ISSUE 11

PAINLESS

An innovative training network (ITN) on

Energy-autonomous portable access points for infrastructure-less networks

NEWSLETTER DATE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 812991

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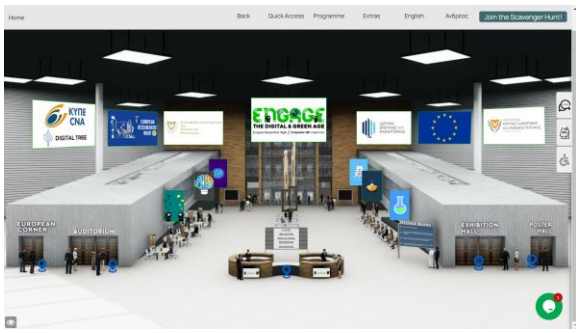
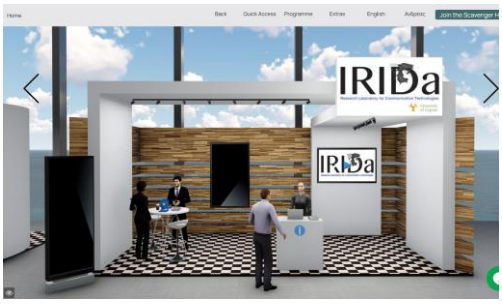
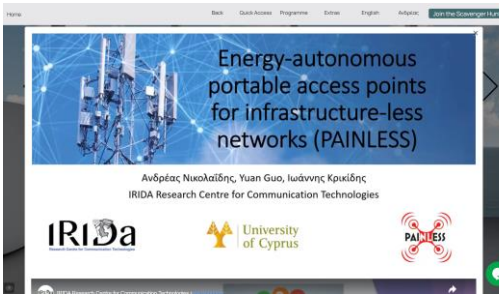
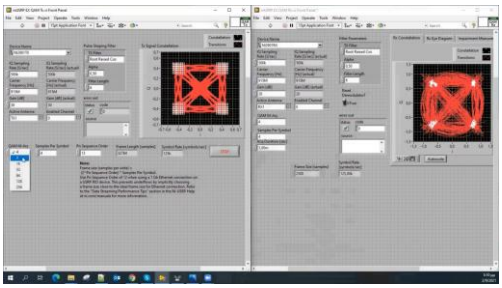


PAINLESS Research projects' Updates







European Researchers' Night 2021 (UCY)

On September 24, 2021, the IRIDA Research Centre for Communication Technologies (UCY) participated in the European Researchers' Night in Cyprus. Due to the current pandemic conditions the event was held virtually through an online platform. The main theme of the event was entitled "ENGAGE – European researchers' Night in Cyprus: the diGitAl and Green AgE". The participating groups promoted their most recent achievements in several research areas towards the transition to the digital and green age, inspired by the European Green Deal and the EU Digital Strategy.

In the digital booth of the Research Centre the visitors had the chance to learn about the equipment and research studies of the group, with greater focus on the 5G and beyond technologies used in future wireless communication networks. The PAINLESS research project was also introduced to the public through a video presentation. Specifically, the attendees were informed about the main activities of the program and the opportunities that arise with the implementation of flexible and energy-autonomous 5G wireless networks. The most recent research advancements of the ESRs were presented, emphasizing on their contributions in resource-efficient green communications and advanced digital technologies.

PAINLESS Research projects' Updates

Mahshid Javidsharifi
ESR #3
(AAU)

Optimum Sizing of Photovoltaic-Battery Power Supply for Drone-Based Cellular Networks

To provide Internet access to rural areas and places without a reliable economic electricity grid, self-sustainable drone-based cellular networks have recently been presented. However, the difficulties of power consumption and mission planning lead to the challenge of optimal sizing of the power supply for future cellular telecommunication networks. To deal with this challenge, this paper presents an optimal approach for sizing the photovoltaic (PV)-battery power supply for drone-based cellular networks in remote areas. The main objective of the suggested approach is to minimize the total cost, including the capital and operational expenditures. The suggested framework is applied to an off-grid cellular telecommunication network with drone-based base stations that are powered by PV-battery systems-based recharging sites in a rural location. The PV-battery system is optimally designed for three recharging sites with three different power consumption profiles with different peak and cumulative loads. Results show that the optimal design of the PV-battery system is dependent on geographical data, solar irradiation, and ambient temperature, which affect the output power of the PV system, as well as the power consumption profile, which affects the required number of PV panels and battery capacity.
https://doi.org/10.3390/drones5040138

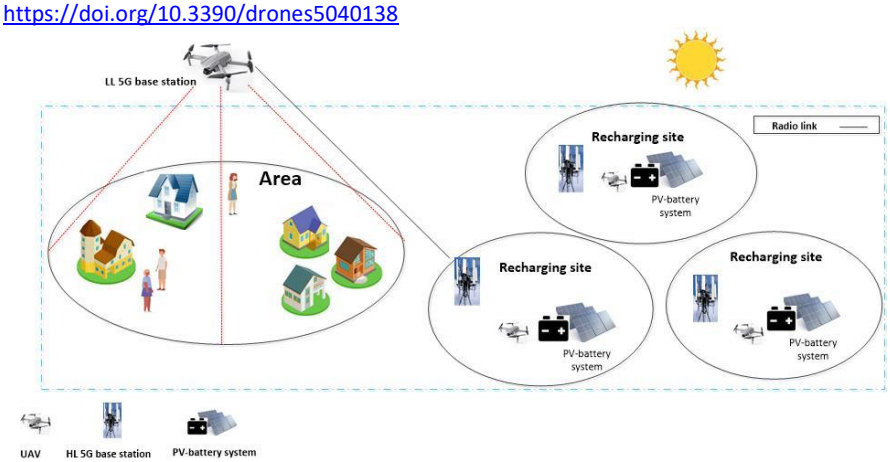


Figure 1. The configuration of an off-grid cellular telecommunication network with drone-based base stations powered by PV-battery systems.

Andreas Nicolaides
ESR #4
(UCY)

A Markov Chain Approach for Myopic Multi-hop Relaying: Outage and Diversity Analysis

In this paper, a cooperative protocol is investigated for a multi-hop network consisting of relays with buffers of finite size, which may operate in different communication modes. The protocol is based on the myopic decode-and-forward strategy, where each node of the network cooperates with a limited number of neighbouring nodes for the transmission of the signals. Each relay stores in its buffer the messages that were successfully decoded, to forward them through the appropriate channel links, based on its supported communication modes. A complete theoretical framework is investigated that models the evolution of the buffers and the transitions at the operations of each relay as a state Markov chain (MC). The performance of the proposed protocol is analysed in terms of outage probability and an expression for the achieved diversity multiplexing trade-off is derived, by using the state transition matrix and the related steady state of the MC. The results show that the proposed protocol outperforms the conventional multi-hop relaying scheme and the system's outage probability as well as the achieved diversity order depend on the degree of cooperation among neighbouring nodes and the communication model that is considered for every relay of the network.
https://doi.org/10.1109/JSTSP.2021.3128810

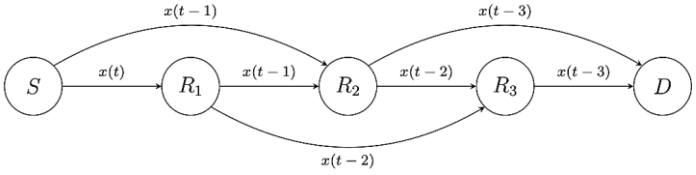


Figure 2. Topology for 2-hop myopic DF strategy in a wireless network with three relays.

PAINLESS Research projects' Updates

Eloise de Carvalho Rodrigues
ESR#11
(Nokia Bell Labs)

On the Latency of IEEE 802.11ax WLANs with Parameterized Spatial Reuse

In this article, the performance of the parameterized spatial reuse (PSR) framework of IEEE 802.11ax is evaluated, mainly focusing on its impact on transmission latency. Based on detailed standard-compliant system-level simulations, a realistic analysis of the effects of PSR considering different scenario densities, traffic loads, and access points (APs) antenna capabilities provided to quantify its performance gains under various scenarios. Results show that, in medium-density scenarios, PSR can offer up to a 3.8× reduction in the 5% worst-case latencies for delay-sensitive stations with respect to an 802.11ax system without PSR. Moreover, this study demonstrates that, for low-latency communications, providing the network with PSR capabilities may be an appealing alternative to the deployment of more costly multi-antenna APs.
https://arxiv.org/pdf/2008.07482.pdf

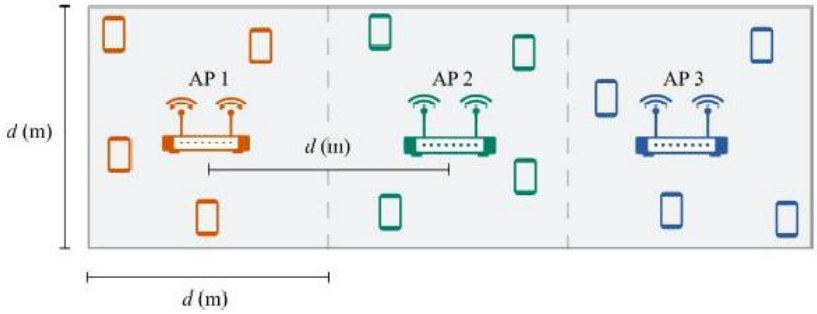


Figure 3. Illustration of a 3d × d indoor scenario with three ceiling-mounted Wi-Fi APs separated by a distance d and s STAs uniformly distributed.

Xiaoye Jing
ESR #9
(UCL)

Energy Aware Trajectory Optimization for Aerial Base Stations

By fully exploiting the mobility of unmanned aerial vehicles (UAVs), UAV-based aerial base stations (BSs) can move closer to ground users to achieve better communication conditions. In this paper, a scenario is considered where an aerial BS is dispatched for satisfying the data request of a maximum number of ground users, weighted according to their data demand, before exhausting its on-board energy resources. The resulting trajectory optimization problem is a mixed integer nonlinear problem (MINLP) which is challenging solve. Specifically, there are coupling constraints which cannot be solved directly. A penalty decomposition method is exploited to reformulate the optimization formulation into a new form and use block coordinate descent technique to decompose the problem into sub-problems. Then, successive convex approximation technique is applied to tackle non-convex constraints. Finally, a double-loop iterative algorithm is proposed for the UAV trajectory design. In addition, to achieve a better coverage performance, the problem of designing the initial trajectory for the UAV trajectory is considered. In the results section, UAV trajectories with the proposed algorithm are shown. Numerical results show the coverage performance with the proposed schemes compared to the benchmarks.
https://doi.org/10.1109/TCOMM.2021.3055525

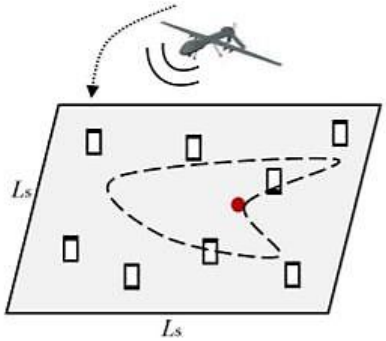


Figure 4. Aerial BS serving ground users.