

INTERVIEW

INTRACOM TELECOM GROUP NEWSLETTER | ISSUE 31

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INTRACOM
TELECOM



INTERVIEW

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CONNECTING PUERTO RICO SINCE 2017

For a fifth consecutive year one of the largest and most comprehensive wireless broadband service providers in Puerto Rico and the United States Virgin Islands (USVI), continues to select Intracom Telecom's WiBAS™ technology at 28 GHz area-licensed frequency band, efficiently connecting enterprise subscribers in Puerto Rico. The new items, for 600 terminals and relevant hubs will be used to expand coverage to new areas and connect more subscribers to the WISP's network. Operators and WISPs looking for zero-footprint installations at hard-to-reach home and business subscriber locations, as well as service at speeds comparable to those of optical fiber can now benefit from the WiBAS™ PtMP technology that has a lightweight and compact design and can be installed in less than 30 minutes. Moreover, it combines advanced networking and Quality of Service (QoS) features, along with exceptional radio performance.



WIND HELLAS SELECTS INTRACOM TELECOM'S CYBER SECURITY SOLUTIONS AND SERVICES



Intracom Telecom announced the implementation of the new cyber security project for WIND Hellas, one of the largest mobile operators in Greece, in order to strengthen the provider's overall security footprint. Following an open tender conducted by WIND Hellas, Intracom Telecom's proposed solution was chosen as the best one that includes various features enabled for perimeter security and more. The aim of this project is to efficiently handle, with increased security levels, the ever-increasing LTE mobile traffic, support the transition to VoLTE and 5G technology, and cover the need for increased security in the perimeter and the Data Center NFV infrastructure. Moreover, within the framework of the project, perimeter security products will be installed and configured in WIND's Data Centers in Athens and Thessaloniki, while a central management and control platform will also be implemented

for all systems. The solution will be based on Fortinet's product portfolio that protects network, users, and data from continually evolving threats. The completion of the project is expected within a year. Pantazis Houlis, Marketing Director of the Services Business Division, commented: *"We are pleased that WIND Hellas has once again trusted Intracom Telecom to deliver high-performance security solutions and cybersecurity expertise, in order to achieve end-to-end network protection, and enable them to continue providing their business services securely."* While, Giannis Gavalas, Supply Chain Director of WIND Hellas, said *"Our main concern is to form solid partnerships with the market's leading companies, so as to be able offer, in return, the best telecommunication services to our subscribers. Cybersecurity is one of our core priorities and with Intracom Telecom's solutions we ensure the best protection for our infrastructure"*.

THE “OUTSTANDING CONTRIBUTION TO TM FORUM ASSETS” AWARD

Intracom Telecom announced its distinction through TM Forum's Catalyst project "AIOps Autonomous Service Assurance", where the company actively participates. The "Outstanding Contribution to TM Forum Assets" award acknowledges best practices on how to deploy and operate AI at scale, contributing back to TM Forum's AIOps Collaboration program. The company focused on optimizing the energy footprint of the Virtualized Network Functions (VNFs) in Network Functions Virtualization (NFV) data centers, while maintaining Service-Level Objectives (SLOs), leveraging its NFV Resource Intelligence (NFV-RI™) platform. Sotiris Bithas, Telco Software Marketing Director of Intracom Telecom, commented: *“Participating in the AIOps Autonomous Service Assurance Catalyst project and working alongside an important team of major international Service Providers & Vendors, apart from being a great experience, inspires us to further keep investing in this new AI area so as to better support CSPs' operations through our innovative solutions, such as the recently launched NFV Resource Intelligence platform.”*



IMPROVING NETWORK PERFORMANCE IN URUGUAY



Intracom Telecom concluded successfully the field tests of its WiBAS™ 26 GHz platform, as part of the process for vendor registration for said technology. The 26 GHz is already in use by a leading telecom operator in Uruguay and during the two months of the tests the operator had the opportunity to test and measure the performance of Intracom Telecom's Point to Multi-Point (PtMP) platform. This network is used for serving high-capacity business subscribers. This project acts as a reference for the leading telecom operator and thus is of high strategic value as it enhances Intracom Telecom's brand name and presence with such an important customer.

OPTIMUM BROADBAND CONNECTIVITY AT AN INNOVATIVE AND NATURAL CIRCUIT IN BARCELONA

One of the main infrastructure operators for wireless telecommunication in Europe, awarded Intracom Telecom the supply of its Point-to-Point (PtP) / Point to Multi-Point (PtMP) technology so as a renowned complex of innovative & natural circuits in Spain and Europe, will achieve efficient connectivity. The operator, which provides services in 10 European countries, was aiming to install a 5G network to accommodate automated vehicles, and to increase the network capacity at the premises of the race track. That way the vehicles will be able to interconnect, and transmit high-definition images of the track to the control center (i.e. from inside the car). Through the improved network the European operator will be able to do real-time monitoring on the status of the track, environmental parameters, a variety of sensors that affect the driving, and install infrastructure that sends all the telemetry for analysis, improving vehicle performance and driver safety. Intracom Telecom taking into account all the aforementioned challenges provided its unique "all-in-one" solution StreetNode™ operating in the 60 GHz frequency, ideally fulfilling the operator's need of a 5G backhauling technology that would provide extensive coverage and minimum power consumption ("zero emissions").



KEEP IMPROVING WARSAW METROPOLITAN POLICE'S CONNECTIVITY

Intracom Telecom is further strengthening Warsaw Metropolitan Police (KSP Warsaw) connectivity, in partnership with Xentia, a Polish wholesale distributor of voice, data and broadband wireless solutions for surveillance systems, by expanding KSP Warsaw existing CCTV backhauling network with the use of the WiBAS™ OSDR PtMP wireless solution at 28 GHz. The network will be used also for Police Stations

backhauling within the city, connecting all district Police headquarters in Warsaw. Through the company's wireless solution KSP Warsaw, will enhance its CCTV surveillance with HD Cameras throughout the city providing accurate information on crimes, offenses and other events occurring in areas covered by the surveillance system.



UNI|MS™ R9 UNFOLDS THE NETWORK LIFECYCLE MANAGEMENT CONCEPT

The company introduced its new uni|MS™ R9 that redefines the management activities throughout planning, rollout, optimization and maintenance phases of the radio transmission and access networks. The General Availability of R9 includes an exciting collection of offerings in the form of network lifecycle automation applications (NLA Apps), leveraging RF planning, network management and SDN control capabilities, introducing operational agility and generating added value from both network and human resources.



INTRACOM TELECOM'S DONATION COMES INTO OPERATION

The five (5) advanced portable telemedicine kits that were donated to the Health Region of Piraeus & the Aegean (2nd Health Region) by Intracom Telecom were put into operation. The equipment will contribute to the effective monitoring and management of health issues, especially in remote and isolated Aegean islands. These mobile kits will offer similar services that are provided by the Telemedicine stations of EDIT (ΕΔΙΤ), to meet the needs of the healthcare personnel in smaller islands of the Aegean, both during the summer period when due to tourism the incidents that have to be managed by the regional clinics of the 2nd Health Region are multiplied, and during the winter period when the few permanent residents are often excluded and the only way to access healthcare services is air medevac. The healthcare personnel on site (which will not necessarily be doctors since the equipment and telemedicine application are easily operated by nurses or emergency services personnel) will connect to the EDIT network and remotely communicate with medical consultants (using teleconference, chat, mail), will be able to send patient health indicators (temperature, oxygen, pressure, etc.) in real time and receive instructions from the specialist based on actual patient medical data. Such donations, significantly contribute and prove that the Public and Private Sector can coexist harmoniously in times of crisis, such as the current situation we are experiencing with the COVID-19 pandemic.



TIER-1 TELECOM OPERATOR CHOOSES INTRACOM TELECOM FOR ITS VOICE PREPAID CHARGING SYSTEM

Intracom Telecom is partnering with a major Greek telecom operator, for the replacement of its Voice Prepaid Charging system along with 5 years of support. The winning solution is based on the company's NGINius-Charging™ platform, a converged real-time charging engine for Digital Service Providers, which has been widely deployed to a number of operators in South-Eastern Europe, serving end-users on fixed & mobile telecom networks. Upon completion, the Tier-1 operator will be in position to monetize all the services their prepaid mobile end-users receive (voice, SMS, data) and easily introduce new blended commercial packages, since the new solution will be seamlessly integrated with the Data Prepaid Charging system which is already running in the operator's network and is powered by the NGINius™ platform. The company won this deal competing against major international vendors, proving the technical strengths of the NGINius-Charging™ platform, as well as Intracom Telecom's complex project delivery efficiency.

ETSI NFV & MEC REMOTE API PLUGTESTS 2021

During February 2021, Intracom Telecom participated in the ETSI NFV&MEC Remote API Plugtests 2021 event, which was held online and attracted more than 30 NFV and MEC solution providers (including Cisco, Telefonica, NEC, Orange), in order to test the API conformance of their implementation of NFV and MEC specifications. In the context of the event, Intracom Telecom provided as Function Under Test (FUT) the 5G-ready Network Function Virtualization (NFV) deployment artifacts of the fs|cdn™ Anywhere solution, as part of the company's innovation activities within the H2020 5GZORRO project, supporting pervasive vCDN Media use case scenarios. In addition, the company tested the cloud-native principles of IoT/Edge Computing research prototype solution developed in H2020 5G-VINNI project and deployed as Cloud-native Network Functions over Kubernetes, with support from the Cloud Native Computing Foundation (CNCF) community.



➤ <https://bit.ly/3uVTsB>

THE PAPAGOS-CHOLARGOS MUNICIPALITY SMART CITY PROJECT

Intracom Telecom proudly completed the installation and commissioning of a major Smart City project in Papagos-Cholargos Municipality, in Athens, Greece. The project was a result of an excellent cooperation and coordination of efforts with the company's partners Globiled Ltd and Globitel S.A., and it consisted of three

smart city applications, the IoT platform and the maintenance software. Watch the related video and listen to the Mayor of the Papagos-Cholargos, Mr. Ilias Apostolopoulos, talking about the implementation of the project and the benefits it brings to the municipality.



▶ <https://bit.ly/353o5ha>

MAKING OUR CITIES GREENER AND MORE SUSTAINABLE



The Municipality of Tirana has initiated the earth works for the creation of the Hellenic Park of Farka Lake, rehabilitating the area and enhancing the city's sustainability. Intracom Telecom is supporting this amazing initiative and participates as one of the donors that is financing this green project. In fact, a few days ago the Embassy of Greece in Tirana proceeded with the plantation of 90 olive trees.

"PERMANENT" RESEARCH PROGRAM

Intracom Telecom announced its participation in the PerManeNt research program that focuses on the development of an integrated platform for operational monitoring, smart control, and sustainable energy management of water supply networks. The integrated platform will be applied to the external aqueduct system of the city of Patras, Greece. In the framework of the project, a high tech control system – an executive operational platform will be developed for the:

- » Real-time data collection and processing from multiple systems/sources, for the visualization, business monitoring, energy management and operational control of water supply networks.
- » Near real-time detection of network malfunctions, failures and bursts, with the option for automatic alarms, system generated alerts and messages.
- » Generation of short and longer-term forecasts for the water demand and the corresponding energy consumption rates, based on hydrometeorological data and environmental indices.



The platform, which is under-development and has the capacity to expand, acts as an "umbrella" to the existing infrastructure, providing tools that facilitate the monitoring of energy consumption, the operation of individual system components, and the assessment of the corresponding environmental footprint. This research project is co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH– CREATE – INNOVATE (project code: T2EDK-04177). The project was launched in July 2020 and it is coordinated by the Centre of Renewable Energy Sources (CRES), while the Municipal Enterprise of Water Supply and Sewerage of the City of Patras and University of Patras are also participating. The duration of the project is 30 months.

"REGENCY" PROJECT

The company participates as the project coordinator in the "REGENCY" (Re-inventing energy efficiency for businesses) research program that started in October of 2020. It is co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH– CREATE – INNOVATE (project code: T2EΔK-04565). The project aims at upgrading the services provided to business consumers, targeting to offer insightful information on their energy profile and consumption behavior, so as to achieve more efficient energy management. The project will develop appropriate models for analyzing large volumes of real-time data, as well as historical energy consumption data, using Machine Learning algorithms. The collection and analysis of this data, which will be generated by smart electricity meters, will be carried out by an integrated energy management platform. This will facilitate the provision of value-added energy services and energy saving programs, tailored to the specific needs of the different types of corporate consumers that will be selected in the initial phase of the project. In this project the Public Power Corporation (PPC) and the companies VIS and DRAXIS are also participating.

➤ <http://www.intracom-telecom.com/regency>

INNOVATIVE TECHNOLOGIES FOR 5G AND BEYOND

On April 20, Intracom Telecom, along with the student branches IEEE NTUA, IEEE AUTH and IEEE University of Patras, organized a webinar entitled "Innovative Technologies for 5G and Beyond". Intracom Telecom's experienced team from the company's R&D department, discussed thoroughly about the latest trends, technologies and concepts in the aforementioned area.

GAINING 4 REPUTABLE STANDARD CERTIFICATIONS

Since the beginning of 2021, Intracom Telecom has obtained four standard certifications:

- » ISO/IEC 17025:2017
- » ISO 45001:2018
- » ISO 27001:2013
- » ISO 22301:2019

More specifically, the company's EMC & Safety Laboratory, located at the company's headquarters in Greece, has been granted ISO/IEC 17025:2017 accreditation, the most reputable quality standard for testing and calibration laboratories, by ESYD (Hellenic Accreditation System), a non-profit legal entity of private law with the purpose of the implementation and management of the National Accreditation System supporting clients worldwide.

Moving on, the company has been certified to ISO 45001:2018, the Occupational Health and Safety management system standard, having successfully transitioned from OHSAS 18001:2007 standard. The company's Health and Safety management system encompasses all company activities as stated in the scope of the certificate i.e. "Design, Development, Manufacturing, Supply, Installation, Set into Operation and Technical Support of Products and Integrated Solutions, as well as provision of Professional Services, in the fields of Electronics, Telecommunications, Information Technologies and Energy". The certificate was issued by Bureau Veritas Certification Holding SAS – UK Branch, one of the world's leading certification bodies.

Finally, Intracom Telecom has successfully completed the re-certification audit for ISO 27001:2013 (Information Security Management System (ISMS)) and ISO 22301:2019 (Business Continuity Management Systems (BCMS)). After the conduction of the relevant audits by experienced auditors the certificate was issued by TÜV AUSTRIA Hellas, Greece's leading Inspection and Certification Organization. Intracom Telecom continues to be properly organized and prepared in order to cope with adverse events and events that endanger its operational continuity (ISO 22301:2019) and to manage overall and effective information security (ISO 27001:2013), in all its three location in Greece (Athens, Patra, Thessaloniki).

GETTING MORE AND MORE INVOLVED IN THE HEALTH SECTOR

Intracom Telecom sponsored a remarkable research program involving the Multiple Sclerosis (MS) Disease treatment. Monitored by Leontios Hadjileontiadis, Senior Professor of AUTH, and with the participation of IEEE students, this project aims at creating a high precision in-ear sensor that will continuously capture



relevant vital signs in everyday life and provide useful data for the treatment. Through this project health professionals will have access to a toolbox capable to quantify a wide range of important disease manifestation & progression parameters, and will have the ability to discover disease-related pathways by creating a new framework for extracting morphological features. The device will be connected through IoT with a mobile phone.

FULL-STACK CONTAINERIZED SW DEVELOPMENT, CLOUD NATIVE APPLICATIONS FOR TELECOMS

On May 25 & 26 Intracom Telecom, along with POS4Work, organized a two-day online workshop, entitled "Full-Stack Containerized SW Development, Cloud Native Applications for Telecoms". The company's experienced team of engineers, comprising of Dimitris Tzoumakas, Christos Katsenos, Panagiotis Dimopoulos, and Dimitris Georgiou, together with Savvas Konstantinidis from the HR department, analyzed all the essentials of cloud-native applications, that are considered a "must-do" for telcos.

AI-POWERED OPINION MINING

HOW SENTIMENT ANALYSIS REVOLUTIONIZES CUSTOMER EXPERIENCE MANAGEMENT

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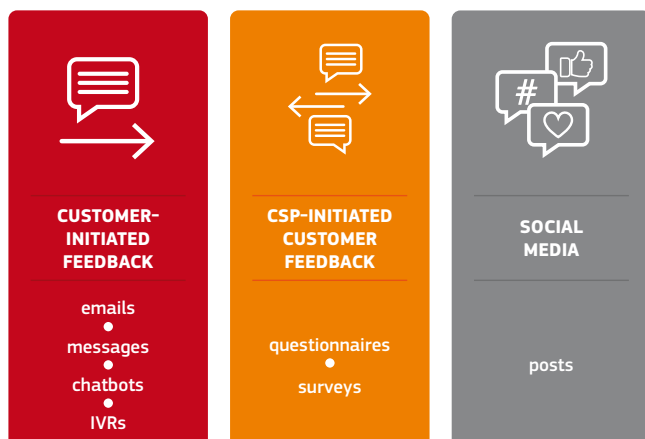
IOANNA SANIDA
Senior Data Scientist, Intracom Telecom

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Senior Product Manager & Solutions Architect, Intracom Telecom

INTRODUCTION

As CSPs constantly strive to stay ahead of the competition, they draw upon their customers' perception – positive or negative – for their products which, perhaps, is the ultimate satisfaction indicator. Customers, in turn, often do realize the power that their feedback has and opt to express their feelings in writing, either to draw the operator's attention on their opinion or even to have their acquaintances involved.

In some occasions, customer care online forms, emails, chatbots or IVR are the digital touchpoints that convey textual feedback spontaneously offered by clients, directly to the CSP. In other instances, it is the CSP that encourages customers to provide feedback via questionnaires or surveys. There is, also, a third option, where a happy or dissatisfied customer may resort to uploading posts on all types of social media, acting like a social influencer.



Evidently, if an operator was able to sift through the abundance of internal and external customer-produced texts referring to its products, then immense business value would come out of it!

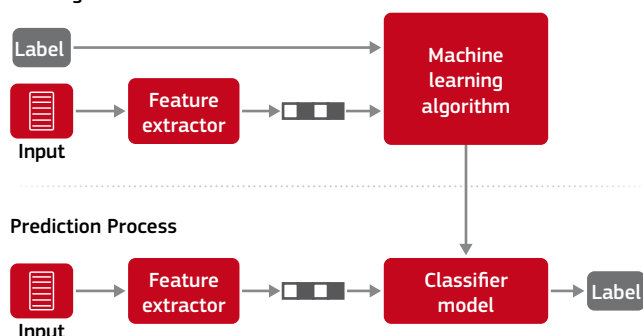
SENTIMENT ANALYSIS: VALUE AND LIMITATIONS

Making sense of textual customer feedback has been a long-standing pursuit for CSPs, usually addressing it on a best effort basis and through manual labor. Not long ago, however, the advances in both Natural Language Processing (NLP) and Machine Learning (ML) have boosted **Sentiment Analysis**: the automatic process that helps identify the topics for which opinions are expressed in texts, and classify them into the proper sentiment tag (positive, neutral or negative).

In simple terms, Sentiment Analysis follows two processes:

- » In the **Training Process**, the NLP model learns to associate each textual input to the corresponding sentiment tag based on already characterized samples. The feature extractor module transforms input into an intermediate representation, a feature vector. Each feature vector, along with its associated annotation, is then fed into the ML algorithm to generate a classifier model.
- » In the **Prediction Process**, feature vectors of unseen text are fed into the model to infer their sentiment tag score.

Training Process



Once properly deployed, a Sentiment Analysis solution can automatically process large quantities of text in near real-time, unearthing otherwise hidden, hard to detect insights. Having said that, two key challenges cannot stay unnoticed:

1. **Lack of native language corpus.** A prerequisite for achieving highly accurate Sentiment Analysis results in a given language is the availability of the respective corpus: a large collection of natural language text organized into datasets that is used by the NLP system to find out how human language is represented. Corpus enables words with similar meaning to have a similar representation by the creation of 'word embeddings'. Due to the very limited research on the Greek language, and some other least-spoken, non-English languages, there is lack of respective corpora.
2. **Insufficient annotated data.** For the Sentiment Analysis system to correctly classify sentiment and learn the textual differences between sentences in various categories, the use of supervised ML is typically required. Creating structured training data that enables machines to understand human speech is heavily dependent on natural language annotation. Through this process, the model is trained with data already annotated in terms of both the product that they refer to and the sentiment tag. It is implied that Sentiment Analysis can only function properly when the available dataset is both large and annotated with respect to its sentiment tag score.

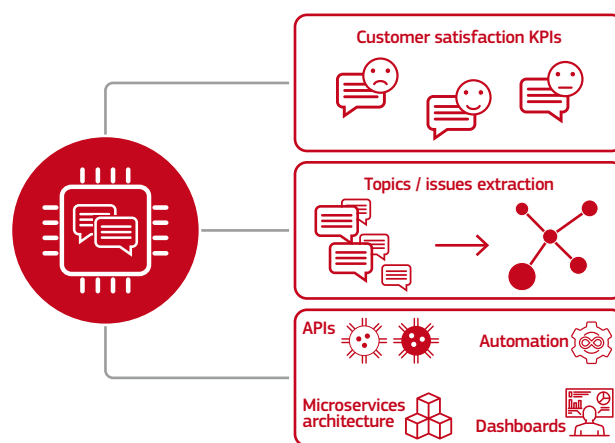
COGNITIVA™ SENTIMENT ANALYSIS FOR TELCOS

Intracom Telecom's Cognitiva™ Sentiment Analysis is an NLP-based solution that analyzes textual information in Greek and extracts meaningful information regarding customer feedback. It empowers CSPs to deep dive into customer-generated textual feedback, 'listen' to their conversations and take into account their messages.

Cognitiva™ Sentiment Analysis addresses the aforementioned key challenges, by making use of a native language corpus into the training process, either annotated with accuracy using highly automated tools or re-using the already annotated textual CSP data verified by experts. This process can be applied not only to Greek language, but to other non-English ones, such as Bulgarian and Serbian.

Cognitiva™ Sentiment Analysis is an approach that can be applied on a wide product range of vertical industries, such as **Telecommunications, Banking and Retail**. In abstract terms, the solution is structured along three pillars:

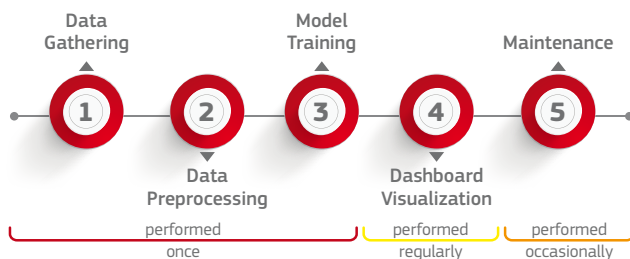
- » Enumeration of **Customer Satisfaction KPIs** by quantifying them in terms of polarity (positive/negative) and prediction confidence.
- » **Extraction of topics/issues** mentioned in the respective texts, helping thus narrow down the subject to which a conversation refers to (such as specific products or services).
- » Flexible **integration and visualization** through powerful features such as well-defined APIs, automation capabilities, modular micro services architecture and customizable dashboards.



The deployment of Cognitiva™ Sentiment Analysis is based on five conceptual steps, each executed in different frequency.

1. **Raw Data Gathering.** Collect a reasonable amount of CSP textual data containing customer feedback, taken from both internal (customer care chat interactions, speech-to-text transcripts of voice conversations) and external (social media posts) sources.
2. **Data Preprocessing.** Clean and label a sample dataset of this input where each sentence belongs to a different class (1 for positive, 0 for neutral, -1 for negative) for training purposes.

3. **Model Training.** Create a classification algorithm that, once trained, classifies correctly the sentiment of each sentence. Evaluate the results and repeat if needed.
4. **Dashboard Visualization.** Evaluate the quantified outcome of the sensitivity analysis process via statistical analytics and information-rich dashboards full of easy to grasp, color-coded information.
5. **Maintenance.** Retrain the model and revisit key system parameters, typically on a monthly basis.



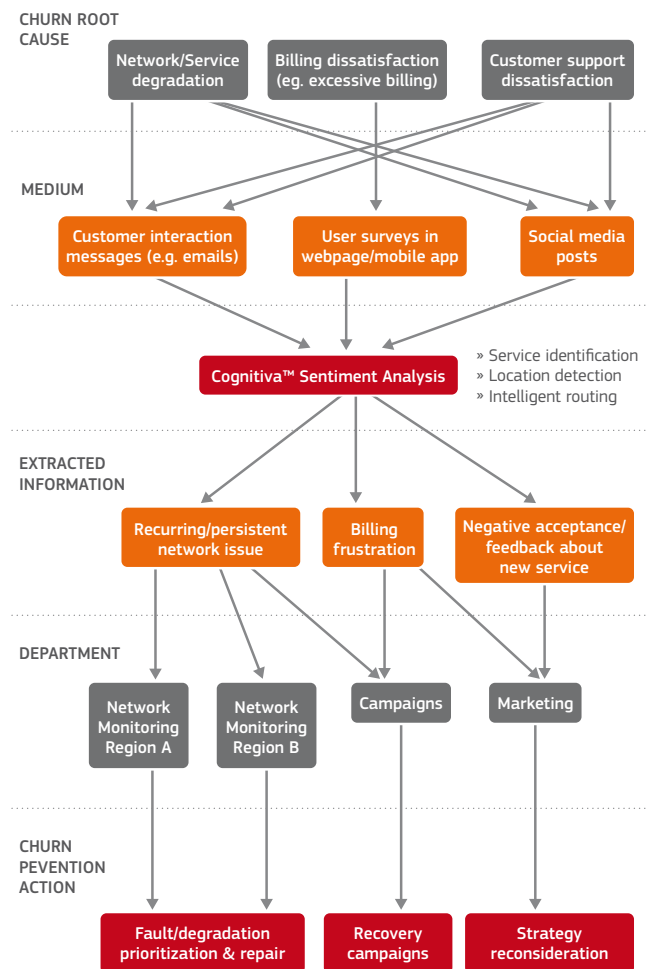
USE CASE: SENTIMENT ANALYSIS FOR CHURN PREVENTION

Network degradations, billing dissatisfactions or bad customer support experiences are often among the top reasons for churn. In those cases customers may choose one of the following means to interact with the CSP in free-text form: send a message directly to the CSP describing their dissatisfaction, respond to a CSP-initiated survey providing their feedback, or even post their experience in public through social media.

Cognitiva™ Sentiment Analysis receives customer input, regardless of its origin, and performs the following tasks:

- » Derives the sentiment tag score of the message
- » Detects the primary reason of dissatisfaction
- » Identifies the service or product the message is referring to
- » Identifies the geographic location the message is possibly referring to
- » Routes the message to the most appropriate function(s) within the organization.

Cognitiva™ Sentiment Analysis reinforces a CSP's churn prevention procedures



For example, Cognitiva™ Sentiment Analysis will automatically identify frustration in a user message and detect that the reason is a network issue affecting IPTV. Based on the user's location, Cognitiva™ Sentiment Analysis will initiate a trouble ticket and route it to the corresponding network Operations/Monitoring Department for immediate corrective actions. At the same time, the ticket will also be routed to the Campaigns Department to propose a recovery offer to the customer. ■

To find out more on the Cognitiva™ artificial intelligence application suite, you may either scan the QR code below or visit <http://www.intracom-telecom.com/cognitiva>.



MMWAVE RADIOS' VITAL ROLE IN LARGE SCALE 5G DEPLOYMENT

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5G RAN ARCHITECTURES

5G standardization process by the 3GPP follows the vision set out by ITU's IMT-2020 requirements. 5G is designed to support enhanced mobile broadband (eMBB) services delivered at orders of magnitude higher capacity/subscriber density and at significantly lower latency than possible by previous generations. More importantly, 5G is specified to optimally support emerging use cases, such as massive machine-type communications (mMTC)/Industrial Internet of Things (IIoT) and ultra-reliable and low latency communications (URLLC). These new use cases are expected to transform many existing social and economic processes and enable the development of novel products and services.

To support enhanced performance, enable new types of services over the mobile network and better exploit new technologies, such as resource virtualization and cloudification, 5G network architecture has been specified in a more modular schema than the previous generation mobile systems. The RAN functions have been decomposed in a way that they can be performed in one or different locations. The 5G Mobile Base station, the gNodeB, is decomposed into three main functional entities Radio Unit (RU), Distributed Unit (DU) and Centralized Unit (CU), which can all be physically co-located in the cell/antenna site (Figure 1) or be flexibly co-located in pairs (Figures 2,3) or located separately in different sites (Figure 4) closer to, or at the network edge. Further decomposition of the control (CU-CP) and user plane (CU-UP) functionality of the CU have been specified, while user applications can be deployed at the CU-UP location. These options allow the functionality of multiple DUs and/or CUs to be pooled in a single location to optimize the use of computational resources and cell co-ordination, but also allow applications involving data storage, processing and feedback to be moved closer to the cell site, or even at the cell site itself, to minimize service latency.

Therefore the 5G RAN can have a flexible distributed, centralized or a hybrid architecture depending on the characteristics of the services to be delivered. Each option has its advantages, disadvantages and implementation cost, and its adoption depends on the market and infrastructure circumstances of a particular Mobile Network Operator (MNO).

The RAN still represents the largest part of the mobile network cost and the cost of adoption of the various RAN architectural approaches depends heavily on the availability/cost of the transport infrastructure, which interconnects the various parts of the RAN and the Mobile Network Core.

RAN TRANSPORT FOR THE 5G ERA

The transport segments between the 5G network entities have been named as fronthaul, midhaul and backhaul, collectively referred to as X-Haul (Figures 1-4). Fronthaul and backhaul concepts are well known from previous generation systems, while the midhaul notion as introduced by 5G has similar transport characteristics to backhaul.

Figure 1: Distributed RAN



Figure 2: Centralized RAN (Low Level Split)

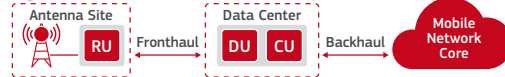


Figure 3: Split RAN (High Level Split)

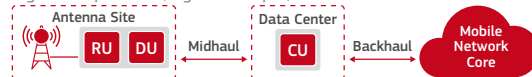


Figure 4: Dual Split RAN



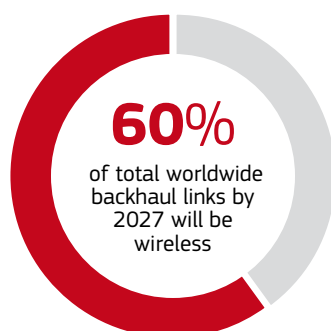
Capacity, latency, synchronization, networking protocols are the main defining features of X-Haul. The features of 5G performance that need to be supported by the transport/X-Haul technology are: peak user capacity of 1-20 Gbps or more depending on cell-site size and end-to-end service round trip latency 1-10ms depending on the application. The dominant networking technology is Ethernet/IP/MPLS and standard packet-based synchronization methods, such as Synchronous Ethernet (SyncE) and IEEE1588-2008 Precision Time Protocol, are required as primary synchronization or as backup to the GNSS-based synchronization on the cell site. Note that transport connections may need to support the capacity of multiple interconnected cell sites, while the overall latency introduced by the transport equipment

needs to be a fraction of that required for the 5G service. Furthermore, fronthaul requirements can be disproportionately taxing in terms of capacity and latency compared to the actual service characteristics.

Many MNOs around the world have already embarked on a 5G technology deployment program mostly covering urban areas. Nevertheless, previous generation technologies are still prevalent in the networks of most established MNOs and are expected to continue to be at least in the medium term. Pre-5G operators that introduce 5G technology to their networks need to ensure that their transport equipment supports the increased capacities and the protocols relevant to 5G, as well as those of the pre-5G technologies. Therefore, a wide range of capacity and latency features, as well as, transport protocols can be required to be supported by the transport systems depending on the type of X-Haul, the requirements of services delivered, the size of the cell sites and their relative positioning in the chain of links between the access side and the aggregation side of the network.

Wireless transport technology is a reliable alternative to optical fiber enabling the widespread deployment of mobile networks of the 5G era and beyond

While optical fiber transport is considered the most desirable choice for X-Haul due to its “limitless” capacity and predictable performance, it is clear that the availability of a fiber interconnection is not expedient or economically favorable in many cases, especially in the numerous final leg(s) towards the cell-sites. Wireless transport technology is a reliable alternative to optical fiber,



which has been playing a major role in Mobile RAN transport for decades and is still considered of vital importance in enabling the widespread deployment of mobile networks of the 5G era and beyond. According to a report authored by ABI Research and published by GSMA in February 2021, wireless is expected to be the dominant backhaul technology until at least 2027 making up around 60% of the total worldwide backhaul links at that time. In the last decade E-Band radio technology has become a wireless technology of choice that MNOs use to support their short and medium range multi-gigabit transport requirements, especially in urban areas. It is now globally recognized, as confirmed by the ITU-R WRC-19 outcomes, as a critical X-Haul transport technology required for the large scale deployment of 5G networks.

E-BAND RADIOS FULLY SUPPORT 5G-ERA X-HAUL NEEDS

Intracom Telecom's UltraLink™ radios, already widely deployed in MNO and WISP networks, are ideal for X-Haul applications as they are at the forefront of performance in terms of link range, spectral efficiency and operational flexibility.

The high end radios of the UltraLink™ E-Band product line, meaning the UltraLink™-GX80, a 10 Gbit/s radio capable of 20 Gbit/s in XPIC configuration, and the new UltraLink™-XR80, a record

breaking 30 Gbit/s radio, have been designed to fully satisfy the X-Haul requirements of 5G, as well as those of previous generation systems. Link transport latency is a few tens of microseconds, a fraction of the desired 5G service latencies, thus allowing the majority of the service latency budget to be allocated to the mobile network equipment itself.

UltraLink™ radios operate in Ethernet transport mode but can also support native CPRI transport via a simple configuration change. They offer a range of GbE interfaces in the 1/10 25 GbE range, as well as, CPRI v7.0 fronthaul interfaces up to Option 7. Therefore, they offer versatility in supporting the transport various traffic types, such as Ethernet/IP/MPLS, CPRI, eCPRI for X-Haul of Any-G systems, and give operators the option to quickly and cost-effectively deploy any RAN architecture according to their needs.

The UltraLink™ platform supports advanced L2 and L3 networking capabilities, as well as SDN-based management principles to allow network and service configuration programmability and automation. Finally, featuring a complete set of packet synchronization options, UltraLink™ radios enable the accurate delivery of frequency and phase synchronization over the transport network.

Intracom Telecom is committed to stay at the forefront of radio transport as the technology in mmWave bands (E, W, D and beyond) progresses towards 100 Gbit/s. ■

For more information, contact us at ultralink@intracom-telecom.com.

5G CHARGING AT THE HEART OF 5G MONETIZATION

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THE TELECOM INDUSTRY TODAY

The landscape of the Telecom industry is changing faster than ever before. Not only because the way that we communicate constantly evolves, requiring more agility, more flexibility and innovative services, but also due to the depletion of the legacy revenue streams that is currently driven by over-the-top (OTT) competitors.

Customer experience continues to be a very important differentiating factor and organizations can place themselves in a better position with modern AI technology. However, the telco market itself perceives 5G as the technology that has the potential to really change the role of telco companies in the emerging global economy.

THE DAWN OF 5G

5G is to succeed the 4G standard with speeds up to 100 times faster and capacity 1,000 times wider. Qualities as such enable mobile networks with far higher reliability and cost effectiveness,

as well as reduced energy usage. 5G networks will eventually not only enable a significant increase in connected devices, but they will also offer highly improved data rates, ultra-low latency and network slicing capabilities. The latter is a technological improvement of great importance in terms of generating direct and indirect revenue for CSPs.

In general, 5G is capable of creating a path with ample opportunities for new services and revenue streams, more effective network operation and new customer experiences. In EU, the plan is to have uninterrupted coverage for urban areas, by 2025.

NEW REVENUE OPPORTUNITIES

Mobile operators may capitalize on 5G disruption and realize new revenue opportunities with the development of numerous applications, based on the new enabled communication services. Apart from the capability of Network Slicing for greater efficiency and cost optimization to users, 5G also provides enriched

and innovative services through technological capabilities that enable the following categories of use cases:

Enhanced Mobile Broadband (eMBB)

eMBB promises fast, high-bandwidth connectivity, paving the way for an incredible consumer experience and providing the first marketable 5G application, offering great improvement over 4G LTE. It will aid the development of today's mobile broadband services, such as emerging AR/VR media and applications like augmented learning, and entertainment including 360-degree streaming or 3D virtual meetings with real-time translation in several languages. However, eMBB is not just content for entertainment purposes and for consumers. It will in fact evolve to augment the capability of all connected devices including IoT.

Ultra-Reliable Low Latency Communication (uRLLC)

uRLLC has been introduced by 3GPP for 5G, with a specified target latency of < 1 millisecond and reliability at 99.9999%. In other words, uRLLC comprises a set of features that provide low





latency and ultra-high reliability. Such qualities will eventually enable consistent responses in real time to allow implementation of high-precision production lines, automated mining and mission-critical /time-sensitive applications, like remote surgery or autonomous cars. Development of this type of services is already underway, for example T-Mobile US is leading the industry with more than 100 points of presence for networking on autonomous driving.

Massive Machine-Type Communication (mMTC)

Considering the proliferation of the Internet and the capabilities of the 5G eMBB, transmitting IoT data will require wireless capacity orders of magnitude greater than the existing one in order to avoid overloading the network. 5G mMTC is to leverage 5G high scalability, cost efficiency, increased availability and low power consumption qualities to interconnect machines through the IoT. mMTC use cases include Industry 4.0 applications such as predictive remote maintenance, management of smart grids, traffic management and connected homes.

Fixed Wireless Access (FWA)

Along with providing highly enhanced mobile broadband and massive low-latency, the 5G infrastructure can provide the perfect platform for delivering FWA coverage. FWA paves the way for mobile operators, to provide fast broadband services comparable to many current wired broadband offerings and enables delivery of ultra-high-speed broadband to suburban and rural areas, mainly supporting households and businesses where fiber is not possible or

too costly. FWA also guarantees indirect revenue to mobile operators through costs cutting by enabling them to deploy the 5G FWA instead of the more expensive FTTP and FTTH.

EVOLUTION OF MONETIZATION AND CHARGING

Emerging Business Models

In the very first phase of 5G, the monetization/charging challenges may look similar to that of 4G. However, as advanced capabilities flow in, business cases will become more complicated and challenging.

Emerging business models, although they cannot be accurately predicted today, will lay the first stone for new synergies and cross-product offerings bringing enhanced commercial transactions. 5G will eventually enable numerous direct or indirect business relationships (e.g. B2B2X) among CSPs, 3rd parties and the end customers. The most common of such models, also applicable today, refers to 3rd party digital content offered to consumers by the CSPs.

Similarly, different verticals may set up and utilize Private Wireless Networks (PWN) optimized for the specific needs of their domain. A PWN provides connectivity similar to a public wireless network, but it is owned and managed by the organization that has built/acquired it.

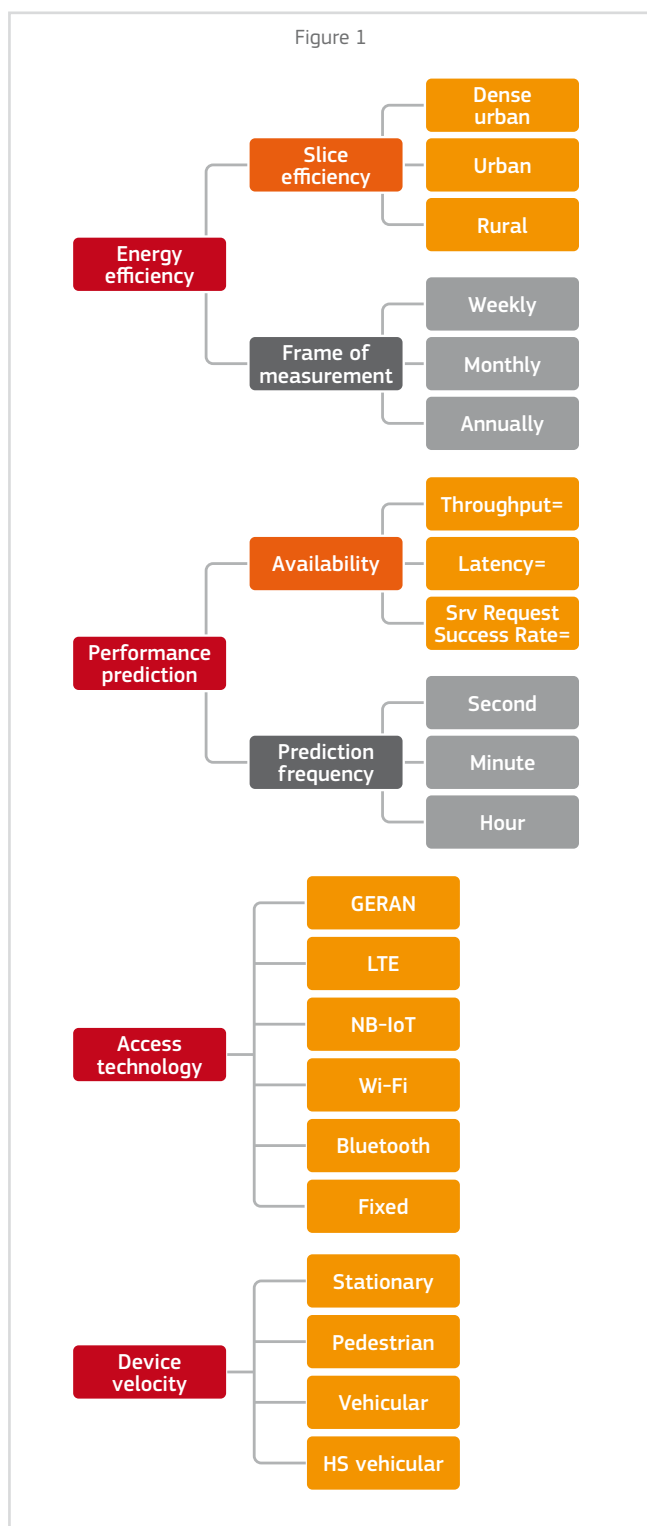
Large enterprises are increasingly turning to PWN for its advantages over cable or Wi-Fi; advantages that are now further strengthened by 5G. For example, Utilities can enjoy the benefits of an mMTC slice, with SLA-dedicated care and Network Management API for Smart Energy, while an Automaker can take advantage of a URLLC slice for Smart Manufacturing.

In other words, the opportunity for CSPs to deliver and monetize significantly enhanced digital services through new B2B partnerships is already multiplied.

The evolution of business and charging models aims at generating more revenue from 5G

Network Slicing Monetization

GSM Association has published the Generic Network Slice Template (Version 4.023, November 2020) to standardize a list of attributes and attribute groups that can characterize a type of network slice. Those attributes will be the main source from the pool of parameters required for a 5G pricing and charging system. Figure 1 below is to depict a structured extract of that pool:



Towards a Convergent Charging System (CCS)

The concept of converged charging is not new. It has in fact been the target architecture of many operators for several years. However, the model of a single engine for both online and offline charging has been proved much slower than the industry expected.

5G technology is here to support dynamic and highly configurable network services that expedite innovative business models and enable new services and enhanced experiences across industries. However, the effective monetization of 5G services and capabilities can be challenging and costly without the right tools and processes, which may be the case if, for example, it is based on a legacy charging system. Charging is critical to any monetization system. So, in order to leverage the features of 5G towards generating more revenues, charging must change; and it appears to be changing as 5G networks roll out and related standards emerge.

The charging system, its function and architecture, has been redefined for 5G. According to the ETSI/3GPP standards, the 5G Charging System must be convergent with no separation between online and offline rating and charging. 5G CCS is based on a services-based architecture (SBA) integrating with the network in new and diverse ways to capacitate novel monetization dimensions, while it relies on cloud technology to deliver agility, automation, flexibility and innovation. Together these capabilities enable a fast reaction to the many conditions of an ever shifting market with minimal effort, providing at the same time those rating and charging capabilities to efficiently monetize 5G services.

Monetization/Charging Example: Private Wireless Network

Figure 2 on next page depicts a set of possible flows for monetizing/charging a PWN in the context of 5G. This example, although concise, is sufficient to show most of the qualities required from a 5G-oriented charging solution. Apart from its competence to support the 5G capabilities as they roll out, such a system must be able to support complex B2B2X relationships and be open to cooperate with legacy and emerging/innovative 3rd party BSS.

NGINus-Charging™ for 5G supports all types of Service Providers and helps them increase their responsiveness, adaptability and performance in the 5G and IoT era

Policy control. Open API

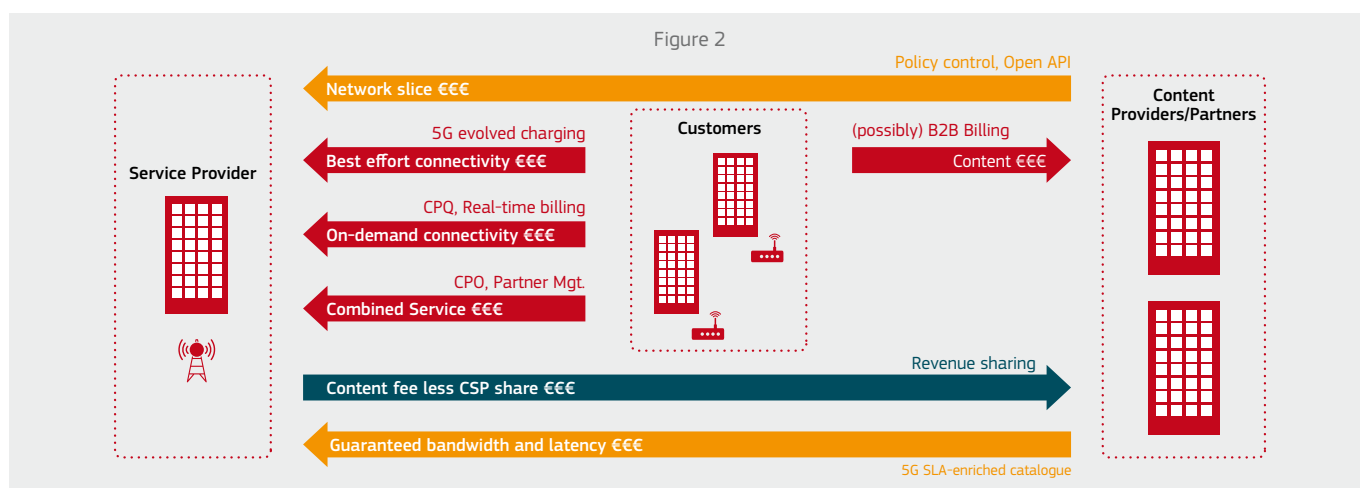
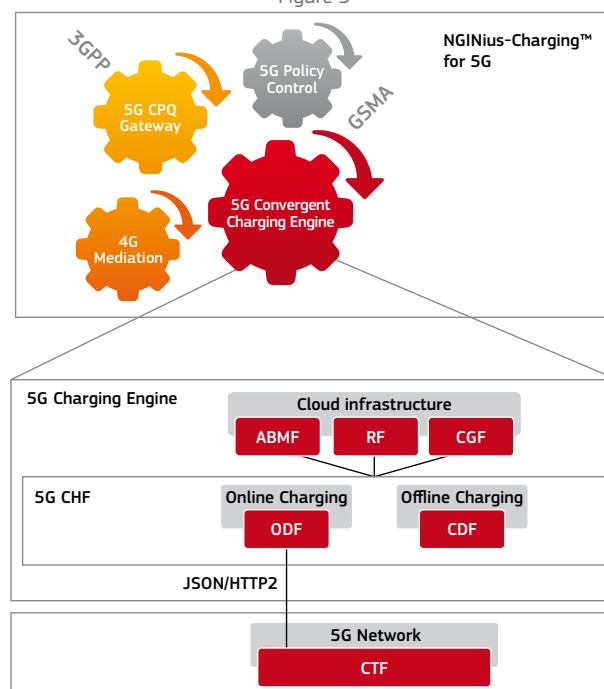


Figure 3 depicts the NGINius-Charging™ for 5G functional architecture at high level.

NGINus-Charging™
for 5G

The continuously evolving NGINus-Charging™ constitutes a fundamental building block for the Greek CSP in order to accomplish its envisions for innovative digital services, and expand in new market segments, capitalizing on the opportunities generated by 5G and growing IoT use cases. ■

ARTICLE

ULTRA-FAST BROADBAND FWA COEXISTING WITH 5G NETWORKS @ 24/26/28 GHZ

FLEXIBLE OPTIONS FOR COEXISTENCE ARE DEPLOYED VIA THE WIBAS™ FWA ADVANCED TECHNOLOGY

PANTELIS TRAKAS

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INTRODUCTION

A promising way of realizing ultra-broadband Fixed Wireless services is to deploy networks that exploit the higher frequency bands, specifically in the millimeter wave (mmWave) spectrum. Access to such spectrum bands enable FWA systems to deliver several hundreds of Mbps to residential and business subscribers, even at the cell edge. 5G, which is based on the 3GPP standard, is a candidate for delivering ultra-broadband FWA, but it is not the only one. There are other purpose built technologies that use mmWave spectrum and are capable of offering similar FWA services with longer cell ranges and less complex core network than 5G. The additional frequency bands that are identified for the deployment of 5G networks are not exclusively tied to 3GPP. Depending on the country and the relevant regulatory bodies there are cases where spectrum is allocated for both IMT-2020 (5G) use and other fixed wireless technologies. This means that there will be cases of coexistence between 5G and other proprietary FWA networks (incumbent or newcomers). The need for peaceful operation between these networks is a hard requirement and can only be accomplished if interference is kept at a minimum.

CHALLENGES OF TDD NETWORKS

To increase flexibility as well as make spectrum usage more efficient, Time Division Duplex (TDD) is becoming increasingly common and important for access applications. TDD uses the same frequency for each duplex direction, with a frame that includes different time periods and slots for uplink or downlink communications. By changing the duration of these, network performance can be tailored to meet different needs and help provide the best possible experience.

However, for this to work all TDD networks, either 5G or other proprietary FWA solutions, operating in the same frequency range and within the same area have to be synchro-

nized. Base stations need to transmit at the same fixed time periods and all devices should only transmit in dedicated time periods. Failure to do so creates interference, which has a major impact on performance as well as coverage.

SYNCHRONIZATION FUNDAMENTALS

Synchronization is one of the most critical functions of a communication system. Especially for Time Division Duplex (TDD) where both uplink and downlink transmission is on the same frequency, the possibility of interference is much more significant.

TDD turns out to be a more attractive option from a spectral efficiency point of view because it requires only an unpaired channel for operation, which is beneficial considering the scarcity of frequency resources. While it brings spectral efficiency, TDD introduces a critical challenge: Timing and synchronization. Stringent timing restrictions are imposed on a TDD system to avoid interference as both downlink (DL) and uplink UL share the same spectrum.

Besides the common clock/timing reference, TDD deployments also need to use a compatible frame structure between FWA incumbents that use specific spectrum resources and collocated newcomers (e.g. 5G carriers). If this condition is not met DL (Down Link) spectrum may leak onto the adjacent channels. For FDD, this is acceptable since UL (Up Link) and DL channels are separated by a guard band. For TDD, UL and DL share the same channel. Any DL spectral imperfection may thus create interference in the UL signal of the adjacent operator, especially when the two cells are at the boundaries of each other.

5G NR is using a configurable slot format which allows the variation of the DL/UL split ratio depending on the type of traffic/services that is exchanged between the base station and the UEs (User Equipment). Besides the benefits of a configurable split ratio it could be challenging if two net-

WiBAS™ satisfies TDD synchronization challenges:



GNSS derived common frame start reference

works that are offering different types of service are located next to each other. Interference can result even though they may be synchronized in time, but their slot formats are not synchronized.

The following bullets summarize the synchronization criteria that have to be met in collocated or adjacent TDD networks and also the solution that the operators need to follow so that they will not interfere with one another.

» Common frame start reference for all transmissions

All operators need to synchronize their air frames by using common timing reference through accurately timed pulse received every second (1PPS) derived by GNSS (Global Navigation Satellite System).

» Common & Synchronized Downlink/Uplink frame structure across all coexistent operators

This is a more challenging requirement since the operators that have deployed non 3GPP based networks will have to rely on the capabilities of their equipment to select different DL/UL split ratios, which will exactly match the split ratio that will be decided in each case by the neighboring 5G operators.

» Common transmission periodicity (periodicity of the DL/UL pattern)

This is a more tricky point that needs to be addressed by operators and equipment vendors. 5G NR has introduced the use of variable OFDM sub-carrier spacing to cover different QoS,



Configurable DL/UL frame split

latency requirements and frequency ranges. This is achieved by the scalable OFDM numerology, which is the magic number that defines the number of slots, as well the slot length in a 5G NR frame. Eventually the numerology also defines the transmission periodicity (in μ s) of a specific deployment. Incumbent FWA operators that need to coexist with 3GPP based networks need to adjust their air frame to match the transmission periodicity set by the applied OFDM numerology.

WiBAS™ G5 SOLUTION

The WiBAS™ G5 PtMP platform is the latest addition to Intracom Telecom's ultra-broadband FWA product offering. It is operating in the 24.25-29.5 GHz area licensed frequency band, utilizing the advantages and efficiency of contiguous TDD spectrum. It can deliver several hundreds of Mbps to subscribers that are located in distances of more than 5km from the base station hub. At the same time, end-to-end SLAs are guaranteed by employing advanced hierarchical Quality of Service mechanism. WiBAS™ G5 is based on a fully purpose-built MAC and Physical Layer, making it thus flexible when it comes to face the challenges that are mentioned in this article.

WiBAS™ G5 can meet all three major challenges. It can deliver various air frame format lengths that match exactly all the available 5G transmission



Air frame matches 5G transmission periodicity

periodicities that result from the numerology agreed between 3GPP operators at a national level. Furthermore, it can also promise common frame start reference by using an external GNSS module achieving, that way, frequency and phase synchronization between all the coexistent base station sites. And finally, it can split the resources of its air frame in such a way that it can match the various Downlink/Uplink split ratios that are used by the 5G deployments.

CONCLUSION

The common use of contiguous frequency spectrum in the mmWave band for access networks from different available FWA TDD technologies is creating an imminent need for interference free coexistence in collocated or neighboring configurations. Since 5G is based on the 3GPP standard all other proprietary equipment vendors will need to comply with the challenges set by the new technology. WiBAS™ G5 is able address all the fundamental synchronization criteria of TDD network coexistence and can guarantee that operators who select this solution for their FWA network will benefit from a simpler core infrastructure and at the same time will not cause interference issues to existing or forthcoming 5G deployments. ■

For more information, contact us at wibas@intracom-telecom.com.

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