Physical-layer Challenges for Satellite Communications in *NewSpace*

Prof. Wallace A. Martins
wallace.martins@ieee.org
ISAE-SUPAERO, Université de Toulouse, 31055 Toulouse, France

Broadband services using *satellite communications* (SatCom) are emerging. In particular, integrating broadband-capable SatCom systems into *terrestrial networks* (TNs) opens many opportunities for new services. Indeed, the coverage of future cellular and even narrowband *Internet of things* (IoT) TNs will significantly benefit from a complementary *non-TN* (NTN). Promising use cases include direct-to-handheld broadband communications and mobile communications coverage in underserved regions. These services can significantly impact society by reducing the digital divide between urban and rural populations. These benefits come at the cost of dealing with minimal SatCom capabilities of smartphones and low-cost IoT terminals, resulting in highly challenging link budgets. On the other hand, the current *NewSpace* trend – the emerging sector of commercial space activities mainly driven by private companies, startups, and innovative initiatives – relies on miniaturization and mass-production of spacecraft. These novel space systems change the paradigm of space-mission design by adding redundancy (due to multiple spacecraft) and lower capital expenditures (due to cost spread over time). However, due to their small size, they are subject to physical limitations such as antenna aperture, power generation, and orbit & attitude control efficiency. This tutorial will provide an introduction to some of the main challenges concerning *physical-layer* (PHY) SatCom. Among other things, by the end of the session the attendees will be able to: identify the main components of a SatCom architecture; understand the differences between the *NewSpace* concept and conventional space approaches; identify the most promising use cases for SatCom in *NewSpace*; identify at least 3 PHY challenges of SatCom in *NewSpace* along with some of the most promising technological enablers to address them.