance indicators, available on reports and graphs, elevate the Operators' experience and ensure timely optimizations.

John Tenidis, Marketing Director of Wireless Network Systems in Intracom Telecom, stated: *"We have been serving our customers in Africa for their needs to connect remote location in mines since 2011. We are very pleased to extend our cooperation with one of the biggest African mines so to provide modern communications to ground crews and machine operating personnel, while safeguarding and monitoring the perimeter of the mine."*



DISTINCTION FOR THE "SMART POLICING" PROJECT

The "Smart Policing" project, that enables faster and more effective access to security information by flying squads on the field and which has been delivered by Intracom Telecom to the Hellenic Police Directorate of the Ministry of Citizen Protection of Greece, was ranked first in the "Best Implemented Idea" category, in the "Security of Citizens" thematic area.



The prize was awarded by the General Secretariat of Digital Governance and Process Simplification of the Ministry of Digital Governance in the framework of the annual Digital Governance Competition. In the competition, 82 proposals in total were submitted from organizations of the public sector and evaluated for their effectiveness, innovation and digitization processes and simplification of administrative procedures according to the directions of the Digital Transformation "Bible".

WIBAS™ G5 FWA TECHNOLOGY TO INCREASE BANDWIDTH IN RURAL N. AMERICA



Intracom Telecom announced the supply of its advanced 5th generation Fixed Wireless Access (FWA) platform, the WiBAS™ G5, at mmWave frequencies to Peoples Wireless, a dynamic US wireless broadband provider, through Winncom Technologies, company's trusted networking solutions distributor in North America. More specifically, Peoples Wireless decided to start the deployment of Intracom Telecom's FWA technology, the WiBAS™ G5 evo-BS and WiBAS™ G5 Connect+, at the 24 GHz frequency band after extended field testing. The WiBAS™ G5 demonstrated outstanding reliability, excellent performance and leading capacity at long ranges, successfully addressing customer's expectations. This new generation of mmWave Point-to-MultiPoint radios will enable the Peoples Wireless network to better serve home and business subscribers.

Keith Kindle, Director of Wireless Operations at Peoples Wireless, said: *"We are constantly looking for new technologies to increase bandwidth to our customers in rural east Texas and help bridge the digital divide. The WiBAS™ product from Intracom Telecom has been a perfect fit to provide the much needed capacity that our customers demand and deserve."*

Mike Cook, Vice President of Business Development at Winncom Technologies, stated: *"In support of our partnership with Peoples Wireless we are always in search of next generation technology solutions to provide diversity in network deployment options and the WiBAS™ G5 mmWave 24 GHz FWA solution has proven to be an ideal fit."*

Dharminder Chanana, CEO of Intracom Telecom's subsidiary in the USA, Conklin-Intracom, commented: *"We are delighted that the partnership with Winncom Technologies is already proving to be fruitful and we are looking forward to our further expansion in North America. Our system's unrivalled capabilities, capacity and leading performance at very long distances will bring great value to Peoples. We are excited with their choice and strategic decision to invest in the 24 GHz band."*

HEDNO ENERGY CONTROL CENTER PROJECT IMPLEMENTATION

Intracom Telecom undertook a joint project with MAS SA, a leading software solutions company in the field of energy, for the implementation of HEDNO Energy Control Centers (ECC), amounting to 6,312,640 euros. The project includes the design, supply, installation of software and equipment and the provision of services for the implementation, commissioning and support of the E.C.C., as well as a three-year maintenance from the completion date of the project. The expected time for the completion of the project is 66 months and it will be fully integrated into the existing corporate Information System of the NII (Non-Interconnected Islands) Operator, covering the operating needs of the Electricity System (ES) of Rhodes and the Energy Control Center of Athens. Intracom Telecom will optimize its IT&C, Cyber Security and Data Warehouse / Management Information System and Helpdesk infrastructure systems, while MAS SA will provide the innovative Energy Management System, Market Management System and Substation Automation & Control through RTUs respectively.

Nikolaos Velentzas, General Manager of the Services Business Division of Intracom Telecom, noted: *"Our innovative technologies, our systems efficiency and company's extensive experience in system integration in high complexity projects, contribute to the development and implementation of solutions supporting Energy Control Centers in the best possible way, both technically and financially."*

Theofanis Anagnostopoulos, Director of Software Solutions Division at MAS EUROPE, noted: *"Being the leading Greek company to have developed a holistic software solution for the management of the whole energy value chain and based on our long experience in a wide range of projects and services for the energy sector, we guarantee the provision of innovative Energy Management System and Market Management System suites that cover all the needs of a sophisticated Energy Control Center."*





INTERNATIONAL DISTINCTION FOR A SMART CITY PROJECT

Intracom Telecom was selected as WITSA Global Innovation & Tech Excellence Award Winner for the Smart & Sustainable City project that it is implementing in the City of Belgrade, Serbia. The ceremony award took place in Malaysia last September, during the World IT Conference "WCIT 2022". More specifically, the City of Belgrade, embarked on a multi-phased, long-term plan, to take advantage of advanced Internet of Things (IoT) & Artificial Intelligence (AI) technologies and build a truly "holistic" Smart City. Emphasis and priority were given to the Environment and the City Sustainability.

As a first step, the City of Belgrade decided to adopt new technologies to deal with noise pollution in the city. As a second step, the City proceeded to the modernization of lighting with LED technology in order to have significant reductions in consumption, while with the use of smart metering, the City manages to closely monitor the relevant consumptions in real time. As a third step, the holistic Smart City approach includes the detection and measurement of air pollution in real time, as well as the forecast of the evolution of pollutants and the Air Quality Index. Thus, this third step of the project involves a complete solution that extends from the supply and installation of complex meteorological stations to the necessary IoT and AI applications for the well-timed and targeted launching of actions to deal with air pollution.

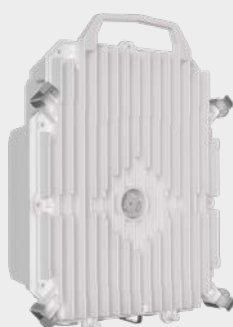
Intracom Telecom, as the technology vendor of this project, accepted the challenge and delivered a complete solution that is seamlessly integrated with the Company's Smart City platform uiTOP™, which monitors and analyzes all the critical factors of a modern city, providing insights to the Authorities in order to make the right decisions, with the right information, at the right time.

Anastasios Dimopoulos, Vice-President of the Board of Directors in Intracom Telecom, noted: *"We are proud to receive such an international award from the renowned association of WITSA, and feel deeply honored for the trust the City of Belgrade has vested in us. This project is a living example of a Smart City that emphasizes on Environmental protection and Sustainability, building a comprehensive, constantly evolving and future-proof solution, addressing real problems and impacting directly and positively the lives of the citizens."*

During Beyond Expo 2022 (Greece), in which the company participated as a Gold Sponsor, Natassa Petrusic, Head of Dept for Monitoring and Environmental Protection of the Municipality of Belgrade, talked to the audience about the importance of this project for the city of Belgrade, as well as for citizens' everyday life, and highlighted the excellent collaboration with Intracom Telecom.



ULTRALINK™-GX80 INCORPORATES IP/MPLS FUNCTIONALITY

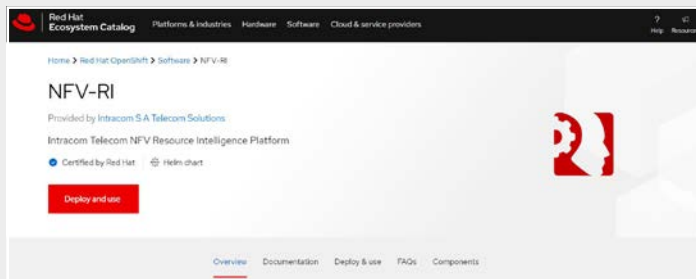


Intracom Telecom has enhanced its E-Band radio portfolio features by introducing support for extensive IP/MPLS functionality into its state-of-the-art xHaul radio, the UltraLink™-GX80. This is a high performance 10 Gbit/s fully outdoor E-Band radio offering market-leading link range and spectral efficiency, now supports advanced Layer 3 (L3) networking functionality by hosting a full IP/MPLS software stack without requiring the use of additional dedicated networking units to host it. Communication service providers, such as fixed access network operators and mobile network operators, can take advantage of this functionality to deliver advanced L3 and L2 multi-gigabit networking services up to the edge of their network, to high-value enterprise customer sites or provision backhaul flows to 4G and 5G base stations.

➔ <https://www.intracom-telecom.com/UltraLinkGX80>

INTRACOM TELECOM CERTIFIES ITS NFV-RI™ SOLUTION FOR RED HAT OPENSIFT

To help CSPs accelerate their sustainability initiatives, Intracom Telecom has certified its NFV-RI™ solution for Red Hat OpenShift, the leading container platform that enables cloud-native infrastructures. Intracom Telecom offers NFV-RI through the Red Hat Ecosystem Catalog, making it easier and faster for CSPs than ever to deploy the solution and reduce the energy footprint of their Cloud-native Network Functions on platforms based on Intel(R) Xeon(R) processors. OpenShift enhances Kubernetes with continuous integration/continuous delivery (CI/CD) pipeline tools, automation, and security capabilities. CSPs benefit from testing, hardening, and multicloud deployment options (including in the data center, at the edge, or on public cloud infrastructure). As part of this process, Intracom Telecom has certified NFV-RI's container images and Helm chart for Red Hat OpenShift. Helm is the package manager for Kubernetes, and Helm Charts are bundles of Kubernetes manifests used to define, install, and upgrade applications, providing pre-validated single-command installation of NFV-RI for OpenShift. As a whole, the certification provides assurances to CSPs for a stable, streamlined and enterprise-ready deployment process for NFV-RI.



Scan to read the details in our recently published Intel Network Builders Solution Brief



Scan to visit NFV-RI's page on Red Hat Ecosystem Catalog

SECURITY ANALYTICS AUTOMATION IN NETWORK SLICING DEMO



Open Source
MANO

In the framework of the OpenSourceMANO OSM13 Ecosystem Day, Intracom Telecom presented a demo of developed Security Analytics automation mechanisms for Network Slicing. The demo introduced a declarative interoperation model between Network Service orchestrators and cloud-native Edge Computing platforms, towards the automated enrichment of slices with security services, such as DDoS mitigation, at the Edge of the network. The presented mechanisms were part of Intracom Telecom's edge management platform for edge automation and interoperability—the "n-Edge Platform"—as a dissemination activity of the Security Analytics research work that Intracom Telecom is leading in context of the EU collaborative project 5GZORRO.

GROUND-BREAKING 30 GBIT/S E-BAND XHAUL RADIO

UltraLink™-XR80 E-Band xHaul radio was presented during the MWC Las Vegas 2022. This is the market's highest capacity E-Band (71-76 / 81-86 GHz) radio that is ideal for use in 5G network transport applications. It offers a ground-breaking 30 Gbit/s full-duplex of air capacity in a single unit, while its leading system gain enables it to deliver the highest capacities at exceptional E-Band link ranges. UltraLink™-XR80 offers the most advanced networking capabilities in combination with networking devices based on the concepts of open and disaggregated transport architecture. It can be seamlessly combined with Telecom Infra Project's (TIP)-based radio-aware Disaggregated Cell Site Gateway (DCSG) devices to deliver Layer 2 (Carrier Ethernet) and Layer 3 (IP/MPLS/Segment Routing) networking services over its multiple 10GbE and 25GbE interfaces. Furthermore, it supports high accuracy synchronization distribution capabilities over Ethernet/IP networks. Operators can benefit from UltraLink™-XR80's advanced features, by using it as a more cost effective, faster and easier to deploy, alternative to optical fibre for satisfying the demanding xHaul (backhaul, midhaul and fronthaul) needs in mobile network RAN deployments and especially in open, O-RAN specification-based, architectures.

➤ <https://www.intracom-telecom.com/UltraLinkXR80>

PROJECTS KICK-OFF

The 48-month Horizon Europe project NextGEM on "Exposure to electromagnetic fields (EMF) and health" held its kick-off meeting on 19-21 of July 2022, at the Foundation for Research and Technology – Hellas (FORTH) premises in Heraklion, Crete, Greece. With a total budget of 7.56M euros and a consortium consisting of 20 organizations—research institutions, universities, public and government organizations and industrial partners from 10 different countries—the project's goal is to ensure



EU citizens' healthy living and a safer working environment when employing existing and future Electromagnetic Field (EMF)-based telecommunication technologies. To this end, NextGEM will provide a framework for generating health-relevant scientific knowledge and data on new scenarios of exposure to EMF in multiple frequency bands. Intracom Telecom is a core partner of this project and will be leading the development of the "NextGEM Innovation & Knowledge HUB" (NIKH), offering a standardized way for European regulatory authorities, citizens and the scientific community to store and assess project outcomes and insights into how EMF exposures affect health.

The kick-off meeting of Horizon Europe collaborative project CORTEX², of which Intracom Telecom is a core partner, took place on 20-21 September 2022 at the project coordinator's (DFKI) premises in Kaiserslautern, Germany. This 3-year project aims at introducing state-of-the-art Augmented Reality (AR) and Virtual Reality (VR) features on video-conferencing tools towards democratizing the uptake of next-generation extended Reality (XR) tele-cooperation among a large number of industrial segments and SMEs. In this direction, CORTEX² will devise an open, extendable and interoperable framework that will provide innovative breakthroughs for advancing teleconferencing experience. Intracom Telecom's main role in the project will be on providing the technological solutions for seamless and resource-efficient integration of heterogeneous connected objects (IoT devices and sensors) and data streams into an immersive video conferencing experience, basing on IoT platform services from the company's Unified IoT Orchestration platform (uiTOP™), as well as AI-driven resource intelligence mechanisms from the company's NFV-RI™ solution.



INTRAROM'S PARTICIPATION IN THE CUSTOMER CARE CONFERENCE & EXPO

Intrarom together with Genesys participated in the 17th Customer Care Conference & Expo Edition that was lining up the hottest CX topics and practical lessons in the field, on June 9-10th 2022, in Bucharest. With this occasion, Intrarom exposed at its stand various communications assets displaying the all-in-one contact center solution based on Genesys Cloud CX platform, a powerful tool that surprise and delight customers with effortless, empathetic experiences. As Genesys Cloud CX platform is designed to take full advantage of modern cloud strategies and technologies, Intrarom team delivered to the multi-verticals audience all the necessary info on how organizations can migrate to the cloud and boost this way agent satisfaction and productivity, making them more agile in a competitive market.



MLOPS AUTOMATION PLATFORM AT IEEE MEDITCOM 2022 CONFERENCE



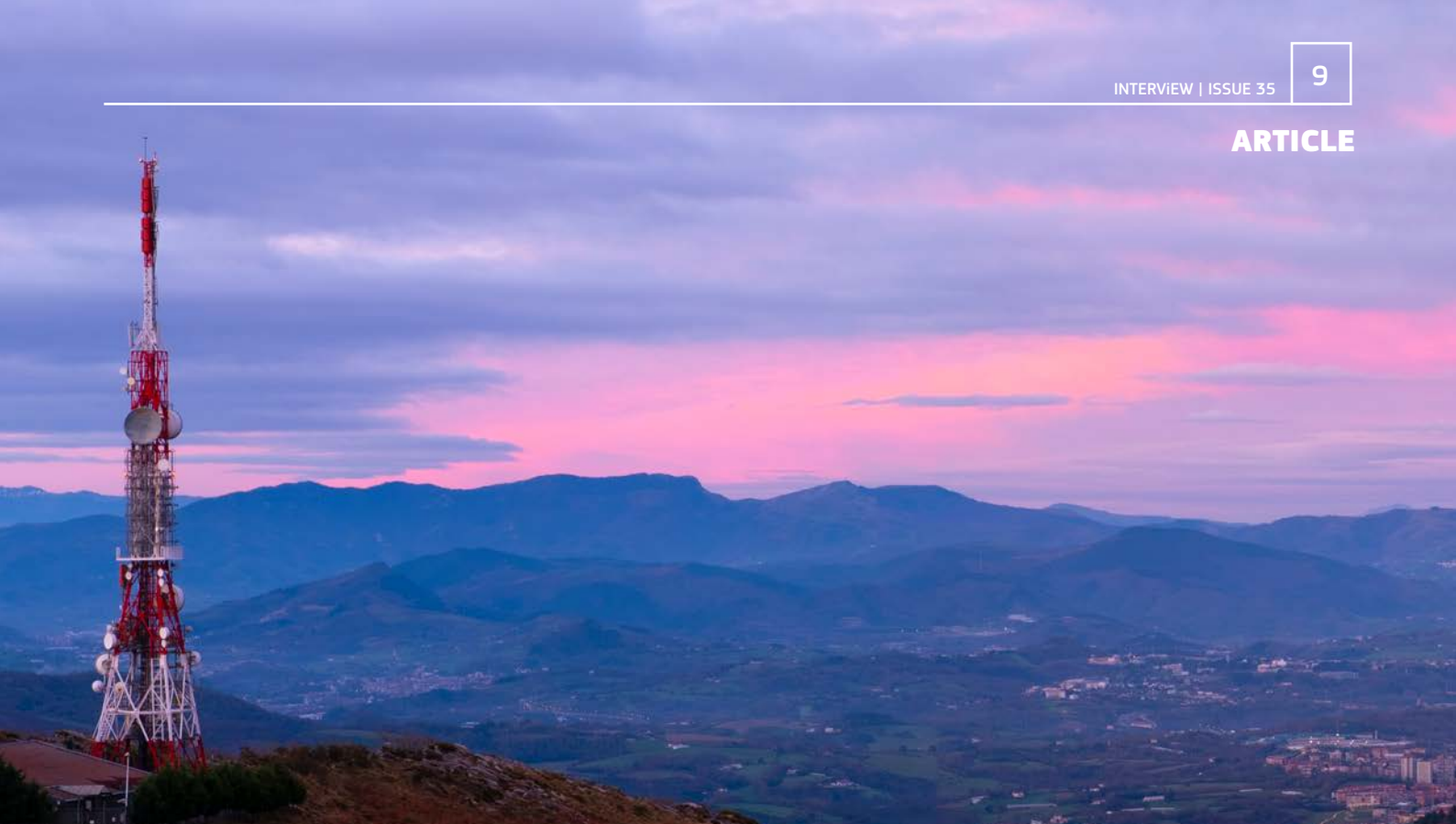
Intracom Telecom presented a demo of its MLOps Automation Platform at the IEEE International Mediterranean Conference on Communications and Networking (MeditCom 2022), which took place on 5-8 September 2022 in Athens, Greece. The presentation regarded an accepted paper publication at the conference, entitled "QMP: A Cloud-native MLOps Automation Platform for Zero-Touch Service Assurance in 5G Systems",

included a live demonstration of an implemented AI-driven platform prototype for proactively assuring Network Slices' Quality of Service (QoS)— and the application of its Machine Learning Operation (MLOps) automation features on vCDN Slices at the network edge, which for the demo purposes were composed using an OpenStack-based deployment of Intracom Telecom's fs|cdn™ Anywhere solution.

INTRACOM TELECOM EXITS RUSSIA

Following Intracom Telecom's suspension of its business in Russia since the beginning of the EU sanctions, last month the company announced its complete exit from the Russian market in the framework of the European Union sanctions on Russia imposed on February 25th 2022. In parallel, Intracom Telecom has reached the deal on selling the 100% of its Russian subsidiary, Intracom Svyaz LLC, on September 5th 2022. Kartlos Edilashvili, Acting CEO of the Intracom Telecom Group, stated: *"We had already halted all our businesses in Russia since the beginning of the EU sanctions on February 25, 2022 and by finalizing this transaction we are completing our exit process. Intracom Telecom will continue focusing on its expansion plan to serve more customers around the globe, addressing their telecom and ICT business needs with Company's innovative products, solutions and services portfolio."*

Intracom Svyaz LLC was a subsidiary of the Intracom Telecom Group, since its establishment in 2002, while the Group has had a long-standing presence in the Russian Federation through its representative office in Moscow since 1998.



HIGH GAIN E-BAND RADIOS FOR MAXIMUM DUAL BAND LINK PERFORMANCE

KONSTANTINOS DIMOPOULOS
Senior Product Manager, Wireless Network Systems

INTRODUCTION

The expansion of 5G mobile networks is moving at full speed, while wired and wireless gigabit-rate fixed access systems deployment accelerates in the wake of the recent pandemic. As telecommunications traffic grows relentlessly, mobile and fixed network operators continuously work at enhancing their transport systems. In the last couple of decades, the majority of telecommunication network traffic has shifted from “narrowband” TDM to broadband packet-based Ethernet/IP. Wired and wireless transport solutions have adapted to accommodate this shift. Microwave radio systems have been an important part in the transport network technology mix and are expected to continue to be in the foreseeable future, as fiber cannot be optimally deployed everywhere.

MW radio systems have been an important part in the transport network technology mix and are expected to continue to be in the foreseeable future, as fiber cannot be optimally deployed everywhere

ADAPTIVE MODULATION AND DIFFERENTIATED AVAILABILITY PLANNING BENEFITS

Native packet radio systems are most suitable for the IP/Ethernet traffic that dominates modern communication systems, fixed and mobile. Such radios exploit automatic adaptation of the radio transceiver’s modulation types (modulation format, coding and bandwidth) to enable robust continuous link operation at the corresponding various capacities of each modulation type. The radios shift their supported modulation types, in a fast and errorless way, from the maximum-capacity modulation type, which is operational for most of the time during dry weather conditions, to the more robust minimum-capacity modulation type, at times of rain precipitation, going through all the supported modulation types in-between. As link capacity decreases the radios continue to transport the data traffic on a higher-priority basis.

The radio planning of such links exploits the concept of differentiated availability, according to which the link is designed for the optimum service availability of four or five 9’s (i.e. 99.999%) for the minimum necessary capacity, while being able to operate at the maximum capacity at a lower, but satisfactory, availability between two to three 9’s (i.e.

for the vast majority of the time). This results in significant reduction of the link's antenna size and/or required spectrum compared to the case in which the link design would require maximum availability at the maximum link capacity. This leads to significant reduction in the link's infrastructure and space requirements, as well as to capex and opex savings. Such treatment has been shown to maintain the quality of experience of a mobile network's end customers.

EXTENDING THE ADAPTIVE MODULATION CONCEPT WITH DUAL BAND CONFIGURATIONS

Combining radio links operating at lower RF spectrum frequency bands, which are capable of bridging longer distances, with links operating at higher frequency bands, which are capable of providing higher capacities, is a most effective method to deliver high capacity and long range connectivity. A number of names is used for such a technique in the industry, such as "Dual Band" when two bands are combined, "Band Carrier Aggregation", "Multi-Band" and others. When the combination of the links is based on L1-link aggregation/ Radio Link Aggregation (RLA), this multi-carrier/ band scheme further extends the concept of adaptive modulation and allows radio link planning based on the differentiated availability concept.

The capacity of a Dual Band link, which is the sum of the capacity of the links of its constituent links, is dominated by the capacity of the higher-frequency band link at favorable weather conditions for 99% to 99.9% of the time.

For 99.9% to 99.99% of the time the combined capacity may be composed of comparable contributions from the links of both bands. Finally, for the last few thousandths of availability percentage points the Dual Band link reverts to the operation of the lower frequency band link only. The modulation format and the between-band transitions happen in seamless way eliminating service interruption to the priority traffic when the capacity is downshifting. As the weather improves the Dual Band link comes smoothly back up to full capacity.

The Dual Band scheme can be applied to brownfield (existing) Microwave link (MW) deployments to offer capacity upgrade to the existing links. This may require ability to combine radios of different vendors in a simple and effective way both in terms of radio operation as well as of the antenna. The Dual Band scheme can also be used for Greenfield deployments to design high-capacity longer-range links.

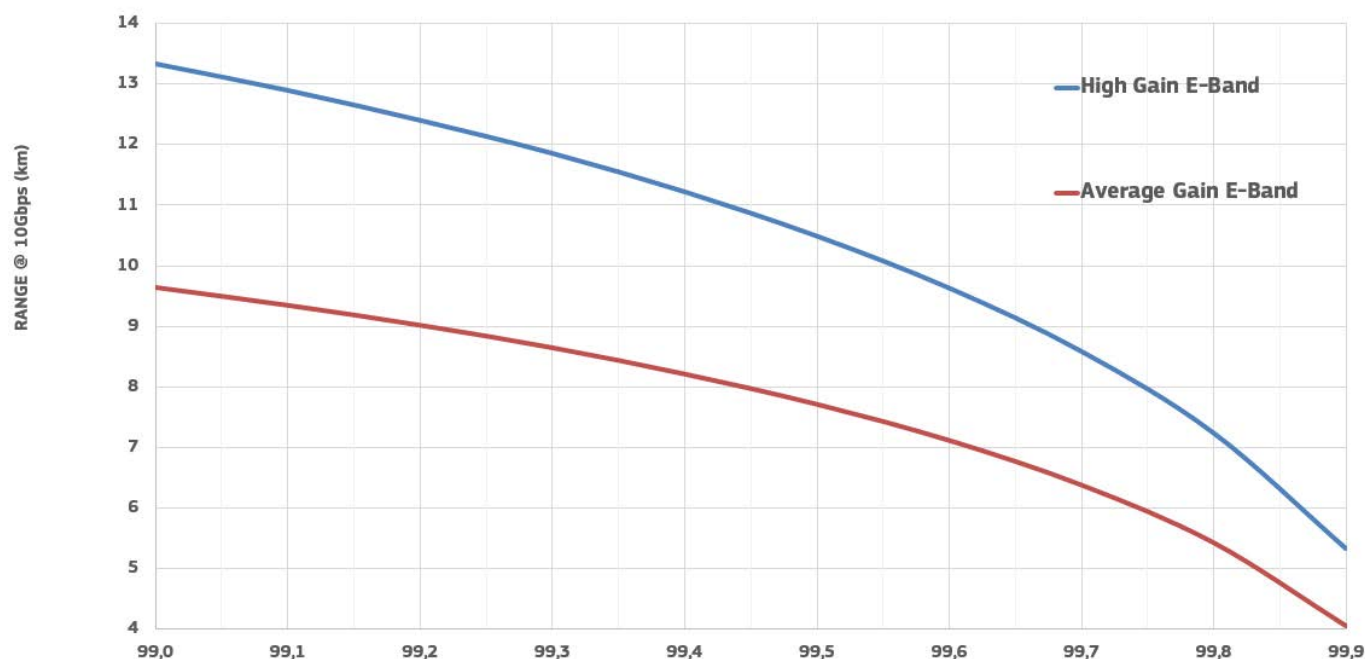
It is the E-Band system gain at high/maximum capacity that will determine the effectiveness of the Dual Band scheme as a link and capacity range-extender

USING HIGH GAIN E-BAND RADIOS OFFERS OPTIMUM DUAL BAND PERFORMANCE

Currently one of the most important band combinations, delivering the required transport capacity for 5G networks, is that between MW systems operating at or below 23 GHz and E-Band radios. E-band radios operating in the 71-76/81-86 GHz part of the spectrum have proven to be the effective and necessary radio solution for the 5G-era network transport. Their importance as a transport solution for the 5G-era has been recognized by the global telecommunication community at WRC-19. E-Band technology operating at the maximum channel size of this band offers abundant capacity, typically 10 Gbit/s and up to 30 Gbit/s.

The physics of electromagnetic wave propagation in the earth's atmosphere dictates that operating at higher frequencies results in smaller link ranges. Typically E-Band links are deployed by operators for backhaul at 2-5km link ranges depending on factors such as, the climate conditions in the deployment area, the required availability of the link's operation and the system gain capabilities of the particular E-Band system. Maximum benefit can be derived for E-Band-only, as well as E-Band-based Dual Band deployments when the E-Band link features the highest possible system gain at high capacities. It is the E-Band system gain at high/maximum capacity that will determine the effectiveness of the scheme as a link and capacity range-extender. By using high gain E-Band radios an operator can extend high capacity connectivity to ranges of 10km or more.

For example, the figure below compares the ranges, for availabilities between 99% and 99.9%, of an average market E-Band solution with a 64dB system gain at 10 Gbit/s with a solution, such as the UltraLink™-GX80, with a leading system gain exceeding 70dB at 10 Gbit/s. The design assumes an E-Band channel size of 2000MHz, an antenna size of 60cm and operation in ITU-R Rain Region K. This region's rain rate matches or exceeds the rain rate applicable to the entire Europe, Canada and most of the U.S.A.



The figure shows that, in the context of a Dual Band solution, the network operator can enjoy up to 30-40% longer link range for the delivery 10 Gbit/s capacity for more than 99% of the time by using a high-performing E-Band radio. Similar benefit can be obtained for smaller channel sizes and the corresponding maximum capacities. MW systems can today easily contribute 1-2 Gbit/s using one or two radios in XPIC configuration. Adding the MW capacity to the E-Band capacity can further enhance the percentage of time when the 10 Gbit/s capacity is available.

INTRACOM TELECOM'S RADIOS OFFER EXCEPTIONAL DUAL BAND PERFORMANCE

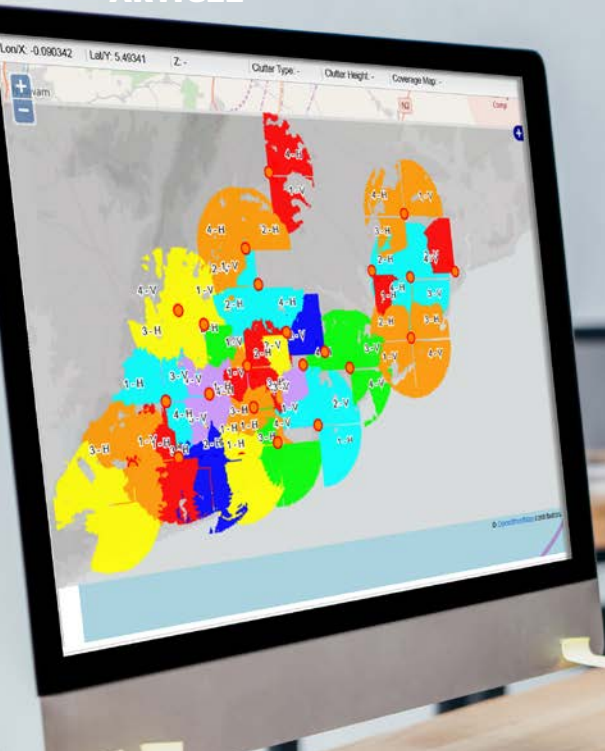
Intracom Telecom's UltraLink™ E-Band radios, already widely deployed in MNO and WISP networks, are ideal for 5G-era transport / xHaul applications, as they are at the forefront of performance in terms of link range, spectral efficiency and operational flexibility. The UltraLink™-GX80, offering a leading system gain of more than 70dB at 10 Gbit/s capacity, supports Dual Band configurations in seamless combination with Intracom Telecom's OmniBAS™ fully outdoor or split mount MW radios using Radio Link Aggregation. OmniBAS™ radios can contribute up to 2 Gbit/s capacity in 2+0 XPIC/RLA configuration in a Dual Band configuration.

Importantly, UltraLink™-GX80 can even be combined with third party vendor radios to enable capacity enhancement of existing MW links in a more effective and economical way, compared to adding one or more MW links. Furthermore, Intracom Telecom can offer a dual band antenna capable of supporting both third party vendor MW radios, as well as the UltraLink™-GX80 greatly facilitating the deployment of such a Dual Band solution.

As a result, UltraLink™-GX80 radio offers an excellent solution for providing the highest performance Dual Band links. ■



ARTICLE



INTELLIGENCE IN ACTION: AUTOMATING THE RADIO LINKS ACCEPTANCE

STAVROS PAPAVALASOPOULOS

Senior Product Marketing Engineer, Wireless Network Systems

INTRODUCTION

As we are moving deeper into the 5G era, the modernization of transport networks pushes Communication Service Providers (CSPs) towards a fast-paced and dense rollout of new radio links, to satisfy demand for increased capacity and quick launch of high quality services.

OSS systems need to adapt to these new challenges and support a tight rollout schedule, extending their offering outside the narrow scope of plain FCAPS management. Intelligent control techniques should be adopted to maximize efficiency by simplification of complex design and operational activities as well as automation of manual and repetitive tasks.

The Radio Link Acceptance process requires great operational engagement and can create bottlenecks, while automation based on a complete set of objective acceptance criteria can be facilitated to streamline and expedite the network rollout and increase the network quality by identifying human errors during installation.

LINK ACCEPTANCE: A CHALLENGING TASK

The acceptance of a link is the final step in a series of complex tasks that are part of the Planning and Rollout network lifecycle phases, starting with the initial link design, the finalization of the correct bill of materials to build the link and the careful onsite works of installation and commissioning. Assuming that all these steps have been completed successfully, the time comes for the link to be smoothly integrated with the network, become ready to carry traffic and finally to be accepted.

The decision to proceed with the acceptance after the installation of a new link in the network is a challenging process that may significantly affect the overall performance of the network. Ideally, after the link acceptance, reinstallation / reconfiguration of the link and time-consuming and expensive site visits should be avoided.

The NOC engineers who are responsible to decide if the link can be accepted or not should perform various checks and collect all the necessary evidence in their hands to validate their decision.

Radio Link Acceptance is now performed faster and more efficiently with automations that validate the link installation and planning through continuous auditing based on objective criteria

Is the link performing as originally designed and planned?

Critical radio parameters such as the RSL, SNR and Tx power should be checked to see if they are within the acceptable limits or there are significant deviations that may lead to performance degradation compared to the performance expected during the design and planning.

At the same time, other important parameters such as the Background Block Error Ratio (BBER) and the number of Severely Errored Seconds (SES) should be also monitored to make sure that they don't exceed a certain threshold that might have an impact on the radio link quality.

Are there any alarms in the equipment?

NOC engineers should check all the equipment related to a link (ODUs, Modems or Network Elements) and verify that no critical alarms exist that affect the link behaviour and performance. All these alarms should be resolved before the final acceptance. In a massive network rollout, all these questions should be answered quickly by the NOC

engineer who is assigned with the acceptance of the link. At the same time, the Project Managers and the Planning Engineers need proof that the link is operating according to the design and the acceptance is done based on solid criteria.

AUTOMATIC RADIO LINK ACCEPTANCE BASED ON CONTINUOUS AUDITING

uni|MS™ with its Acceptance Testing & Audit for Radio Links NLA App offers an automated tool that controls and monitors the acceptance process utilizing the interworking of Planned and Physical views and exploiting its outstanding reporting capabilities. The acceptance of newly deployed links is no longer performed manually by the operations team based on vague or subjective criteria but relies on actual data collected and analysed by uni|MS™.

Operators that use the Acceptance Testing & Audit for Radio Links NLA App for their Link Acceptance can be assured that the correct acceptance criteria are met following the phases of network lifecycle.

All radio links can be audited by the NLA app and are categorized based on user-defined criteria in three link state categories: Planning, Error and Fault Audit State. When the auditing process is finished, the Planning Audit, Error Audit and Fault Audit state of each link is updated and reported in the Links Inventory Report.

The screenshot displays the uni|MS NLA App interface, which is used for radio link acceptance. The interface is divided into three main sections: Planning Audit, Error Audit, and Fault Audit.

Planning Audit: This section shows parameters for RSL, SNR, and Tx Power, along with their acceptable deviation limits. The statistics show 0 Passed, 0 Failed, and 275 Unknown.

Error Audit: This section shows parameters for Maximum Acceptable SES and Maximum Acceptable BBER, along with their acceptable deviation limits. The statistics show 0 Passed, 0 Failed, and 275 Unknown.

Fault Audit: This section shows a list of alarms, including Alarm ID, Description, and Status. The statistics show 0 Passed, 0 Failed, and 275 Unknown.

1. Planning Audit Process

The Planning Audit Process checks and compares the actual values of specific parameters such as ATPC/ACM, RSL, SNR, Tx Power, Peak/Guaranteed PHY Mode Availability collected by Radio Link and Radio Utilization performance schedules, against the corresponding planning values. If the actual values are the same as the planned values or within the configured allowed limits, the Planning Audit state of the link will change to “Passed”, otherwise the state will change to “Failed” and a Planning Deviation alarm will be raised, available to the NOC engineer in the active alarm list report of uni|MS™. If no planning data is found for the link or no actual data has been collected in the audited time window, the state will be set to “Unknown”, which is also the default initial state for a new radio link. When a link state is changed to “Passed” or “Unknown” all related Planning Deviation alarms are ceased.

2. Error Audit Process

The Error Audit Process commences when the uni|MS™ performance collection schedule is finished and checks the BBER and SES values of each side of the link. If the values are less than the configured maximum acceptable limits, the Error Audit state will change to

“Passed”, otherwise the state will change to “Failed” and an Errors alarm will be raised in the active alarm list report of uni|MS™. If there is no collection of error data in the audited time window, the state will be set to “Unknown”, which is also the default initial state for a new radio link. When a link state is changed to “Passed” or “Unknown” all related Error alarms will be ceased.

3. Fault Audit Process

The Fault Audit Process commences when the Alarms synchronization schedule is finished and checks if the alarms raised in the Radios/ODUs, Modems or Network elements of the radio link are included in the Fault Audit Alarm List defined by the user. If the Network Elements on each side of the link are both Available and Synchronized, and no such alarms are in the list, the Fault Audit state will change to “Passed”, otherwise the state will change to “Failed” and a Fault alarm will be raised in the active alarm list report of uni|MS™. If the Network Elements on either side of the link are not both “Available” and “Synchronized”, the state will be set to “Unknown” which is also the default initial state for a new radio link.

Perspectives ▾ Navigators ▾ Inventory ▾ Faults ▾ Performance ▾ Audit ▾ Configuration ▾ Software ▾ NLA Apps ▾ Settings ▾ Rows 1 - 50													
Physical View ▾ Acceptance Testing & Audit for OmniBAS Radio Links ▾ Links ▾													
User Label	Link State	Power Save Mode	Planning Audit State	Error Audit State	Fault Audit State	Link Type	From Site	From NE	From NE Label	From Port	To NE	To NE Label	To Port
Rightunit - LOW	Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio		172.28.120.168	Rightunit	Radio	172.28.120.167	LOW	Radio
8W-121-29 - 172.28.120.28	Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio	Site01	172.28.121.29	8W-121-29	ODU 1	172.28.120.28		ODU 1
aa	Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.121.124	BS-124	Radio	172.28.121.122		Radio
BS-141 - TS-142	Operational	Disabled	Unknown	Unknown	Unknown	RF	BS3	172.28.121.141	automatedtest-2	Radio	172.28.121.142	automatedtest-2	Radio
bs-141 - TS3	Operational	Disabled	Unknown	Unknown	Unknown	RF	BS3	172.28.121.141	automatedtest-2	Radio	172.28.121.143	automatedtest-2	Radio
hub141 - Test-1-25a	Operational	Disabled	Unknown	Unknown	Unknown	RF	BS3	172.28.121.141	automatedtest-2	Radio	172.28.121.144	automatedtest-2	Radio
SRB-UD-D-0007-1 - TS1	Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.121.146	SRB-UD-D-0007-1	Radio	172.28.121.148	TS1	Radio
SRB-UD-D-0007-1 - TS2	Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.121.146	SRB-UD-D-0007-1	Radio	172.28.121.222	TS2	Radio
172.28.121.27 - 172.28.121.22	Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio		172.28.121.27		ODU 1	172.28.121.22		ODU 1
172.28.121.21 - 172.28.121.26_1	Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio		172.28.121.21		ODU 1	172.28.121.26		ODU 1
172.28.121.21 - 172.28.121.26	Not Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio		172.28.121.21		ODU 2	172.28.121.26		ODU 2
	Not Operational	Disabled	Unknown	Unknown	Unknown	Gigabit Etherne...		172.28.121.25	autotest	GbE 1	172.28.121.29	8W-121-29	GbE 1, 5
	Operational	Disabled	Unknown	Unknown	Unknown	Gigabit Etherne...		172.28.121.146	SRB-UD-D-0007-1	GbE 1	172.28.121.71		GbE 1
81 - 80	Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio		172.28.121.81		Radio	172.28.121.80	test2	Radio
172.28.122.64 - 172.28.122.64	Operational	Disabled	Unknown	Unknown	Unknown	Omni Radio		172.28.122.64		Radio	172.28.122.64		Radio
172.28.123.214 - CONNECT-PLU...	Operational	Disabled	Unknown	Unknown	Unknown	RF	TDD 1x4	172.28.123.214		Radio	172.28.123.215	CONNECT-PLUS-...	Radio
172.28.123.214 - CONNECT-PLU...	Operational	Disabled	Unknown	Unknown	Unknown	RF	TDD 1x4	172.28.123.214		Radio	172.28.123.216	CONNECT-PLUS-...	Radio
172.28.123.214 - TS-on-Test	Operational	Disabled	Unknown	Unknown	Unknown	RF	TDD 1x4	172.28.123.214		Radio	172.28.123.217	TS-on-Test	Radio
172.28.123.214 - 172.28.123.218	Operational	Disabled	Unknown	Unknown	Unknown	RF	TDD 1x4	172.28.123.214		Radio	172.28.123.218		Radio
172.28.123.198 - WBAS-Connect...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF	1x5 26GHz	172.28.123.198		Radio	172.28.123.221	WBAS-Connect-...	Radio
172.28.123.198 - 172.28.123.222	Operational	Disabled	Unknown	Unknown	Unknown	RF	1x5 26GHz	172.28.123.198		Radio	172.28.123.222		Radio
172.28.123.198 - WBAS-Connect...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF	1x5 26GHz	172.28.123.198		Radio	172.28.123.223	WBAS-Connect-...	Radio
172.28.123.198 - WBAS-Connect...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF	1x5 26GHz	172.28.123.198		Radio	172.28.123.224	WBAS-Connect-...	Radio
172.28.123.198 - OSDR-PMP	Operational	Disabled	Unknown	Unknown	Unknown	RF	1x5 26GHz	172.28.123.198		Radio	172.28.123.225	OSDR-PMP	Radio
172.28.123.243 - CONNECT-PLU...	Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.123.243		Radio	172.28.123.244	CONNECT-PLUS-...	Radio
172.28.123.243 - CONNECT-PLU...	Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.123.243		Radio	172.28.123.245	CONNECT-PLUS-...	Radio
OSDR-PMP - 172.28.125.101	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.3	OSDR-PMP	Radio	172.28.125.101		Radio
DUALBSGS-1X240 - 172.28.125...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.6	DUALBSGS-1X240	Radio	172.28.125.101		Radio
OSDR-PMP - 172.28.125.102	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.3	OSDR-PMP	Radio	172.28.125.102		Radio
DUALBSGS-1X240 - 172.28.125...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.6	DUALBSGS-1X240	Radio	172.28.125.102		Radio
DUALBSGS-1X240 - 172.28.125...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.6	DUALBSGS-1X240	Radio	172.28.125.103		Radio
OSDR-PMP - 172.28.125.103	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.3	OSDR-PMP	Radio	172.28.125.103		Radio
OSDR-PMP - 172.28.125.104	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.3	OSDR-PMP	Radio	172.28.125.104		Radio
DUALBSGS-1X240 - 172.28.125...	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.6	DUALBSGS-1X240	Radio	172.28.125.104		Radio
OSDR-PMP - 172.28.125.105	Not Operational	Disabled	Unknown	Unknown	Unknown	RF		172.28.125.3	OSDR-PMP	Radio	172.28.125.105		Radio



The Acceptance Testing & Audit for Radio Links NLA application is integrated in uni|MS™ GUI and allows the operator to configure in a single screen all necessary parameters affecting the NLA app's decision on the Audit States. Following the initial configuration, the app will run for the time period defined by the user and the Audit states will be automatically updated.

The three Audit States of each link are available in the links inventory report, while statistics about the number of radio links in each audit state are also available in the application screen and all events concerning the NLA app (start / stop / configure) and the link acceptance are stored in logs for future reference.

Furthermore, the NOC engineer can manually accept a radio link, regardless of the aforementioned Audit States, using the Link Acceptance action available in the Link inventory report. This action will set all audit states to "Passed", ceasing all related Audit alarms. The NOC engineer is prompted to enter a date that the NLA app may resume the automated radio link auditing even though the link has been manually accepted. This allows the continuous monitoring of the link and all its critical parameters that affect its performance.

BENEFITS

The Acceptance Testing & Audit for Radio Links NLA App is part of a bouquet of NLA Apps offered by uni|MS™ to enhance the Network Lifecycle Management experience that improves collaboration among decision-makers, tackles complexity throughout the network lifecycle and provides multiple benefits for the Communication Service Providers during the link acceptance phase.

More specifically, the uni|MS™ Acceptance Testing & Audit for Radio Links NLA App delivers:

- » Automation of Link Acceptance process
- » Faster and more efficient acceptance performed by a tool instead of manual processes
- » Increasing the quality of the network by eliminating human errors during installation
- » Acceptance based on measurable criteria (link performance parameters and alarms)
- » Validation of link installation as per planning
- » Continuous auditing of radio links
- » Off-the-shelf reporting of all link statuses in the network
- » Logging of link acceptance data with details about when it happened, who did it and what criteria were used.

The link auditing and testing provided by the uni|MS™ NLA App is used during the link acceptance period but it can also be extended after the link acceptance, offering a powerful and intelligent tool that performs round-the-clock monitoring of the link status from a single pane of glass throughout the whole network lifecycle. ■

TOWARDS SUSTAINABLE RADIO ACCESS NETWORKS

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INTRODUCTION

The radio access network (RAN) is a critical part of a mobile network as it provides connectivity between end-user devices (like cellphones, computers or any remotely controlled devices) and the rest of a Communication Service Provider's (CSP) core network.

RANs represent significant CAPEX & OPEX (>60% of the overall network expenses), perform intensive and complex processing, and currently are facing rapidly increasing demand as more 5G and edge computing use cases emerge for telco customers.

A typical RAN network is composed of remote cell sites and each of them includes collocated the following three major RAN components:

- » **Antenna:** Interfaces a cell phone wirelessly and transmits/receives RF signal.
- » **Radio Unit (RU):** Interfaces with an antenna on one end and BBU on the other and converts RF signal into data signal and vice versa.
- » **Baseband Unit (BBU):** A proprietary, purpose-built box comprised of Hardware and Software that provides a set of signal processing functions to make wireless communication possible.

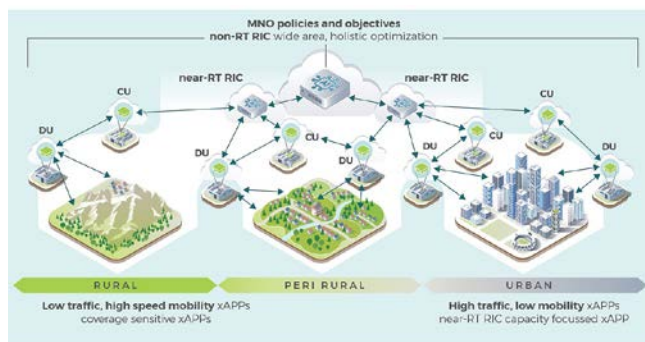
RAN DISAGGREGATION AND VIRTUALIZATION

Until recently, RAN held out in the virtualization process because of its heavy and strict performance requirements. Actually, the RAN cannot be fully virtualized, unlike many other network domains. Antennas and RUs will remain physical and will continue to provide their functionality over dedicated hardware.

However, exactly as network functions virtualization enables CSPs to transform and modernize their core packet network, similar principles and methodologies are now applied to virtualize the most crucial and complicated part of the RAN, the BBU.

Virtualized RAN decouples the software from hardware by virtualizing Network Functions. It uses virtualization technologies like virtual machines or containers to deploy the disaggregated BBU software components (Central and Distributed Units - CUs and DUs), on top of a Kubernetes based cloud-platform over COTS (commercial off-the-shelf) servers.

Virtualized RANs allow CSPs to separate the BBU functions and run them as virtualized network functions on general-purpose Hardware. In this way, the RAN becomes more cost-effective, flexible, agile, scalable, and resource-friendly, making it easier to introduce new features and innovations through regular software updates. Furthermore, it allows getting full advantage of BBU pooling (one BBU to serve many cell sites). Centralization of the BBU processing reduces the equipment required at the cell sites as well as their power, cabling, space, cooling, and maintenance requirements.



Source: Telecom Infra Project (TIP)

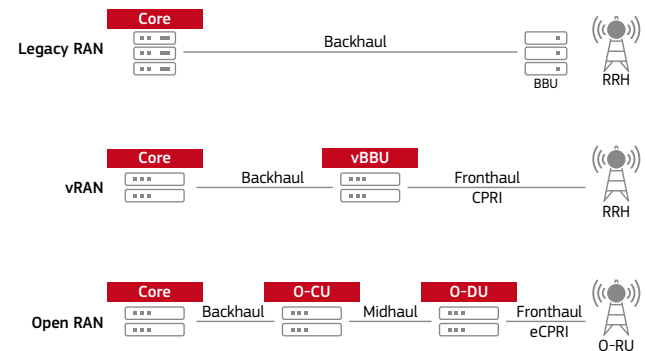
OPEN RAN

The trend toward virtual, containerized, and cloud-native network implementations inspired standardization entities like O-RAN Alliance to specify standards for more intelligent, open, virtual, and fully interoperable “Open RAN” implementations.

“Open RAN” makes the RAN open within all aspects and components, building a modular BBU software stack that operates on commodity hardware, with open and standard north- and south-bound interfaces. This standard-based “Open RAN” architecture enables to mix and match “white box” RAN hardware, meaning that BBU units (CUs and DUs), radio units and remote radio heads can be assembled from any vendor and managed by “Open RAN” software to form a truly interoperable and open “best of breed” RAN.

This way, the underlying hardware layer (radios from vendor A, CUs from vendor B, DUs from vendor C and COTS servers) enables CSPs to select and integrate the best RAN components avoiding vendor-lock at the same time.

On the other hand, “Open RAN” introduces a number of challenges like the integration and ongoing management of a complex multi-vendor RAN, automation of multi-vendor RAN components, accountability for issue resolution and ensuring that network performance is comparable to an optimized single-vendor solution.



VIRTUALIZED RAN MANAGEMENT AND OPTIMIZATION

5G architecture defined by the 3GPP, brings the promise of new and diverse use cases across multiple industries taking advantage of enhanced mobile broadband (eMBB), massive machine type communications (mMTC), and ultra-reliable low latency communications (uRLLC) services defined in the standard.

Either a single-vendor virtualized RAN or a multi-vendor Open RAN implementation enable the disaggregation and integration of RAN components, allowing the flexibility to efficiently accommodate the new 5G use cases. In fact, the ongoing 5G network transformation depends on the virtualization of RAN and increasing demands for a container-based and cloud-native RAN that runs over a common cloud infrastructure and uses common cloud infrastructure management approaches.

However, virtualized RAN is not a panacea. The number of 5G network-configurable parameters will reach the thousands, especially when the orchestration of multiple network slices and beamforming from massive-MIMO antennas are taken into consideration. Manual configuration and optimization will no longer be manageable or cost-efficient and CSPs should rely on RAN Intelligent Controllers (RICs) that will provide the required levels of automation together with AI/ML tools to better control the RAN complexity.

A RAN Intelligent Controller (RIC) is a software-defined component of the RAN architecture that is responsible for controlling, managing and optimizing the radio resources and functions. The RIC is a critical part of the RAN disaggregation strategy, bringing intelligence, agility and programmability to radio access networks. It provides advanced control functionality, which delivers increased efficiency and better radio resource management. These control functionalities leverage analytics and data-driven approaches including advanced ML/AI tools to improve resource management capabilities.

The RIC enables the onboarding of third-party applications (rApps & xApps) that automate and optimize the RAN operations at scale. Use cases include traffic steering, energy efficiency, quality of experience optimization, quality of service-based resource optimization and MIMO optimization.

rApps and xApps are tools to automate the RAN and maximize the radio network's operational efficiency. rApps are specialized microservices operating on the non-Real-time RIC, usually handling the non-real-time functions that may need more than 1 second to be executed (e.g. may take minutes or hours). Typically, rApps are single-purpose AI/ML applications that provide policy-based guidance for RAN elements and their resources to xApps. For example, an rApp can predict the utilization of every cell in a network in the near future (e.g. next 30') taking as input the current utilization, the mobility of subscribers, historic patterns, etc.

xApps are hosted on the near Real-time RIC and are targeted for functions running between 10 milliseconds and 1 second, like those focusing on optimizing the radio spectrum efficiency, performing handover actions, etc. Either working independently or together, rApps and xApps provide essential control and management features and functionality.

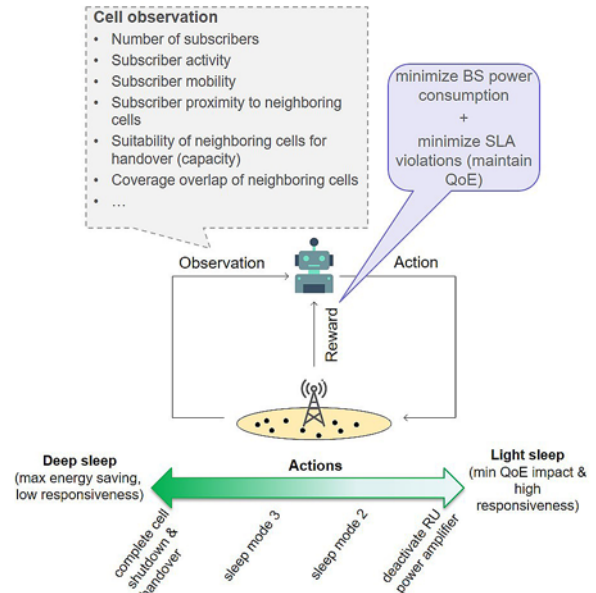
AN INTELLIGENT rAPP FOR IMPROVING RAN'S ENERGY EFFICIENCY

The RAN can account for 50%-60% of the total network energy consumption for an operator, with the largest part of it (50%) being attributed to the main equipment of a base station (radio unit, baseband unit and main control). To help CSPs address the RAN energy efficiency challenges and meet their sustainability goals, Intracom Telecom has conceived an rApp for intelligent management of 5G cell energy consumption based on Deep Reinforcement Learning (DRL), and driven by Quality of Experience (QoE) as perceived by the end users.

In Deep Reinforcement Learning (DRL) a cognitive agent learns by itself to make optimal decisions in an initially unknown environment, by interacting with it in a trial-and-error fashion. During training, the agent takes random actions to learn which ones will lead to bigger reward. During inference, the agent has already learned what the best actions in each different state are and leverages this knowledge to maximize the reward gathered.

In the context of the specific rApp, a DRL agent is trained to activate the ideal type of power saving mode for each cell, to reduce overall RAN energy consumption, but always

under the premise of maintaining the QoE within acceptable levels. In DRL's terms, the agent is trained to earn bigger reward when minimizing the energy consumed by a cell, and at the same time minimizing the QoE degradations experienced by its subscribers (e.g., SLA violations).



To train the agent, the rApp uses as input several metrics and KPIs from every cell that are indicative of its local traffic and neighbouring conditions, such as:

- » number of subscribers
- » subscriber activity (e.g., traffic volume)
- » subscriber mobility
- » subscriber proximity to neighbouring cells
- » capability of neighbouring cells for handover (in terms of capacity, coverage overlap with the current cell, etc.)

For example, a cell with low subscriber activity and good coverage overlap with neighbouring cells will be put more easily into a deep power saving mode (e.g., shutdown and handover), as opposed to a busy cell or an isolated cell without much overlap with neighbouring cells.

The outcome of the training process is a DRL model able to determine the ideal power saving action for every different state. While the DRL model is built and maintained centrally in the context of the rApp, its actual use takes place locally and independently on each cell, according to the cell's current conditions, using the underlying interfaces of the corresponding xApp.

An advantage of the rApp is that it offers the flexibility to the CSP to adapt it to whatever power-saving actions are available on his RAN, without being tightly coupled to a specific RAN implementation. Different RAN implementations may feature different power-saving actions, but the rApp is

The OpenRAN architecture promises great agility, but to get the most out of it CSPs must combine it with AI & ML to guarantee efficient use of resources without performance compromises

generalizable enough so that the CSP can configure it with whatever actions are considered most proper or applicable. This abstraction is possible because every power-saving action can be in principle associated with a particular level of QoE, and therefore the rApp decision logic can be trained upon the costs & benefits associated with those actions, without being dependent on the actions per se.

For example, a complete cell shutdown suggests the most energy-efficient mode a cell can be driven into, but can be potentially associated with the largest QoE impact, because of the subsequent handovers, or because of the need to reactivate the cell at the longest possible latency, if handovers are not an option. Conversely, deactivating a few components of the base station (e.g., the RU power amplifier) may incur minimum QoE impact due to the low wakeup latency, but will lead to limited energy gains.

Finally, the rApp is designed to offer flexibility to the CSP to employ differentiated policies on every cell of his network. It allows multiple DRL models to be trained according to different policies (e.g., energy-oriented, QoE-oriented, balanced, etc.), which the CSP may then apply selectively on each cell, depending on its geographical region, time of the day, seasonality, and other criteria. For example, the operator can opt for more energy-oriented DRL models at sparsely populated areas or during quiet periods, or to opt for more QoE-oriented DRL models during busy hours or at dense cells.

IMPROVING THE ENERGY FOOTPRINT OF RAN'S VIRTUALIZED COMPONENTS

To deliver competitive performance on COTS hardware, the virtualized components of RAN, i.e. vCU and vDU, often employ high-performance packet-processing frameworks like DPDK or VPP. These frameworks enable accelerated packet processing, providing high packet rates, deterministic performance, low latency, and zero packet drops, but on the other hand they keep the servers constantly running at a

high power-up state, as if the servers are always operating at peak demand. The reason is that DPDK and VPP rely on polling mechanisms to achieve these stringent KPIs, which keep CPUs at the highest utilization at all times, even during idle periods, thus consuming the maximum possible power and elevating operational expense (OpEx).

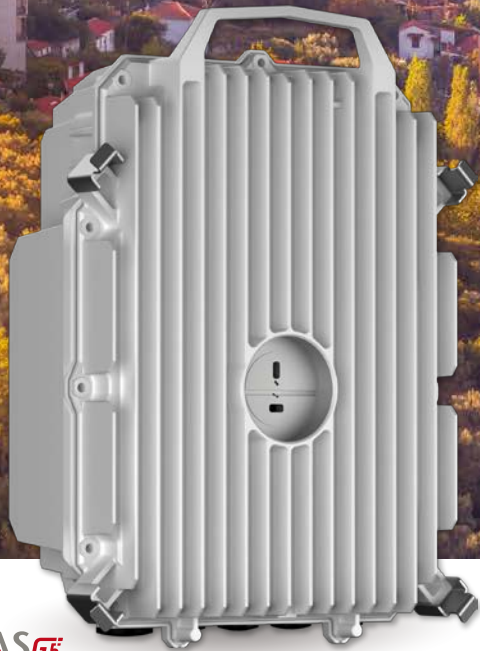
To overcome the power waste associated with DPDK and VPP virtualized network functions (VNFs) constantly running at a high-power state, even when not necessary, Intracom Telecom has added the frequency feedback loop (FFL) workflow to its NFV-RI™ solution. The FFL uses machine learning to predict VNF traffic levels to enable reduced power usage during light or off-peak traffic periods, without compromising performance. The solution can dynamically adjust the frequencies of CPUs processing DPDK and VPP VNFs according to their incoming load, while helping meet the goal of zero packet drops, in a fully automated way. FFL has a real-time, closed-loop mechanism that adapts the frequency of the cores the VNF is running on to match their actual traffic load, while helping ensure that frequency is high enough to support zero packet drops. This means that VNFs are operating at maximum CPU frequencies during peak hours, and moderate or minimum frequencies during off-peak or light traffic hours.

In several PoCs and demos conducted over the last two years involving a variety of packet-processing VNFs, NFV-RI has demonstrated an impressive potential to reduce the total energy consumed on a COTS server running such functions by 15–35% on average (during a 24-hour period), while maintaining the service level objectives (SLOs) and ensuring zero packet drops. These savings are significant, especially since the solution is entirely transparent to the existing network architecture and operation, and can quickly bring operators closer to their sustainability goals.

CONCLUSION

The OpenRAN architecture promises great agility and flexibility, but to get the most out of it CSPs must combine it with AI & ML technologies to guarantee optimized operation of the network and energy efficiency, while meeting the performance demands for their subscribers. Intracom Telecom, leveraging the deep expertise in the underlying technologies of telco networking, Network Function Virtualization, Artificial Intelligence & Machine Learning, is in position to offer such advanced solutions and customize them to its CSP's special needs. ■

DEPLOY ULTRA-BROADBAND LONG RANGE FWA NETWORKS



WiBAS^{G5}
dual-BS



3.2
Gbps
capacity



240
subscribers
density



11
kilometers
coverage



WiBAS^{G5}
smart-BS

Intracom Telecom has developed new techniques to enhance the density of subscribers and the speed of connection. The technological innovations are being introduced on the 28 GHz FDD hub radio WiBAS™ G5 dual-BS and on the 24 / 26 / 27 / 28 GHz TDD hub radio WiBAS™ G5 smart-BS. The subscriber density reaches 240 per hub and the available capacity goes up to 3.2 Gbps using wide channels of 100 MHz and 112 MHz. The signature feature of the WiBAS™ portfolio has always been the extended range, and this is reconfirmed for the new products WiBAS™ G5 dual-BS as well as for the WiBAS™ G5 smart-BS, reaching connections of up to 11 km.



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