MTT Society SCV Chapter

Date: Wednesday November 14th 2018

Time: 6:00-8:00 pm (6:00 - 6:30 social, 6:30 - 7:30 talk) snacks will be served

Location: National Instruments, 4600 Patrick Henry Dr., Santa Clara CA 95054

Title: Role of Si-Based Technology for 5G Frontend

Speaker: Sushil Kumar, Director of RF Design, IDT San Jose

Role of Si-Based Technology for 5G Frontend

Sushil Kumar, Director of RF Design, IDT San Jose

'5G' is next generational step for the wireless industry after 4G and is envisioned as virtualized, software-defined, next-generation wireless networks that connect many more people, devices and things at even greater speeds and quality of connection, over much wider areas. Currently 5G trials are being implemented in sub-6GHz and in near future will likely operate at 28 GHz (United States) and 39 GHz (Europe). Over time, 5G could involve other spectrum, such as 50GHz, 60GHz, 71-86 GHz and a few other bands. 5G **mobile systems** and **base stations** require new and faster application processors, basebands and for RF chips it would use Beam Forming & steering (phased-array antennas). Beam forming transceivers can be used in many applications like multi-Gbps communications, industrial and automotive radars and both active and passive mmW imaging systems.

Worldwide TDD/FDD based mobile and Base station **IC chipset** are being researched and one of the popular TDD 5G-mmW based **front-end** chipset for smartphone being developed uses 16-antenna elements. Each antenna element has separate **front-end** consisting of highly linear, low loss SPDT Switch, Phase Shifter (4-6 bit) in common path, PAs and LNA in each leg of SPDT switch to separate Tx-Rx path.

Use of right technology process for beam-steering front-end chipset is being debated and traditional wisdom tilts towards GaAs as state-of-the-art microwave systems are generally implemented with GaAs components, but Si based processes (BiCMOS/CMOS) are overcoming the barriers of high frequency operation to rival GaAs in many of the signal path functions including SPDT, Phase shifter, LNA and even mmW handset PA. Output power requirement in beam forming network for PA is moderate for per antenna element (ex. 16-18dBm/element @28GHz). When multiple PA are used in beam-forming network combined with high directivity antenna, total combined Pout is much higher than single PA and meets system spec.

Si (BiCMOS/CMOS) processes also enable a high level of integration required for these beamforming systems encompassing much of the signal chain as well as auxiliary control functions.

CMOS process like 45RFSOI/22FD-SOI from Si-foundries are highly attractive for chip-set designers as it can leverage the collective benefits of RF-centric features, device stacking, an optimized BEOL and a high-resistivity substrate to develop differentiated products—across a range of 5G base station, backhaul, satellite and smartphone FEM

applications. 45RFSOI process has high ft /fmax (305/380GHz) and its limitation of low breakdown voltage is overcome by design method of stacking multiple FET devices.
Other technology that could draw a lot of attention in future is GaN-on-Si. GaN-on-SiC has outstanding performance but cost prohibitive, unless absolutely required it does not find much application for mass deployment at this moment. It could find major use in mmW Base station along with GaAs.
Overall SiGe BiCMOS and SOI based CMOS add a compelling value proposition due to low cost, mutli-function circuit integration on one die and in one process. Si-based chips could be assembled with GaAs/GaN chips in MCM to get best performing system and can do 60-80% multifunction RF signal processing of a system, this providing a low cost high performance solution for any large scale deployment system.

Bio;

Sushil Kumar is currently working as a Director, RF Design at IDT, San Jose. Prior to IDT he was Director at Global Foundries working in RF & Analog Pathfinding team on 5G Si-Based MMIC development and supporting architecture definition team for 5G. He also served as Sr. Director at GigPeak (IDT), San Jose, CA responsible for Wireless IC product development and at RFMD (Qorvo now) he was Director of Engineering managing GaAs and GaN MMIC development team. Other organizations where Sushil Kumar worked in his 30 years career are Hewlett-Packard, Agilent and Avago in USA and Defense R&D Organization (India) mostly developing MMICs for various applications in the frequency range DC-100GHz. Sushil Kumar holds MS in Electronics Science form University of Delhi, India