

# The Hybrid 2021 RFIC Symposium

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The 2021 IEEE Radio Frequency Integrated Circuits (RFIC) Symposium is an annual forum focused exclusively on presenting the latest research results in RF, millimeter-wave (mm-wave), and wireless ICs. RFIC is a part of Microwave Week, the world's largest RF and microwave technical convention. In 2020, the symposium was held as a fully virtual conference, and we saw record attendance, with more than 1,800 people participating in our plenary session and increased viewership for our technical presentations. Additionally, we saw this increased virtual attendance from diverse geographies around the world, especially Asia. Although we missed seeing everyone in person, the 2020 Virtual RFIC Sym-



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posium points to the exciting opportunities we have in providing more content virtually for our community.

In light of this opportunity as well as the continuing challenges from the ongoing COVID-19 pandemic, RFIC 2021 is being organized as a first-ever hybrid event, with both in-person and virtual sessions. In-person events will be held at the Georgia World Congress Center in Atlanta, Georgia, starting on Monday, 7 June, and lasting through Tuesday, 8 June 2021. Remote participants will attend online using an inter-

active virtual platform. Note that the RFIC is committed to participant safety, and potential modifications to these plans may be made as the public health situation evolves. More discussion on the hybrid event and how it compares to previous years is found at the end of this article, but we first want to highlight our exciting technical program.

As the premier forum for RFICs, the RFIC Symposium publishes papers describing the latest breakthroughs in all areas related to RF, mm-wave, and wireless ICs. This year's technical

Time Slot	Sunday 6 June	Monday 7 June		Tuesday 8 June	Wednesday 9 June		
Morning		Registration	RFIC Workshops	Registration	RFIC Technical Sessions	Registration	
Lunch					RFIC Panel		
Afternoon	Registration		RFIC Workshops		RFIC Technical Sessions		*Connected Future Summit
Evening			Joint RFIC and IMS Plenary Session				

\*The Connected Future Summit is a separate conference with 5G-focused technical talks.

**Figure 1.** The RFIC 2021 program at a glance.

papers will be presented through parallel sessions on Tuesday for in-person attendees. These will also be presented live at the virtual event for remote attendees. Our sessions will include topics spanning from highly integrated wireless systems-on-chip and low-power radios to detailed publications on new power amplifiers (PAs), voltage-controlled oscillators, and front-end circuitry. As the mm-wave IC market heats up, more mm-wave content is increasingly being published at the RFIC Symposium. For example, in 2020, more than half of our papers were related to mm-wave and 5G technologies. We expect that trend to continue for 2021, with many papers in the areas of mm-wave phased arrays, transceivers, radars, and imagers and exciting developments in ICs operating above 100 GHz.

Continuing in 2021, the RFIC Symposium has an expanded scope that includes RF systems and devices related to novel applications of RFICs at the systems level. This reflects the fact that more research challenges are being addressed at higher levels through new architectures, usage models, calibration techniques, and integration approaches. We think this systems initiative will bring together researchers and practicing engineers at the

boundary of RFICs and systems to the benefit of all. Additionally, in 2021, we continue with a wider range of topics including emerging technologies in RF, such as quantum computing, optoelectronics, microelectromechanical systems, hardware security, and machine learning (Figure 1).

The 2021 RFIC Symposium will feature a rich educational and workshop program, with both in-person and virtual workshops and one virtual Technical Lecture. The RFIC workshops were carried over from our 2020 plans and cover diverse, advanced topics in RFIC technology. The 12 virtual RFIC-focused workshops cover the following topics:

- mm-wave phased-array transceiver design: from basics to advancements
- 5G radio circuits and systems exploiting multiple-input/multiple-output and digital beamforming
- 100–300-GHz mm-wave wireless for 0.1–1-Tb/s networks
- CMOS mm-wave imaging radars: state of the art and a peek into the future
- highly linear and linearized PAs for broadband and mm-wave communications
- fully integrated silicon versus hybrid RF front-end systems for 5G mm-wave, highly efficient PAs



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- sub-6-GHz advanced transmitter architectures and PA-linearization techniques
- low-power radios and wireless technologies for indoor positioning and localization
- recent advances in frequency-generation techniques for sub-6 GHz, mm-wave, and beyond
- coherent optical communications for cloud data centers, metro, and submarine networks
- cryogenic electronics for quantum computing and beyond: applications, devices, and circuits
- satellite communication: from radiation-hard devices to low-Earth orbit/geosynchronous-Earth orbit CubeSat systems.

Also, RFIC 2021 will feature an excellent one-and-a-half-hour short course, which we are calling a “technical lecture”; it will be delivered live during the virtual event and will also be available on demand afterward. Prof. Peter Asbeck from the University of California, San Diego, and a member of the U.S. National Academy of Engineers, will teach “Fundamentals of PA Design.” This lecture should be instructive for newcomers and practicing designers alike.

This year, the RFIC plenary session will be held jointly with the IMS plenary on Monday night. Additionally, the virtual RFIC Symposium will have a separate live-streamed plenary. The in-person and virtual plenaries will feature different RFIC and IMS speakers.

- Dr. Ahmad Bahai (Figure 2), chief technology officer and senior vice president at Texas Instruments, will share his perspective and vision in the presentation “New Horizons for Millimeter-Wave Sensing.” Dr. Bahai will provide an overview of the rapidly evolving mm-wave sensor market, including radar, imagers, and spectroscopies, along with R&D opportunities at the device, packaging, system, and algorithm levels.



**Figure 2.** Dr. Ahmad Bahai.

- Dr. Bram Nauta (Figure 3), distinguished professor at the University of Twente, The Netherlands, will present a forward-looking talk with “Transceiver Roadmap for 2035 and Beyond.” In this presentation, Dr. Nauta will discuss what the RF transceiver may look like 15 years from now and what research is needed to get us there. Dr. Bahai will present the in-person RFIC plenary talk, and Prof. Nauta will present the virtual RFIC plenary talk.

Immediately following the plenary session is the joint RFIC and IMS welcome reception, an engaging and lively social event supported by the corporate sponsors. We eagerly look forward to seeing so



**Figure 3.** Dr. Bram Nauta.

many of our colleagues at the 2021 RFIC reception.

We will have two lunchtime panels at RFIC 2021. At the virtual event, panelists will discuss the safety of automotive radars and artificial intelligence (AI) during the session “Automotive Radars and AI: Is My Car Really Safe?” This will provide an interesting debate related to the roles of RF circuits and AI in enabling autonomous driving. At the in-person event, panelists will debate the topic of RFIC start-ups during the session “Are RFIC Start-Ups a Dead Horse in the Era of Software Unicorns?” to help both students and aspiring entrepreneurs understand the evolving RF start-up landscape in today’s economy.

RFIC 2021 and Microwave Week offer many educational and professional development opportunities for students, all delivered at an exceptional value. First, students have the opportunity to purchase the student superpass, allowing them to experience every activity during Microwave Week, including a workshop, all three conferences [RFIC, the IEEE Microwave Theory and Techniques Society (MTT-S) International Microwave Symposium (IMS), and the ARFTG Conference], the Connected Future forum, a technical lecture, and much more, all at a deeply discounted price for IEEE Members. Second, RFIC will offer students National Science Foundation-sponsored registration/travel awards, for which all interested students from U.S.-based universities are encouraged to apply. Selected awardees can use the stipend to offset their RFIC conference expenses, with more details and requirements for applications available on the RFIC website. Third, RFIC will once again conduct a contest to select the top student papers from the symposium. These top papers will be featured at our Sunday Symposium Showcase. Fourth, all RFIC students will have the opportunity to apply for and participate in the Three Minute Thesis Competition, held virtually this year. Fourth, as part of the IMS, students will have the opportunity to participate in design competitions

and RF Boot Camp. Lastly, the MTT-S offers the Ph.D. Student Sponsorship initiative, which encourages new students to become engaged with Microwave Week and provides learning, networking, and volunteer experiences along with complimentary registration and accommodations to qualified and selected students.

Finally, readers may wonder what is different with regard to a hybrid RFIC Symposium compared to a normal in-person RFIC or last year's fully virtual RFIC. *Hybrid* means we will have both a live and a virtual event, accommodating both in-person and remote attendees. Because so many of the plans related to both the live and virtual events are evolving at the time of this article's writing, we refer readers to the RFIC website at <http://rfic-ieee.org> for the latest details; however, a summary of our plans follows.

- First, authors have the opportunity to present their work either in person or virtually. This will provide our authors the greatest flexibility and means that there will be a combination of live and prerecorded talks for those attending in person. For those attending the virtual event, all talks will be live-streamed by our speakers using the virtual platform.
- Second, the virtual symposium will start two weeks after the live event and will be accessible by both in-person and remote attendees. This means that in-person attendees can go back and watch the presentations they may have missed or would like to review for additional learning, which should be a great way to maximize the benefits of attending the conference.
- Third, our plans are to allow access to all virtual content asynchronously over an approximate one-month duration. This on-demand access enables attendees to intersperse their RFIC participation with work and home life.
- Finally, our goal is to maximize the virtual content available for our remote attendees. We will ensure that workshops, panels, a live-streamed plenary, the technical lecture, and all of our paper presentations are available virtually.

On behalf of the RFIC Steering and Executive Committees, we welcome you to join us at the hybrid 2021 RFIC Symposium, either in person in Atlanta, Georgia, or online, in our virtual platform. Please visit the RFIC 2021 website (<http://rfic-ieee.org/>) for more details and updates.



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