ICT chaired by Anne-Johan Annema/Hans Hilgenkamp – room 7

14.15-14.50	*Features and Technology Challenges in next generation BLE Systems* Chris Smit (Dialog Semiconductor)
14.55-15.10	*Towards robust, high performance and efficient RF-power amplifiers* Maikel Huiskamp (ICD)
15.15-15.30	*Field-effect transistors with a high-K channel material* Sander Smink (ICE/NE)
15.35-15.50	*Dopant Network Processing Units: A New Hardware Paradigm for Artificial Neural Networks* Hans-Christian Ruiz Euler (NE)

Features and Technology Challenges in next generation BLE Systems, Chris Smit (Dialog Semiconductor)
This talk starts with an short introduction into novel features in next generation bluetooth low energy systems, that are expected form the core of IoT systems in the near future. This includes features such as angle of arrival (AoA), angle of departure (AoD) and time of flight (ToF) that are introduced nowadays in beam steering, and localizing. The talk reviews some current technical details and challenges and gives an outlook to more longterm research and development challenges for future advanced wireless communication systems.

Towards robust, high performance and efficient RF-power amplifiers, Maikel Huiskamp (ICD)
The introduction of the Internet of Things (IoT) resulted in a huge increase in the number of battery-powered wireless transceivers. In these transceivers, the Radio Frequency Power Amplifier (RF-PA) is one of the most power-hungry blocks and as a consequence it significantly limits the duration the transceivers can operate on a single battery charge. Therefore, to enable wireless sensors that can operate autonomously for a long period of time requires efficient RF-PAs.
Switched mode PAs such as the Class-E RF-PAs can achieve high efficiency (ideally 100%), increasing the time the sensor can operate from a single battery charge. However, Class-E PAs are inherently highly sensitive to Process-Voltage-Temperature and Environment (PVT-E) spread, that can significantly degrade the performance of the Class-E PA and can even result in full breakdown of the RF-PA. In this talk, we discuss some of our advances made in the design of PVT-E robust, high performance and efficient Class-E RF-PAs.

Field-effect transistors with a high-K channel material, Sander Smink (ICE/NE)
In the search to extend the functionality of electronic devices, the rich physics exhibited by complex-oxide interfaces has sparked intense research effort over the past decades. This class of advanced materials differs from 'classical' semiconductors in many physical aspects, among which the dielectric properties are key to understand device operation. Here, we explore field-effect transistors based on the $LaAlO_3$-$SrTiO_3$ interface, in which the channel material ($SrTiO_3$) has a room-temperature dielectric constant of over 300: a factor 25 larger than that of silicon.

The implications of this high dielectric constant are manifold. The most appealing is that it enables efficient charge modulation because the gate-source capacitance is practically insensitive to the out-of-plane distribution charges in the channel. This allows the modulation of ~3.2 x 1013 cm-2 of charge within a gate-voltage window of ±1 V, corresponding to a sub-nm equivalent oxide thickness. On the other hand, our results show that there is a large 'stray' gate-source capacitance in absence of a conducting channel, and that short channel effects emerge already in devices with channel lengths of several micrometres.

Dopant Network Processing Units: A New Hardware Paradigm for Artificial Neural Networks, Hans-Christian Ruiz Euler (NE)
The computational demand of state-of-the-art artificial neural networks (ANNs) translates into increasing energy and hardware demands. The present fast deployment of ANN technology is therefore unsustainable with modern computational devices. Hence, new hardware paradigms must be developed to address the challenges of the ANN revolution. We propose the Dopant Network Processing Unit (DNPU), a disordered nanoscale device that solves simple, yet non-linear, binary classification tasks in an energy-efficient way. Using the DNPU as a powerful computational node, we can create scalable computational systems that emulate artificial neural networks. We demonstrate the computational capacity of a single node and explore different architectures to increase the computational power of this technology.