| TD Number | TD Author | TD Title | TD Abstract | TD WG | Name | Surname | Email | Acronym |
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| TD(26)13001 | Lorenzo Italiano, Mattia Brambilla, Monica Nicoli | Towards 6G Single-Anchor Vehicle Localization Exploiting Radio-Reflective Road Markings in Tunnel Environments | Accurate vehicular localization remains a key challenge for cooperative intelligent transport systems (C-ITS), especially in areas without global navigation satellite system (GNSS) coverage, such as road tunnels.<br>This paper proposes a novel vehicle positioning method with a single anchor equipped with multiple antennas, exploiting near-field (NF) propagation and passive radio-reflective structures deployed along the GNSS-denied tunnel. The method assumes a wideband vehicle-to-everything (V2X) communication between the vehicle and the anchor, in line with the undergoing standardization of cellular V2X beyond 5G.<br>We first derive the validity condition that allows us to approximate the multipath channel with a single reflector point, defining a geometry validity bound on the number of antennas that can be employed. Building on this result, we propose JAVELIN, a 6G-compatible single-anchor localization framework that leverages tensor-based NF parameter estimation, adaptive NF/far-field (FF) processing, and recursive Bayesian tracking to enable sub-meter positioning without multi-anchor synchronization. The method integrates angle, delay difference, and curvature measurements into a variable-dimension extended Kalman filter with gated nearest-neighbor association, enabling operation without prior environmental knowledge. Radio-reflective road markings are further introduced to enhance geometric diversity. Simulation results in realistic tunnel scenarios demonstrate accurate and robust localization under different conditions, outperforming state-of-the-art single-anchor approaches and benefiting from passive reflector deployment. | WG2 | Lorenzo | Italiano | lorenzo.italiano@polimi.it | POLIMI |
| TD(26)13002 | Mojtaba Mahmoudi, Carles Antón-Haro and Xavier Mestre | Channel Estimation for RSMA in Nonlinear Channels with Kolmogorov-Arnold Networks | Massive MIMO combined with advanced multiple access strategies such as Rate-Splitting Multiple Access (RSMA) offers notable gains in spectral efficiency, interference management, and reliability. The performance of RSMA hinges on<br>accurate channel state information (CSI) for precoding, power allocation, and message splitting. However, CSI acquisition becomes challenging in low-cost receivers with limited hardware, coarse ADCs, and nonlinearities (e.g., amplifier distortion and IQ imbalance), which undermine conventional linear estimators. Deep learning methods have therefore emerged as strong candidates for modeling the nonlinear relationships between transmitted signals, channels, and distorted observations. In this work, we investigate Kolmogorov-Arnold Networks (KANs), which exploit the Kolmogorov-Arnold theorem to express multivariate nonlinear mappings as sums of univariate functions, providing both interpretability and expressive power. We show that KANs accurately recover the linear channel from nonlinearly distorted pilots, maintain solid performance with limited training data, and achieve consistently lower NMSE than other deep learning baselines across all SNRs. Although KANs entail longer training times, this drawback is alleviated by offline training, making them a practical and robust solution for nonlinear channel estimation in RSMA-based MIMO systems. | WG2 | Carles | Anton-Haro | carles.anton@cttc.es | CTTC |
| TD(26)13003 | Shrayan Das, Tommaso Zugno, Mate Boban, and Pekka Kyösti | Wideband Near-Field Extension for the 3GPP Geometry-Based Stochastic Channel Model | Traditional geometry-based stochastic channel models, including 3GPP TR 38.901, are fundamentally built on the plane-wave assumption and are therefore most accurate in the far field. However, higher carrier frequencies, larger array apertures, shorter link distances, and wider bandwidths make radiative near-field propagation increasingly relevant. In this work, we propose a wideband near-field extension to the 3GPP geometry-based stochastic channel model by replacing pathwise scalar delays with element-wise propagation delays derived from spherical-wave geometry. For the line-of-sight (LoS) component, the model directly incorporates exact element-pair distances. For specular non-line-of-sight (NLoS) components, an image-based virtual-array construction is introduced to recover physically consistent per-element propagation distances while preserving the original 3GPP path parameters. For scattered components, an effective-scattering formulation is developed that combines an effective-roughness-based angular-weighting model with a geometrically consistent effective-path construction. The proposed framework preserves the structure and interpretability of the legacy 3GPP model while extending it to wideband near-field operation. Simulation results show that the proposed model accurately captures near-field phase curvature, beamfocusing behaviour, beam spreading, and the practical transition from near-field to far-field. In addition, the results demonstrate that conventional far-field or narrowband beamforming models incur substantial performance loss in large-aperture wideband near-field systems, whereas the proposed model provides a physically consistent basis for evaluating such systems. | WG1 | Shrayan | Das | shrayan.das@oulu.fi | OULU |

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| TD(26)13004 | Simona Valbonesi, Claudia Carciofi, Andrea Garzia, Marina Lotti and Paolo Grazioso | In-vehicle exposure to radiofrequency signals from mobile base stations: measurements and ray-tracing analysis in multi-frequency scenarios | Aim of the present work is to evaluate exposure to radiofrequency electromagnetic field within cars due to emissions from base stations in the vicinity. We present results of measurements taken in two different scenarios and with two different cars, and of numerical simulations for the scenario with highest measured field values, using typical values of electromagnetic parameters of real base stations. The studied frequency range is 800 MHz – 3.8 GHz.<br>The results show that field values within cars are generally lower than those found in the exterior, owing to the attenuation caused by the car body and windows. Nevertheless, one may find some points within the car where exposure levels are higher than in the exterior, in locations that depend on the orientation of the car with respect to the direction of arrival of the transmitted signal. These points are characterised by exposure levels up to three times higher than the average field value within the cabin.<br>In any case, for typical exposure scenarios, the exposure values are remarkably lower than the limits defined by the ICNIRP. | Sub-VT1 | Paolo | Grazioso | pgrazioso@fub.it | FUB |
| TD(26)13005 | Konstantin Mikhaylov, Matti Hamalainen | Integration of IoT and Beyond-5G Radio Access Based on 3GPP Private IoT Networks: SmartBAN reference example | Recent developments in 3GPP, particularly the introduction of the Personal IoT Network (PIN) concept, provide new architectural opportunities for integrating personal-scale IoT systems into beyond-5G ecosystems. However, systematic integration of non-3GPP body area frameworks with 3GPP PIN-based radio access remains insufficiently explored and only partially supported by existing standards. In this context, this paper focuses on 3GPP-centric IoT and beyond-5G integration, using SmartBAN as a representative reference example. The paper reviews available SmartBAN–3GPP interworking options, examines the 3GPP PIN architecture and its capabilities, and proposes a unified SmartBAN–PIN integration approach that illustrates how personal IoT networks can be efficiently incorporated into 3GPP-based systems. Key implementation aspects, feasibility considerations, and open standardization challenges are discussed to highlight pathways toward seamless personal IoT integration in future beyond-5G networks. | WG3,VT1 | Konstantin | Mikhaylov | konstantin.mikhaylov@oulu.fi | OULU |
| TD(26)13006 | Diego Dupleich, Sebastian Semper, Steffen Schieler, Christian Schneider, Damir Sitdikov, Daniel Stanko, Jonas Gedschold, Ainur Marc Miranda, Lorenz Mohr, Ainur Ziganshin, Zhixiang Zhao, Markus Landmann, and Reiner Thomä | The Digital-Twin Representation of Radio Channels (D-TRaCe) Framework | In this paper, we introduce the Digital-Twin Representation of Radio Channels (D-TRaCe), a framework for constructing calibrated, measurement-based digital twins of real-world radio propagation channels. The primary objectives are twofold: (i) to generate realistic channel impulse responses (CIRs) for accurate propagation characterization in specified environments, thereby reducing both the duration and complexity of physical measurement campaigns; and (ii) to enable CIR estimation for applications in Integrated Communications and Sensing (ICAS). The proposed framework is inherently multidisciplinary, encompassing channel sounding design, metrology for calibration and validation, classical parameter estimation techniques, and Machine Learning (ML)-based methods for modeling and inference. | WG1 | Diego | Dupleich | diego-andres.dupleich@tu-ilmenau.de | TUIL |
| TD(26)13007 | Simona Valbonesi, Riccardo Suman, Stefano D'Elia, Andrea Garzia, Paolo Grazioso | Bridging Scalar and Vectorial RF EMF Assessment in 5G Massive MIMO Networks Using Spatial–Temporal Power Reduction Factors | The deployment of massive multiple input multiple output (mMIMO) and beamforming in 5G networks increased the complexity of radio frequency electromagnetic field (RF EMF) exposure assessment. Conventional worst case methodologies based on static antenna patterns significantly overestimate realistic exposure levels. Technical Standard IEC 62232 addresses this limitation through the Actual Maximum Approach (AMA), introducing the Power Reduction Factor (FPR) to capture temporal and spatial transmission dynamics. This paper compares FPR calculated with scalar, semi vectorial, and vectorial approaches using real power counter data from operational 5G mMIMO base stations deployed in urban and rural scenarios. Three dimensional power counters are exploited to quantify spatial multiplexing effects. A strong correlation between scalar and vectorial FPRs is identified, enabling the derivation of stable conversion factors. This correlation could allow realistic exposure levels—and associated exclusion zones—to be estimated using scalar metrics alone, significantly simplifying the assessment process while maintaining acceptable accuracy across different deployment scenarios. | Sub-VT1 | Simona | Valbonesi | svalbonesi@fub.it | FUB |
| TD(26)13008 | Simona Valbonesi, Andrea Garzia, Marina Lotti, Claudia Carciofi | Car Penetration Loss assessment and modelization: a novel model based on extensive experimental campaign in FR1 Band | This paper presents a comprehensive experimental analysis quantifying Car Penetration Loss (CPL), a critical parameter to be considered for reliable in-vehicle communication and overall cellular network capacity performance. Measurements have been performed across key mobile frequency bands, from sub-1 GHz to 3.8 GHz; the subsequent analysis highlighted and quantified a set of physical factors significantly impacting the CPL, including the characteristics of car window glass, the construction material of the seats, the vehicle's orientation, and the presence of passengers. Based on the measured data, CPL values have been calculated for three distinct sub-bands: sub-1 GHz, 1–3 GHz, and above 3 GHz, confirming the expected increase in loss with frequency. The CPL values have been then used to develop a simplified link budget model specifically designed for network feasibility studies, coverage analyses, and throughput calculations in complex mobile scenarios up to 3.8 GHz. Furthermore, evaluations performed through interpolation allowed to extend the considerations up to the 6 GHz frequency range, which is relevant for emerging V2X (Vehicle-to-Everything) applications. These findings provide essential data for link budget accuracy and underscore the need for network designs that specifically account for the high variability and frequency-dependent nature of CPL in mobile environments. | Sub-VT1 | Simona | Valbonesi | svalbonesi@fub.it | FUB |

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| TD(26)13009 | Lutfi Samara, Mate Boban | Computationally efficient human blockage model | This TD investigates human blockage modeling in high-frequency wireless systems. In the high frequency ranges, the received signal is highly dependent on the finer details of the blocker, such as physical geometry and clothing material; consequently, this leads to rapid fluctuations in the received signal strength. To characterize this behaviour, we derive a human blockage loss range based on the upper and lower envelopes of the loss function.<br>Following this derivation, we propose a simplified human blockage model generated by strategically sampling the well-known mmMAGIC model. Our analysis demonstrates that this envelope-based approach captures the essential shadowing dynamics while significantly reducing computational complexity. Ultimately, this model provides a practical framework for simulating realistic human-induced interference in next-generation wireless network deployments. | WG1 | Mate | Boban | mate.boban@huawei.com | HUAWEI | |
| TD(26)13010 | Siyuan Shao, Peize Zhang, Shrayan Das, Pekka Kyösti, Trung Q. Duong, Simon L. Cotton | Statistical Analysis of Primary and Random Clusters in 318 GHz Terahertz Channels for Industrial IoT | The ultra-high data rates enabled by terahertz (THz) communications pave the way for the demanding requirements of industrial Internet of Things (IIoT) applications, making the investigation of THz channels in industrial environments a critical research topic. This paper presents a comprehensive statistical analysis of the propagation channel at 318 GHz in an industrial environment. In particular, a new clustering scheme is proposed for the sparsity observed in the multipath components (MPCs) of the measured channel. Furthermore, statistical analyses are conducted separately for the group of strong reflections, defined as primary clusters, and other propagation phenomena, defined as random clusters, in rich-scattering environment. The results demonstrate that the large-scale parameters are predominantly influenced by these strong reflections. This study provides reliable support and guidance for subsequent THz stochastic channel modeling. | WG1,Sub-WG1.1 | Peize | Zhang | shrayan.das@oulu.fi | OULU | |
| TD(26)13011 | Xuanyu Liang, Ahmed Al-Tahmeesschi, Swarna Chetty, Cicek Cavdar, Berk Canberk, Hamed Ahmadi | Scalable machine learning-based approaches for energy saving in densely deployed Open RAN | Densely deployed base stations are responsible for the majority of the energy consumed in Radio access network (RAN). While these deployments are crucial to deliver the required data rate in busy hours of the day, the network can save energy by switching some of them to sleep mode and maintain the coverage and quality of service with the other ones. Benefiting from the flexibility provided by the Open RAN in embedding machine learning (ML) in network operations, in this work we propose Deep Reinforcement Learning (DRL)-based energy saving solutions. Firstly we propose 3 different DRL-based methods in the form of xApps which control the Active/Sleep mode of up to 6 radio units (RUs) from Near Real time RAN Intelligent Controller (RIC). We also propose a further scalable federated DRL-based solution with an aggregator as an rApp in None Real time RIC and local agents as xApps. Our simulation results present the convergence of the proposed methods. We also<br>compare the performance of our federated DRL across three layouts spanning 6–24 RUs and 500–1000 m regions, including a composite multi-region scenario. The results show that our proposed federated TD3 algorithm achieves up to 43.75% faster convergence, more than 50% network energy saving and 37. 4% lower training energy versus centralized baselines, while maintaining the quality of service and improving the robustness of the policy. | WG3 | Hamed | Ahmadi | hamed.ahmadi@ucd.ie | UOY | |
| TD(26)13012 | Jie Zhang, Swarna Bindu Chetty, Paul Daniel Mitchell, Mostafa Rahmani Ghourtani, Mohammad Shojafar, Hamed Ahmadi | Unlocking Efficient Connectivity: Advanced AI-Driven Planning for Multi-Hop IAB Networks | In the evolution toward sixth-generation (6G) and open radio access network (RAN) architectures, cost-effective and high-performance network deployment has become increasingly important. Multi-hop integrated access and backhaul (IAB) networks that leverage millimeter-wave technology can reduce infrastructure costs by lowering fiber dependency, but optimal node deployment remains challenging in diverse urban scenarios and involves a large discrete action space. This paper proposes a framework that combines transfer learning with deep reinforcement learning (DRL) to address the node deployment problem<br>under varying donor configurations. Extensive simulations show that the proposed approach reduces the required number of nodes by approximately 20% and cuts model training time by up to 50%, improving adaptability across different donor layouts. These results indicate that the proposed transfer-enabled DRL<br>framework can streamline deployment, optimize coverage, and improve overall efficiency in dynamic settings, supporting scalable and sustainable next-generation wireless networks. | WG3 | Hamed | Ahmadi | hamed.ahmadi@ucd.ie | UOY | |
| TD(26)13013 | Swarna Bindu Chetty, David Grace, Simon Saunders, Paul Harris, Eirini Eleni Tsiropoulou, Tony Quek, Hamed Ahmadi | Sovereign AI for 6G: Towards the Future of AI-Native Networks | The advent of Generative Artificial Intelligence (GenAI), Large Language Models (LLMs), and Large Telecom Models (LTM) significantly reshapes mobile networks, especially as the telecom industry transitions from 5G's cloud-centric to AInative 6G architectures. This transition unlocks unprecedented capabilities in real-time automation, semantic networking, and autonomous service orchestration. However, it introduces critical risks related to data sovereignty, security, explainability, and regulatory compliance especially when AI models are trained,<br>deployed, or governed externally. This paper introduces the concept of 'Sovereign AI' as a strategic imperative for 6G, proposing architectural, operational, and governance frameworks that enable national or operator-level control over AI development, deployment, and life-cycle management. Focusing on ORAN architecture, we explore how sovereign AI-based xApps and rApps can be deployed Near-RT and Non-RT RICs to ensure policy-aligned control, secure model updates, and federated learning across trusted infrastructure. We analyse global strategies, technical enablers, and challenges across safety, talent, and model governance. Our findings underscore that Sovereign AI is not just a regulatory necessity but a foundational pillar for secure, resilient, and ethically-aligned 6G networks. | WG3 | Hamed | Ahmadi | hamed.ahmadi@ucd.ie | UOY | |

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| TD(26)13015 | Tad Matsumoto | Is Maximum Ratio Combining (MRC) the Best you can do? Cell-free Wireless Networks with Distributed MIMO/MAC using Packet Combining | This talk is started by the most critical question, "Is maximum ratio combining (MRC) the best you can do?" The answer is NO. This talk then provides Information Theoretic reason for the superiority of Packet Combining (PC) over MRC, followed by mathematical evaluation of the outage probabilities with MRC and PC in various channel conditions, including impact analysis of the fading correlation of the links. The most important finding of this investigation is that the PC structure can be seen as a Network Level LDPC code.<br>This talk then also provides practical complexity pros-and-cons with PC and MRC, especially in terms of the necessity of symbol level synchronism. At the final stage, this talk provides Wyner-Ziv inequality set required to be satisfied when PC is applied to Cell-free Wireless Networks with Distributed MAC/MIMO using PC. | WG2 | Tadashi | Matsumoto | matumoto@jaist.ac.jp | JAIST |
| TD(26)13016 | Nopphon Keerativoranan, Tang Rong, Tad Matsumoto, Jun-ichi Takada | Semi-Blind Channel Estimation for OTFS-Based ISAC via Companion-Matrix Diagonalisation and Unitary-Constrained Least Squares | Orthogonal Time-Frequency Space (OTFS) modulation is a promising waveform for high-mobility wireless communications and integrated sensing and communication (ISAC) systems, achieved by modulating information into the delay–Doppler (DD) domain. However, severe energy leakage caused by off-grid fractional delay and Doppler shifts, and degraded spectral efficiency due to the extensive guard bands required for pilot-isolated channel estimation, are challenging hurdles in OTFS schemes. This temporary document (TD) proposes a semi-blind channel estimation framework that integrates a Turbo-coding-based soft-decision approach with a 2D subspace method. The framework introduces three key innovations: first, a companion-matrix reformulation that generalizes the standard integer-grid DD channel model to support real-valued fractional delay and Doppler exponents; second, a Vec-Vec matrix restructuring that reformulates the DD channel into a sum of Kronecker products, enabling super-resolution parameter estimation via 2D subspace algorithms; and third, a Unitary-Constrained Least-Squares (UCLS) estimator that iteratively resolves the rotation matrix to estimate the channel using a limited number of pilots and soft-bit data symbols. | WG2 | Nopphon | Keerativoranan | nopphon.keerativoranan@ap.ide.titech.ac.jp | TITECH |
| TD(26)13017 | Jun Yin, Greta Vallero, Michela Meo | Cluster-Aware Structured Pruning for Robust and Sustainable Edge Intelligence | Edge intelligence for sustainable 6G must operate under strict constraints on latency, energy, and computational availability, motivating structured pruning for efficient on-device inference. However, at high pruning ratios, current global magnitude-based channel pruning solutions remove entire feature groups, leading to severe accuracy collapse. To cope with this, we present PKPrune (PCA-KMeans Pruning), a data-free cluster-aware structured pruning method that groups convolutional filters in weight space and prunes within each group while keeping at least one representative per cluster. Ablation study reveals that clustering granularity plays a dominant role in preserving robustness under extreme pruning, while the PCA variance retention ratio has a comparatively minor impact on post-pruning accuracy. To assess practical deployment feasibility, we further study the impact of the fine-tuning budgets, showing catastrophic accuracy collapse without adaptation and rapid recovery with lightweight retraining, which enables explicit accuracy and energy trade-offs under constrained edge resources. Finally, we evaluate PKPrune on CIFAR-10 using ResNet-18 with pruning ratios up to 90%. At 90% pruning, PKPrune achieves 72.94% Top-1 accuracy after lightweight fine-tuning, compared to 63.72% with conventional L2-norm structured pruning, while exhibiting competitive efficiency behavior relative to a dependency-aware structured pruning baseline in our measurement setting. | WG3,VT4 | Greta | Vallero | greta.vallero@polito.it | POLITO |
| TD(26)13018 | Nopphon Keerativoranan, Auksarapak Kietkajornrit, Jun-ichi Takada | Site-Specific Channel Modeling via Spatial MPC Interpolation: Techniques and Applications | This TD presents a database-driven site-specific channel modeling technique based on multipath component (MPC) interpolation, with wireless channel emulation as its primary application target. The proposed technique precomputes site-specific propagation parameters that are obtained either from ray tracing (RT) or channel measurement at discrete spatial grid nodes and stores them in a structured MPC database. At any arbitrary position within the coverage area, the channel parameters are then recovered in real time through spatial interpolation, enabling fast and accurate site-specific channel synthesis without repeating the expensive propagation computation. A revised technique is introduced that solves path association using an iterative DBSCAN-based algorithm. Evaluation in a calibrated indoor office environment at 28 GHz shows correct association rates exceeding 88–90% while comparing with the RT result. Initial outdoor scenario results at 4.85 GHz confirm reasonable agreement between time-variant power delay profile with vehicular measurement data. Beyond emulation, the MPC database concept is discussed as a privacy-preserving alternative framework for the standardization of deterministic site-specific channel models. | WG1 | Nopphon | Keerativoranan | nopphon.keerativoranan@ap.ide.titech.ac.jp | TITECH |

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| TD(26)13019 | Marina Lotti, Claudia Carciofi, Simona Valbonesi | Analysis of 5G/6G Non-Terrestrial Networks: Architectures, Use Cases, and Sustainability | Non-Terrestrial Networks (NTN) are emerging as a key enabler of global connectivity, extending 5G capabilities beyond terrestrial infrastructures and paving the way for fully integrated 6G architectures. This paper provides a comprehensive analysis of NTN scenarios, including satellite constellations and High-Altitude Platform Systems (HAPS), highlighting their roles in enabling ubiquitous and reliable communications. A comparative assessment of satellite orbits, including Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and Geostationary Earth Orbit (GEO), and stratospheric platforms is presented, focusing on coverage, latency, and system performance trade-offs. Particular attention is given to coverage modeling and beamforming characteristics, which directly impact network design and capacity. The paper also outlines the evolution toward 6G NTN, discussing emerging use cases such as integrated sensing and communication, space-edge computing, and global Internet of Things deployments. Finally, key challenges related to sustainability, spectrum management, and orbital congestion are analyzed, emphasizing the need for efficient and coordinated solutions to ensure scalable and environmentally responsible network deployment. | WG1,Sub-WG1.1,WG3 | Simona | Valbonesi | svalbonesi@fub.it | FUB |
| TD(26)13020 | Ana Jeknić, Aleš Švigelj, Tomaž Javornik, Andrej Hrovat | Non-Contiguous Wi-Fi Spectrum for ISAC: Impact on Multipath Delay Estimation | Leveraging channel state information from multiple Wi-Fi bands can improve delay resolution for ranging and sensing when a wide contiguous spectrum is unavailable. However, frequency gaps shape the delay response, introducing sidelobes and secondary peaks that can obscure closely spaced multipath components. This paper examines multipath delay estimation for Wi-Fi-compliant multiband configurations using channel state information (CSI). For a two-path model with unknown complex gains and delays, the Cramér-Rao lower bound (CRLB) for delay separation is derived and analyzed, confirming the benefit of larger frequency aperture, while revealing pronounced, separation-dependent oscillations driven by gap geometry and inter-path coupling. Given the local nature of Cramér-Rao lower bound, the delay response is analyzed next. In the single-path case, the combined subband responses determine how delay-domain sidelobe levels are distributed. The dominant peak spacing is set primarily by the separation between subband center frequencies. In the two-path case, increased aperture sharpens the mainlobe but also intensifies sidelobes and leakage, yielding competing peaks and, in some regimes, a dominant peak shifted from the true delay. Finally, a normalized leakage metric is introduced to predict problematic separations and to identify regimes where local Cramér-Rao lower bound analysis does not capture practical peak-leakage behavior in delay estimation. | WG2,Sub-WG2 | Ana | Jeknić | ana.j@ucg.ac.me | IJS |
| TD(26)13021 | Wim Kotterman | Does Nyquist apply to channel emulation update rates? | When updating emulation channels, it is not sufficient to consider only the Doppler bandwidth of the channel's time variance. Of course, the Nyquist sampling theorem applies, but it is important to note that with channel emulation, a convolution is performed of the channel with the communication signal. The bandwidth of the channel variance is within a few kiloHertz but that of the communication channel typically is orders of magnitude higher. This has consequences for the channel update rate. | WG1,Sub-WG1.1 | Wim | Kotterman | wim.kotterman@tu-ilmenau.de | TUIL |
| TD(26)13023 | Champaka Damuddara Gedara and Konstantin Mikhaylov | Link-Level Performance Evaluation of 5G NR NTN Broadcast for Direct-to-Device Communications | Non-terrestrial networks (NTNs) are emerging as an important extension of fifth-generation (5G) systems to provide wide area connectivity and enable service delivery beyond terrestrial coverage limitations. The 3rd generation partnership project (3GPP) initiated standardizing NTN in Release 15, aiming to establish a unified framework for integrating satellite communications into the 5G ecosystem. With the introduction of multicast and broadcast services (MBS) in 5G, NTN-based delivery becomes an attractive solution for efficiently serving large numbers of users over wide geographic areas. MBS allows efficient transmission of data from a single source to multiple recipients by using shared time and frequency-domain resources and a common modulation-coding scheme (MCS) at the physical layer. However, reliable MBS transmission presents significant physical-layer challenges due to the large propagation delays, Doppler shift and channel impairments. Therefore, accurate link-level performance evaluation is essential for assessing the feasibility and for generating physical-layer abstraction data for higher-layer system analysis. This study develops a link-level simulator to evaluate MBS transmission in NTN direct-to-device (DtD) scenarios. The simulator is further used to estimate the block error rate (BLER) performance across multiple modulation and coding schemes to generate link-to-system mapping curves. Additional evaluations investigate the impact of transport block size variations on decoding performance and analyze the influence of satellite-induced Doppler impairments under transmitter and receiver side compensation strategies. The results demonstrate the expected BLER performance variation across MCS index values and show that the transport block size can significantly influence decoding behaviour. Doppler analysis highlights the importance of frequency offset mitigation to maintain reliable NTN MBS communication. The presented study provides a useful foundation for higher-layer NTN system design and future adaptive or intelligence-enabled radio resource management. | WG1,VT2,VT4 | Konstantin | Mikhaylov | konstantin.mikhaylov@oulu.fi | OULU |

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| TD(26)13024 | Giacomo Melloni, Enrico M. Vitucci, Vittorio Degli-Esposti, Samuel Berweger, Jack Chuang, Camillo Gentile, and Nada Golmie | A Computationally Efficient Reciprocal Effective Roughness Model for Diffuse Scattering | Ray-tracing (RT) has become central to site-specific electromagnetic propagation modeling in dynamic complex environments. Yet its computational burden grows sharply as high-fidelity digital twins of these environments scale to millions of facets whose material parameters must be continuously updated as the environment changes. The challenge is amplified at mmWave and sub-THz frequencies, where surface roughness becomes comparable to the wavelength and so diffuse scattering can account for up to 40% of the received power, making accurate yet tractable models essential. The popular Effective Roughness (ER) approach offers physical consistency but become increasingly costly when highly directive lobes are required or when parameters must be iteratively tuned. This communication introduces a directive, reciprocal diffuse scattering model that preserves the structure of the ER while enabling an order-of-magnitude reduction in computational cost. Validation across eight materials shows no loss in accuracy—and a slight improvement—demonstrating a scalable and physically meaningful solution for RT in scenarios where diffuse scattering is non-negligible. | WG1 | Enrico Maria | Vitucci | enricomaria.vitucci@unibo.it | UNIBO |
| TD(26)13025 | Giacomo Melloni, Jack Chuang, Samuel Berweger, Enrico M. Vitucci, Vittorio Degli-Esposti, Camillo Gentile, and Nada Golmie | Super-Resolution Experimental Validation and Polarimetric Extension of the Effective Roughness Diffuse Scattering Models | The experimental validation of diffuse scattering models has long been limited by the inability to spatially separate specular and diffuse contributions in measured channels. This paper overcomes this limitation by combining super-resolution multipath component (MPC) extraction, which resolves individual propagation paths including the specular component, with digital-twin-assisted geometry, enabling the spatial separation of specular and diffuse contributions from bistatic measurements at 28~GHz.<br>Using this framework, we provide the first measurement-driven validation of the Effective Roughness (ER) model with independent characterization of diffuse scattering across ten common building materials, each measured over 266 angular configurations and all polarization combinations (HH, HV, VH, VV).<br>Furthermore, we extend the ER framework by proposing a novel angle-dependent cross-polarization discrimination (XPD) model, capturing the geometry-dependent nature of depolarization that is neglected in existing approaches.<br>The proposed method reproduces the measured diffuse power trends, achieving RMSE values as low as 3 dB across the tested materials, and improves XPD prediction over the baseline constant-XPD model for nearly all material-polarization cases. These results establish a physically consistent and practically viable approach for high-fidelity channel modeling in mmWave systems. | WG1 | Enrico Maria | Vitucci | enricomaria.vitucci@unibo.it | UNIBO |
| TD(26)13026 | Maram Mezlini, Thierry Lacrevaz, Fernando J. Velez , Pietro M. Ferreira | Sustainable Goal-Oriented Weather Prediction in the 6G IoT-Edge AI-Cloud Mountain Sports Continuum | In high-altitude mountain environments, rapid micro-climate shifts pose significant safety risks for adventure sports such as paragliding, trekking, and winter sports. Traditional cloud-based meteorological services often fail in these regions due to intermittent connectivity in "white zones" and a lack of spatial granularity. This paper proposes a sustainable Edge-AI sensing solution that shifts weather intelligence to the extreme edge of the 6G IoT-Edge-Cloud continuum. The heart of our METEONET v2 framework implements a multioutput deep neural network on the low-power STM32 N657X0-Q microcontroller, which delivers recommendations about weather situations. Using only three physical variables, namely temperature, humidity, and pressure, AI model achieves a 99.8% accuracy whilst simultaneously producing rain probability forecasts and classifying 13 weather states with a memory footprint of less than 384 B of RAM, enabling "near-instant" local inference. To ensure network efficiency, we integrate semantic and goal-oriented communication strategies, where only safety-critical "knowledge states" are transmitted across the hybrid terrestrial and non-terrestrial (TN/NTN) 6G infrastructure. Experimental results from in-situ monitoring at Mont Révard (1,500m) demonstrate that this edge-centric approach provides robust, low-power safety alerts, paving the way for sustainable AI solutions in 6G-enabled autonomous mountain safety systems. | WG3,VT4 | Fernando José | VELEZ | fjv@ubi.pt | UBI |
| TD(26)13027 | Andrey Malikov, Marina Lotti, Manuel Faccioli, Valeria Petrini, Claudia Carciofi | Comparison of Monte Carlo and Minimum Coupling Loss Approaches for MFCN–Fixed Service Coexistence Analysis in the upper 6 GHz Band | The increasing spectrum demand in the upper 6 GHz band requires accurate coexistence studies between Mobile/Fixed Communication Networks (MFCN) and incumbent Fixed Service (FS) systems. Two major methodologies are commonly<br>employed for interference assessment: deterministic Minimum Coupling Loss (MCL) analysis and stochastic Monte Carlo simulations.<br>This work presents a comparative study between a MCL-based tool developed by Fondazione Ugo Bordoni (FUB) and the Monte Carlo framework implemented in SEAMCAT, which is widely adopted within CEPT compatibility studies. The<br>analysis focuses on co-channel interference from 5G MFCN base stations toward FS receivers operating in the 6425–7125 MHz range.<br>A reference coexistence scenario derived from ECC Report 375 is reproduced in both simulation environments using consistent radio and propagation parameters. The study investigates the influence of antenna assumptions, spatial randomness, and angular discrimination on the resulting interference-to-noise ratio (I/N) distributions. | WG1,WG3 | Marina | Lotti | mlotti@fub.it | FUB |

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| TD(26)13028 | Mostafa Rahmani, Alister Burr, Rob Maunder | RBIR-Based Physical Layer Abstraction in 5G NR Under Frequency-Selective Channels | Physical layer abstraction (PLA) is essential for efficient system-level evaluation of 5G New Radio (NR), but its accuracy under strongly frequency-selective channels remains insufficiently understood. This paper investigates RBIR-based PLA for 5G NR uplink transmission under varying delay spread conditions using a detailed link-level simulator. The results show that, while RBIR provides accurate predictions under near frequency-flat channels, a systematic optimistic gap emerges as delay spread increases. This gap is shown to depend not only on channel selectivity, but also on bandwidth occupancy, indicating that practical coded systems do not exploit frequency diversity as completely as implied by mean-based abstraction. To explain this behavior, we analyze the dispersion of mutual information across resource elements and show that two channel realizations with similar average mutual information can yield different decoding performance when their variability differs. Based on this insight, we first interpret the conventional calibration factor in modified RBIR as an implicit compensation for dispersion-induced loss, and then propose a dispersion-aware mutual information mapping (DA-MIM) that explicitly incorporates this effect in the mutual information domain. The proposed abstraction achieves improved agreement with link level results while maintaining low computational complexity and reduced sensitivity to channel-dependent tuning. In addition, the paper establishes a unified frequency-diversity perspective by showing that the required SNR to achieve a target BLER can be characterized by the product of delay spread and signal bandwidth. This relationship is validated across different numerologies, code rates, and modulation orders, and is preserved by the proposed DA-MIM abstraction. The overall results provide both a physical interpretation of RBIR mismatch and a practical framework for more accurate and scalable PLA in 5G NR frequency-selective channels. | WG2,WG3 | Alister | Burr | alister.burr@york.ac.uk | UOY |
| TD(26)13029 | Ali Kourani, Lauri Vähä-Savo, Zhijie Tang, Clemens Icheln, Katsuyuki Haneda | Dynamic Directional Wideband Channel Sounding at 15 GHz Using a Spinning Antenna Platform | This paper presents a dynamic directional wideband channel sounder operating at 15 GHz band using a high speed rotating antenna platform. The mobile station side is equipped with a reference omnidirectional antenna and a lightweight eight-element ultrawideband H-slotted patch array with tapering realized by substrate-integrated waveguide feed. The directional antenna achieves a 14 dBi realized gain, 12◦ E-plane half power beamwidth and -20.4 dB sidelobe level. The directional antenna is mounted on a shaft rotating up to 20 000 round-per-minute (RPM) using a rotor giving torque through two gears. The antenna is fed through an optical rotary joint interfacing with a non-rotating transmitter. The rotor was configured through a microcontroller unit such that it rotates with a desired speed and reads the present angular position. At the beginning of channel sounding, the transmitter switches from the omnidirectional antenna to the spinning directional antenna as signature of a start of the directionally-resolved channel measurements and to have precise correspondence between the angular position of the rotor and channel estimates at the receiver base station. The switching moment is identified from normalized cross correlation of the time-series of channel impulse responses. The sounder was tested in anechoic chamber and laboratory environments, confirming repeatable estimates of power angular profiles up to 1500 RPM and ability of dynamic directional channel sounding. | WG1 | Ali | Kourani | ali.kourani@aalto.fi | AALTO |
| TD(26)13030 | Steffen Kroos, Lukas Gebert, Frédéric Dutin, Rita Younes, Simon Haußmann, Victor Torres, Sébastien Chartier, Peter Schlegel, Uwe Hellrung, Guillaume Ducournau, Thomas Kürner | Design and Experimental Validation of a 300-GHz Beam-Steering System Using a Leaky-Wave Antenna | In low terahertz communications, highly directive antennas with large antenna gain are required to compensate for the significant loss of free-space propagation. Consequently, precise alignment between the transmitter and receiver becomes essential. In dynamic scenarios with moving devices, beam steering is therefore a key technology for maintaining a stable communication link. This work presents the development, integration, and experimental validation of a system at 300 GHz using a leaky-wave antenna for beam steering. For this purpose, dedicated indoor units for frequency up conversion and frequency tuning were developed together with a leaky-wave antenna operating in the frequency range from 220 GHz to 320 GHz. The complete system was experimentally characterized in both static and dynamic scenarios by measuring the achievable data rates as a function of operating frequency and steering angle.<br>Using the developed system, a stable dynamic link was demonstrated while following the movement of a mobile station. The results confirm the suitability of leaky-wave antennas for beam steering in dynamic communication systems at 300 GHz. | Sub-WG1.1,VT3 | Steffen | Kroos | steffen.kroos@tu-braunschweig.de | TUBS |

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| TD(26)13031 | Andrey Malikov, Gianni Pasolini, Roberto Verdone, Marina Lotti, Lorenzo Mario Amorosa, Valeria Petrini, Claudia Carciofi, Paolo Grazioso, Hayat Kourani | When Does Reinforcement Learning Help? A Co-Design Study of Licensed-Side Coexistence Control in the Upper 6 GHz Band | The upper 6 GHz band (6425–7125 MHz) is emerging as a key mid-band candidate for future 6G mobile networks while remaining a target for unlicensed Wi-Fi, thereby creating a coexistence regime in which a fully licensed transmitter must operate alongside Wi-Fi devices that may interfere with cellular communications. This paper investigates this scenario and envision the adoption of a controller at the licensed 6G transmitter, which acts on the basis of channel sensing information to tune transmit power level, duty cycle, and bandwidth usage, adapting in real time to the surrounding interference conditions, so as to maximize the mobile network performance (jointly accounting for block error rate, throughput, and queue backlog). Two control strategies are investigated: a reinforcement-learning agent operating on a short observation history and a rule-based heuristic strategy. The paper aims to answer the question: “when does a learning-based controller outperform a well-tuned reactive heuristic?” Two complementary experiments are discussed, whose outcomes are derived through a simulator specifically developed for this study. The first considers licensed-side adaptation against a partially observable, uncoordinated Wi-Fi interferer, comparing fixed baselines, an interpretable heuristic, and a Deep Q-Network (DQN) controller across different traffic regimes. In this scenario, DQN mainly helps diagnose and improve the heuristic. A complementary second experiment considers a different control problem: the licensed gNB is subject to an internal time-averaged transmit-activity constraint motivated by electromagnetic-field compliance and thermal management, such that aggressive actions accumulate over time and may trigger forced cooldown periods, where learning-based controllers may become more valuable.<br>The two experiments yield contrasting answers as to when learning provides a measurable benefit. We discuss the resulting implications for the role of reinforcement learning in licensed-side coexistence control. | WG1,WG3 | Marina | Lotti | mlotti@fub.it | FUB |
| TD(26)13032 | Nicolò Cenni, Elena Bernardi, Matteo Albani, Enrico M. Vitucci, Vittorio Degli-Esposti | Modeling of Quantized RIS Reradiation: A Fourier-Based Method | Reconfigurable Intelligent Surfaces (RIS) are emerging as a key enabling technology for next-generation wireless networks. However, most analytical and ray-based models rely on the assumption of continuous and differentiable phase functions across the RIS surface, while real RISs are inherently composed of discrete unit cells with quantized phase responses. This paper proposes a methodology to extend ray-based simulation models to account for discrete and quantized phase profiles, by exploiting a Fourier-optics interpretation of the re-radiated field. The approach enables the identification of the main propagation modes and their associated powers, allowing quantization effects to be represented within a ray-based framework. A reference example demonstrates the appearance of undesired spectral modes as the quantization resolution decreases. The proposed method is validated against a reference Huygens-based model, showing good agreement and reduced computational complexity. | WG1,Sub-WG1.2 | Enrico Maria | Vitucci | enricomaria.vitucci@unibo.it | UNIBO |
| TD(26)13033 | Elena Bernardi, Nicolò Cenni, Silvi Kodra, Settimio Pavoncello, Luca Chiaraviglio, Marina Barbiroli, Enrico M. Vitucci, Vittorio Degli-Esposti | A Power-Balance Model for Quantized mm-Wave RIS: Concept and Experimental Assessment | Reconfigurable Intelligent Surfaces (RIS) are emerging as low-cost, energy-efficient solutions to control wireless propagation. Practical RIS reconfigurability is achieved through phase quantization, e.g. using 1-bit PIN diodes, which may lead to anomalous reradiation modes, limiting the signal coverage enhancement towards the intended direction. Such quantization modes should be taken into account to tune realistic RIS models through proper, physically sound parameters. The goal of this work is to design and evaluate a power balance model for reflective RIS, explicitly accounting for both quantization-induced and parasitic reradiation modes alongside desired reradiated power. We parametrize the model by performing signal measurements in a realistic scenario, using a 1-bit RIS operating at mm-Wave frequencies. The proposed approach analyses how phase quantization redistributes power across modes and provide a framework for realistic RIS modeling. | WG1,Sub-WG1.2 | Enrico Maria | Vitucci | enricomaria.vitucci@unibo.it | UNIBO |
| TD(26)13034 | Ivan Miguel Pires, Paulo Jorge Coelho, Saif Al-jumaili, Fernando J. Velez and Sana Salous | AI-Driven Wireless Systems and Smart Textiles: Existent Research Landscapes, Integration Pathways, and Future Direction | Integrating Wireless Body Area Networks (WBANs) at the 60 GHz frequency bands with electro-textiles and AI-driven propagation modeling can revolutionize wearable health monitoring by enhancing speed and reducing intrusiveness. This paper reviews research from 2015 to 2025, focusing on the intersection of AI/ML, 60 GHz on-body propagation, and electro-textile integration. Despite advancements in each domain, no study has addressed all four areas simultaneously, revealing a significant research gap. Challenges include limited 60 GHz on-body datasets, material losses in textile substrates, computational constraints for AI integration, and performance issues under fabric deformation. We screened 362 records and fully reviewed 35 studies. Solutions include physics-informed AI, co-design strategies, and the creation of shared datasets and testbeds. Solutions such as physics-informed AI, co-design strategies, and shared datasets are proposed to overcome the identified barriers. This study highlights the need for interdisciplinary collaboration to develop adaptive, high-speed wearable systems for healthcare and monitoring applications. | VT1 | Fernando José | VELEZ | fjv@ubi.pt | UBI |

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| TD(26)13035 | Óscar Silva and Fernando J. Velez | Analysis of Cellular Coverage in Hospital Environments: A Measurement-based Study in Resource-Constrained Settings | The increasing reliance of healthcare systems on wireless communication technologies has brought cellular connectivity to the centre of digital health deployment. Yet, in hospital environments, coverage is often assumed rather than verified, particularly in resource-constrained settings where infrastructure limitations are more pronounced. This work presents a measurement-based analysis of cellular coverage in the Hospital do Mal de Hansen de Cumura (Guinea-Bissau) whilst comparing it with the outcomes of the measurements in the Centro Hospitalar Universitário Cova da Beira (Portugal). By considering a combination of spectrum analysis and network scanning tools, data were collected across multiple indoor and outdoor locations, allowing the evaluation of signal strength and communication quality through metrics such as RSSI, RSRP, RSRQ and RSCP. The results reveal clear differences between the two scenarios. While CHUCB benefits from stronger and more stable signal conditions, significant variability is still observed due to the complexity of its indoor environment. In Cumura, coverage is generally weaker and less consistent, reflecting both infrastructural limitations and the dispersed layout of the hospital. Across both environments, LTE emerges as the technology providing the most reliable performance. At the operator level, Orange shows better overall behaviour in Cumura, whereas MEO presents the strongest and most consistent coverage in CHUCB. These findings highlight that the existence of coverage alone is not sufficient for supporting digital health applications. Stability, predictability, and context-aware network deployment play a critical role in ensuring reliable communication. The study provides practical insights for the design and optimisation of cellular connectivity in hospital environments, particularly in low-resource economy contexts. | Sub-VT1 | Fernando José | VELEZ | fjv@ubi.pt | UBI |
| TD(26)13036 | Bernardo Galego, Luis M. Correia, Marek Natkaniec, Pawel Kulakowski, Athanasios G. Kanatas, Demosthenes Vouyioukas, Mimoza Ibrani, Bujar Krasniqi, Marina Barbiroli, Silvi Kodra, Begum Korunur Engiz, Cetin Kurnaz, Adnan Ahmad Cheema, Óscar Silva, Fernando J. Velez, Wout Joseph, Leen Verloock, Marina | A Wide Measurement Based Approach to Extrapolate EMF Exposure Levels from 6- to 30-Minute Intervals | This paper presents the results of several measurement campaigns of the Electromagnetic Field (EMF) originated from mobile communications systems, coming from 12 different European countries. Since the most recent ICNIRP guidelines state that EMF levels must be averaged over 30 minutes, the objective of this work is to find a factor to extrapolate values taken from 6-minute measurements to 30-minute ones, to allow one to continue taking 6-minute measurements and compare their results to the ICNIRP guidelines. A total of 1245 6-minute intervals were measured with a variety of broad- and narrow-band measuring devices, in urban scenarios. A statistical model based on the measured EMF relative differences between 6-minute and 30-minute intervals is proposed. | VT1,Sub-VT1 | Bernardo | Galego | bernardo.galego@tecnico.ulisboa.pt | ULISBOA |
| TD(26)13037 | Nicolò Decarli, Caterina Giovannetti, Francesco Guidi, Anna Guerra, Alberto Zanella, Barbara Mavì Masini | Extremely Large Aperture Arrays for V2X Communication, Localization and Sensing<br>Extremely Large Aperture Arrays for V2X Communication, Localization and Sensing | Future 6G vehicular networks are expected to support connected, autonomous, and cooperative driving through ultra-reliable, low-latency, and context-aware V2X communications. In this paper, we investigate the role of ELAAs deployed on-board vehicles as a key enabler for the joint enhancement of communication, localization, and sensing functionalities, with particular focus on V2X sidelink transmissions. Leveraging the large spatial aperture of ELAAs, advanced beamfocusing and LOS-MIMO techniques are reviewed to improve communication reliability and spatial multiplexing in highly dynamic vehicular scenarios. Moreover, we analyze vehicular near-field single-anchor localization and sensing capabilities enabled by large arrays, as well as predictive beamforming strategies based on Doppler analysis that enable the estimation of multiple velocity components of surrounding objects and vehicles. The paper highlights the tight interplay between communication and sensing, demonstrating how it can enhance performance across these domains. Our analysis provides insights into the potential of ELAA-based ISAC architectures for next-generation vehicular networks. | WG2 | Caterina | Giovannetti | caterinagiovannetti@cnr.it | UNIBO, CNR-IEIIT, FUB |
| TD(26)13038 | Nigus Shimuye, Claude Oestges, and Franc¸ois Quitin | Target Trajectory Estimation from Blockage-Induced Multipath Dynamics in mmWave Systems | Millimeter-wave (mmWave) communication systems are highly sensitive to blockage caused by moving objects, producing temporal variations in propagation paths that are typically treated as communication impair-<br>ments. This paper proposes an opportunistic sensing framework that exploits blockage-induced attenuation in multipath components (MPCs) to estimate target trajectories from directional mmWave channel measurements. Unlike reflection-based sensing methods that rely on detectable target echoes and often assume fully digital multiple-input multiple-output (MIMO) architectures, the proposed approach exploits attenuation naturally induced in communication paths and operates in sparse mmWave systems with analog beamforming architectures. The framework first estimates the static propagation geometry using a beamsteering-domain Space-Alternating Generalized Expectation-Maximization (SAGE) algorithm. The slowtime evolution of MPC gains is then tracked to detect blockage events and estimate path-crossing times from MPC power trajectories. Finally, blockage observations across transmitter (Tx)–receiver (Rx) links are fused within a maximum-likelihood estimator to recover the target trajectory, including initial position, speed, and direction of motion. Simulation and experimental results from an indoor 28 GHz mmWave measurement setup demonstrate sub-meter trajectory estimation accuracy under different beam-scanning periods, highlighting the feasibility of opportunistic trajectory sensing using directional mmWave communication measurements. | | Nigus | Shimuye | nigus.shimuye@ulb.be | |

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| TD(26)13039 | Lorenzo Farina, Vittorio Todisco, Federico Gavioli, Salvatore Iandolo, Francesco Moretti, Giuseppe Perrone, Matteo Piccoli, Francesco Raviglione, Marco Rapelli, Antonio Solida, Claudio Casetti, Paolo Burgio, Carlo Augusto Grazia and Alessandro Bazzi | A Practical Implementation of Day-3 Cooperative Intersection with Automated Connected Mini-Cars | Recent advancements in sensing, automation, and wireless communication are enabling connected and autonomous vehicles (CAVs) to exchange information with other vehicles and roadside infrastructure through vehicle-to-everything (V2X) technologies. These capabilities support cooperative driving strategies in which vehicles adapt their behavior based on shared information. The development of cooperative-intelligent transport systems (C-ITS) services is often described through a progressive roadmap referred to as Day 1, Day 2, and Day 3. Day 1 applications focus on cooperative awareness through the periodic exchange of vehicle status information. Day 2 services extend this paradigm through collective perception, where vehicles share information about objects detected by their onboard sensors. Day 3 introduces cooperative maneuver coordination, where vehicles exchange information about their intended actions and coordinate their trajectories to perform complex maneuvers. In Europe, such coordination is expected to be supported by Maneuver Coordination Messages (MCM), currently under standardization within ETSI. | Lorenzo | Farina | l.farina@unibo.it | UNIBO |
| TD(26)13040 | Vittorio Todisco, Mattia Andreani, Alessandro Bazzi, and Maria Luisa Merani | The Role of Collective Perception and 5G NR-V2X Sidelink in Road Safety | Road safety remains a global challenge, with vehicle-to-everything (V2X) communication technologies playing a pivotal role in reducing traffic accidents and enhancing transportation efficiency. The evolution of V2X safety applications, which began with Day 1 cooperative awareness and is envisioned to reach Day 3 coordinated driving, is currently centered on Day 2 collective perception. The so-called collective perception service (CPS)enables sensor-equipped road users and infrastructures to share information about their surroundings, thereby extending the situational awareness of connected vehicles to include unconnected or occluded objects. This capability represents a major step toward future intelligent transportation systems, but also introduces significant challenges in terms of utilization of radio resources and communication reliability. The present work portrays the status of CPS from a standardization viewpoint and investigates its impact on communication performance, assuming that a large number of vehicles are equipped with CPS and communicate via fifth generation (5G) New Radio (NR)-V2X sidelink (SL). Object traces extracted from a real-world dataset are leveraged and integrated into a network-level simulation framework to evaluate key performance indicators that measure communication effectiveness, timeliness, and radio channel occupancy. The results demonstrate that NR-V2X can aptly support CPS, thereby addressing earlier concerns, provided that CPS traffic is carefully shaped. | Vittorio | Todisco | vittorio.todisco@unibo.it | UNIBO |
| TD(26)13041 | Sara Cavallero, Fabio Saggese, Junya Shiraishi, Israel Leyva-Mayorga, Shashi Raj Pandey, Chiara Buratti, Petar Popovski | Dual-Mode Wireless Devices for Adaptive Pull and Push-Based Communication | This paper introduces a dual-mode communication framework for wireless devices that integrates query-driven (pull) and event-driven (push) transmissions within a unified time-frame structure. Devices typically respond to information requests in pull mode, but if an anomaly is detected, they preempt the regular response to report the critical condition. Additionally, push-based communication is used to proactively send critical data without waiting for a request. This adaptive approach ensures timely, context-aware, and efficient data delivery across different network conditions. To achieve high energy efficiency, we incorporate a wake-up radio mechanism and we design a tailored medium access control (MAC) protocol that supports data traffic belonging to the different communication classes. A comprehensive system-level analysis is conducted, accounting for the wake-up control operation and evaluating three key performance metrics: the success probability of anomaly reports (push traffic), the success probability of query responses (pull traffic) and the total energy consumption. Numerical results characterize the system's behavior and highlight the inherent trade-off between push and pull success probabilities as a function of allocated communication resources. Our analysis demonstrates that the proposed approach achieves up to a 42% reduction in energy consumption per served packet compared to traditional approaches, while maintaining reliable support for both communication paradigms. | Sara | Cavallero | sara.cavallero@wilab.cnit.it | CNIT |