



IEEE-CASS event “*Industry in Europe*” & DOCTE6G Workshop on

“Technological bricks for the start of 6G”

Thursday, November 6th, 2025, AMPHI 6

Télécom Paris, 19, place Marguerite Perey, 91120 Palaiseau

Organizers: Philippe Meunier, NXP, Patricia Desgreys, Germain Pham, TELECOM Paris, Palaiseau

Scope:

The DOCTE6G project proposes the development and implementation of the technological bricks necessary for the start of 6G. The hardware and software technological bricks are individually evaluated in this project and they then are validated through use cases. The DOCTE6G project addresses one of the major issues of permanent increase of energy consumption in telecommunication sector. The ultimate incarceration of various DOCTE6G facets is converged to allow and foster the development of sovereign technological bricks in industry and research. These bricks are the basis of the future 6G telecommunications networks.

Program:

- 9:30AM-9:45AM Introduction DOCTE6G – Philippe Meunier, NXP Caen
- 9:45AM-10:25AM Ayad Ghannam, 3DiS : "Enabling Advanced 3D WLP of mmWave Antenna-in-Package using 3D Interconnects"
- 10:25AM-10:40AM Coffee Break
- 10:40AM-11:20AM Bruno Barelaud, XLIM, “DOCTE6G - A W-Band Bidirectional Switchless PALNA in SiGe BiCMOS Technology”
- 11:20AM-12:00AM Desalegn Kassaw Belete, XLIM, “Design of a Pyramidal Horn Antenna With Artificial Magnetic Conductor Surface”

Lunch

2:00PM-3:00PM	Domenico Zito, AGH University of Science and Technology, Krakow, Poland, “Compact Low-Power mm-wave ICs for Next-Generation (5G/6G) Wireless Transceivers”
3:00PM-3:40PM	Pierre Almairac, NXP Toulouse, “DOCTE6G – Création des blocs technologiques 6G - amplificateurs de puissance large bande, économes énergétiquement, linéarisables”
3:40PM-3:55PM	Coffee Break
3:55PM-4:35PM	Germain PHAM, Institut Mines-Télécom, Télécom Paris, “Toward Scalable and Efficient Digital Predistortion: Spectral Insights and Neural Modeling of Wideband Power Amplifiers”
4:35PM-5:15PM	Aung Kaung MYAT, Institut Mines-Télécom, Télécom SudParis, “End-to-End 5G Simulations with Situation-awareness for Digital Twin Applications”

Registration:

The workshop participation, including coffee breaks, lunch, etc., is free of any charge. To help the organizers with the logistics please register by sending an e-mail (Last Name, First Name, Institute or Company, member IEEE, IEEE-CAS) to patricia.desgreys@telecom-paris.fr by Sunday, November 2nd, 2025.

Abstracts:

Enabling Advanced 3D WLP of mmWave Antenna-in-Package using 3D Interconnects Ayad Ghannam

This presentation will highlight the work carried out within the Docte6G project, focusing on the development of advanced 3D wafer-level packaging (WLP) for mmWave Antenna-in-Package (AiP) modules. After introducing the AiP concept and its relevance for next-generation 5G/6G systems, I will outline the main challenges in integrating high-frequency antennas with semiconductor devices, particularly regarding performance, material selection, and scalable manufacturing. The talk will then present the 3D interconnect solutions explored in the project and share the key results and insights achieved, demonstrating the potential of this approach for enabling compact, high-performance mmWave modules.

DOCTE6G - A W-Band Bidirectional Switchless PALNA in SiGe BiCMOS Technology Bruno Barelaud

We present an advanced W-band bidirectional Power Amplifier–Low Noise Amplifier (PALNA) implemented using 130 nm SiGe BiCMOS technology. The proposed RF front-end eliminates the need for conventional transmit/receive (T/R) switches by employing a bidirectional architecture with a passive matching network. This approach minimizes area requirements and reduces signal losses. Post-layout simulation results demonstrate that the designed PALNA achieves a peak small-signal gain of 30 dB in Tx mode and 26 dB in Rx mode, with reverse isolation better than 40 dB. The 3 dB bandwidth spans from 94 to 106 GHz. In LNA mode, the design achieves a minimum noise figure of 6 dB at 100 GHz, remaining below 6.5 dB across the entire 3 dB bandwidth. In PA mode, the simulated saturated output power is 10.5 dBm, with a maximum power-added efficiency of 12% at 100 GHz. The chip size is 0.7 mm² including pads. It consumes 78 and 22 mW in the Tx and Rx modes, respectively.

Design of a Pyramidal Horn Antenna With Artificial Magnetic Conductor Surface

Desalegn Kassaw BELETE

A multilayer integrated pyramidal horn antenna operating from 140 GHz to 158 GHz has been designed for low-cost fabrication using standard PCB technology. The antenna leverages gap-waveguide principles, with a hollow rectangular waveguide flared in both E- and H-planes to form a four-layer horn. Each layer includes a stepped cavity to shape the aperture, while periodic artificial magnetic conductor (AMC) cells are employed to suppress leakage and surface wave propagation, forming a robust PEC-AMC boundary. The proposed design achieves a realized gain of 13.4 dBi and a 12 % fractional bandwidth.

Compact Low-Power mm-wave ICs for Next-Generation (5G/6G) Wireless Transceivers

Domenico Zito

Ultra-scaled active devices in both CMOS and BiCMOS technologies have reached outstanding fT/f_{max} , enabling an ever-increasing number of future emerging applications in the microwave/mm-wave frequency range, for the next-generation (5G/6G) wireless transceivers for communication, sensing and imaging applications. This lecture addresses some fundamental and most severe design challenges for low-power mm-wave ICs, and advanced design methodologies that can mitigate the performance degradation and allow getting the largest potential out of the ultra-scaled technologies. It reports the design of innovative building-blocks as key enabling solutions for compact low-power mm-wave array ICs for next-generation (5G/6G) wireless transceivers.

DOCTE6G – Création des blocs technologiques 6G - amplificateurs de puissance large bande, économes énergétiquement, linéarisables

Pierre Almairac, NXP Toulouse

L'évolution des technologies 5G vers la 6G implique le développement de nouvelles briques technologiques, tant digitales qu'analogiques, constituant les transmetteurs radio. Dans le cadre du projet Docte6G, nous avons conçu, réalisé et testé un premier prototype d'amplificateur RF de puissance destiné aux applications Massive MIMO, opérant dans la bande N104 (6,4–7,1 GHz). Ce prototype nous a permis de développer des solutions de linéarisation à large bande, basées sur la pré-distorsion digitale (DPD), spécifiquement adaptées à cette gamme de fréquences. Grâce à ce prototype et aux algorithmes de linéarisation associés, nous avons pu identifier les axes d'amélioration nécessaires pour répondre aux exigences du marché en matière de coût et de performance. Cette présentation mettra en lumière les avancées réalisées au centre R&D de NXP Toulouse, en collaboration avec IMT Saclay, dans la conception et la caractérisation d'amplificateurs large bande pour les technologies 5G et 6G, alliant haut rendement et linéarisation efficace. Elle abordera également la conception et les tests de nouvelles techniques de pré-distorsion digitale, accélérées par des algorithmes d'apprentissage automatique.

End-to-End 5G Simulations with Situation-awareness for Digital Twin Applications

Aung Kaung MYAT

This work develops an end-to-end 5G simulation framework by integrating ns-3 5G LENA with Sionna to combine system-level evaluation with realistic ray-traced channel modeling. In the first phase, the framework assesses the impact of different MIMO antenna configurations on traffic profiles such as constant bit rate, video streaming, VoIP, and IoT. The second phase extends the study to a Digital Twin use case, focusing on a smart warehouse scenario. In the third phase, situation-awareness is introduced through adaptive antenna designs that react to environmental and contextual conditions. Performance is evaluated using both application KPIs (throughput, latency, jitter, payload size) and infrastructure KPIs (transmit power, bandwidth, SINR, propagation loss, BER, BLER), providing insights into the benefits of advanced MIMO and situation-aware antennas for Digital Twin applications in 5G and beyond.