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"Efficient and Pragmatic Resource Orchestration in Communication and Computing Interdependent Cyber-Physical Systems"

Abstract – The Future Internet paradigm is evolving towards a competitive environment, where users and devices have access to various resources, while their behaviors become strongly interdependent. This vision is further motivated and supported by the convergence of various emerging technologies enabling Cyber-Physical Systems operation, including 5G/B5G technologies, Internet of Things (IoT), Mobile Edge Computing and Software Defined Networking, all targeting flexibility and efficiency. To deal with the involved complexity, and driven by the requirements of autonomy and scalability, distributed resource orchestration approaches appear as a necessity rather than a desire. In this talk the focus is placed on the introduction of a novel alternative decision-making paradigm, where actions are taken autonomously by devices interacting with each other. We challenge the conventional approaches that mainly aim at maximizing Quality of Service (QoS) which are generally energy costly, and we argue that more desirable solutions, both from the user and the network provider perspective, can be obtained by targeting satisfactory QoS levels only. This is addressed by a game theoretical solution founded on the concept of satisfaction equilibrium. Furthermore, we claim that efficiency can still meet reality in the considered setting of the emerging distributed environments. In particular, in terms of end users actual behavior perspective, we argue that individuals in real life do not behave as neutral expected utility maximizers, but they tend to exhibit risk seeking or loss aversion behavior under uncertainty. This is dealt with the exploitation of Prospect Theory. To tackle the wireless and computing environment dynamicity and uncertainty of realistic systems, as well as treat the lack of detailed knowledge about the actions of the rest of the users, learning approaches are introduced in the resource orchestration paradigm. The holistic nature and applicability of the proposed approach is demonstrated under several examples and settings of Cyber-Physical systems. To this end, initial results drawn from the areas of co-existence and sharing of licensed and unlicensed spectrum in next generation wireless networks, data offloading in mobile edge computing environments, and UAV-assisted public safety networks, are highlighted.