THE IMPORTANCE OF ANALOG/ANALOG VLSI IN THE WORLD OF DIGITAL AND BIG-DATA

Presented by: Rezaul Hasan, Ph.D. (UCLA), Director

Center for Research in Analog and VLSI microsystem dEsign (CRAVE), School of Engineering and Advanced Technology, Massey University Auckland 0632, New Zealand
• The wider semiconductor industry is worth around US$350 Billion and is growing at around 3% annually
• The analog IC part is worth around US$70 Billion and growing at 7% annually
• Some market drivers for Analog ICs include Automotive, wireless and wireline communication devices, Handset /cellphone etc.
• In SKA analog is required in signal reception (cryo-LNA and conversion (A-to-D), SERDES (clock recovery) etc.
Analog computing for Deep machine learning Engines

* Neuromorphic (like neural interaction in the brain through action potential) and cytomorphic (like molecular interaction in the cell/ DNA-Protein machinery) computing in Analog VLSI

* Mobile applications (sensing, data-conversion, actuation)

* Internet of things (battery-less RF)

* Next-gen wireless/wireline (low-power RF, optical)

* Autonomous entities (sensing and actuation)
Without Analog IC

(a) Device will not turn-on (power supply and regulation)
(b) Display will not work (display driver, buffer)
(c) Camera won’t work (CMOS pixel capture using photodiode)
(d) S –pen won’t work (pressure sensor)
(e) many other sought after functions won’t work (even if the above weren’t big enough problems)
How does analog handshake with the Digital World?
A MIXED SIGNAL SOC WITH ANALOG SECTIONS
COMPUTING FOR SKA
ANALOG CIRCUITS SCALING

Graph showing the relationship between technology feature size and transistor size for different types of circuits:
- Power/HV
- Analog
- Digital

The graph indicates that as technology feature size decreases, the transistor size decreases for all types of circuits, with analog circuits having a steeper decrease compared to digital circuits.
ANALOG/RF COMPONENTS IN A DIGITAL CMOS PROCESS

(1) THICK-OXIDE TRANSISTORS

(2) THICK METAL LAYERS FOR INDUCTORS

(3) COPPER METAL LAYERS

(4) ISOLATION LAYERS BETWEEN ANALOG AND DIGITAL FOR NOISE IMMUNITY (TRENCH ISOLATION)

(5) SEPARATE I/O AND VDD/GND PADS FOR ANALOG AND DIGITAL

(6) SECOND POLY LAYER FOR NON-VOLATILE MEMORY

(7) SPECIAL P-CELLS FOR CAPACITORS AND INDUCTORS
ASIC for TDBF

- Analog design using 28nm GF HPP
- 15 G/s SERDES
- Power: 20W/chip (@ 1.2 GHz)
- size: 11mm x 11mm
- cost: $230 @ 10K quantity
- Package: Flip-chip BGA
COMPUTING FOR SKA
ANALOG IS EVERY WHERE
Analog IC is a Growth Market

Analog is Everywhere!

Analog - SoC’s are here....
Thank You!