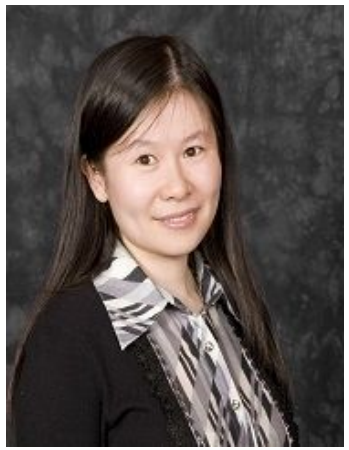
Overview of the MICS Group

- **Four faculty and ~30 graduate students**

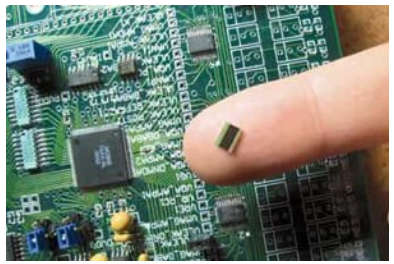
Dong Ha
(Director)
Analog & RF ICs

Energy Harvesting, High Temperature RF Circuits



Yang (Cindy) Yi
(Associate Director)
High Performance Computing

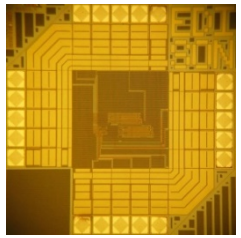
Neuromorphic Computing

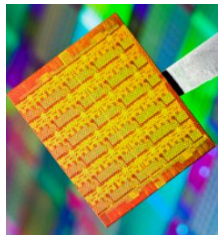


Paul Ampadu

Multicore/Networks-on -Chip

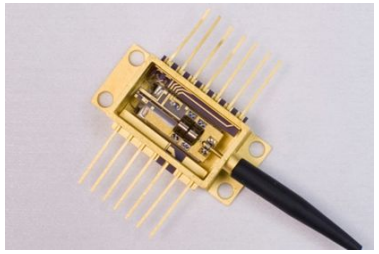
Digital SoCs/NoCs





Luke Lester
Optoelectronics/OEICs, Semiconductor Lasers, Photovoltaics

Optoelectronics



Research Capabilities

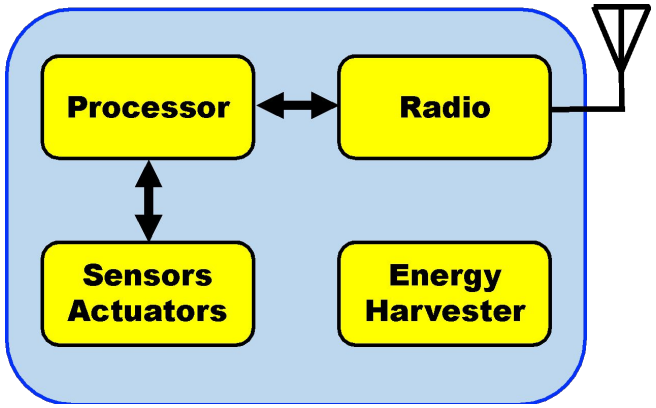
- One of the largest and best equipped measurement lab within ECE Department
- Full suites of CAD tools for digital, analog, and RF ICs, and microsystems
- Foundry fabrication in CMOS, SOI, SiGe, and GaAs

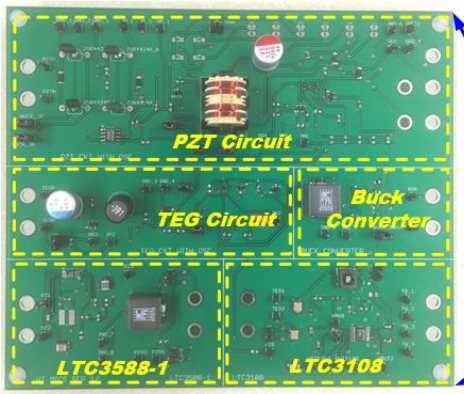
MICS Goal

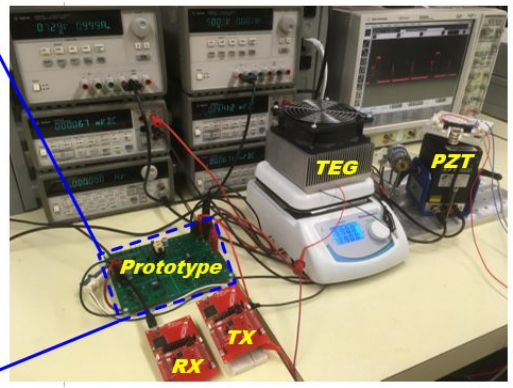
- We will be one of the best research groups in circuit and systems area in the nation by 2022 through
  - Collaboration and team work
  - Quality research and publications
  - Adequate research funding

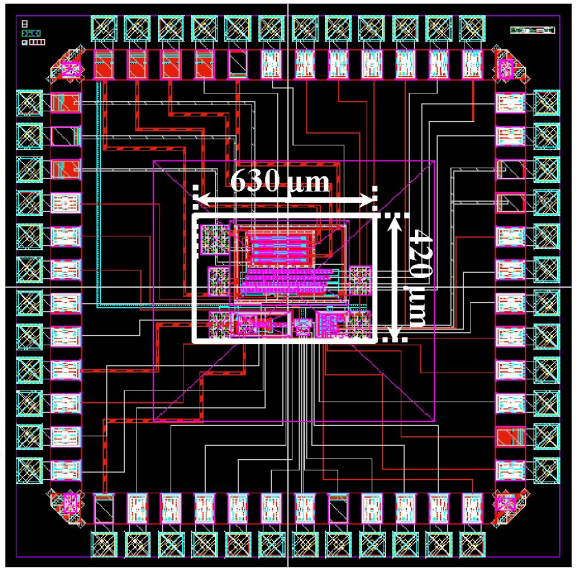
Energy Harvesting

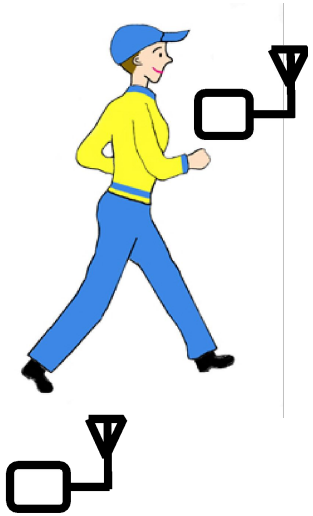
- Energy harvesting ICs and circuit design for various sources such as automobiles, factories, farms, RF signals, and power line cables.
- Focuses on
  - Low power design
  - Wake-up / sleep mode
  - Multiple energy sources







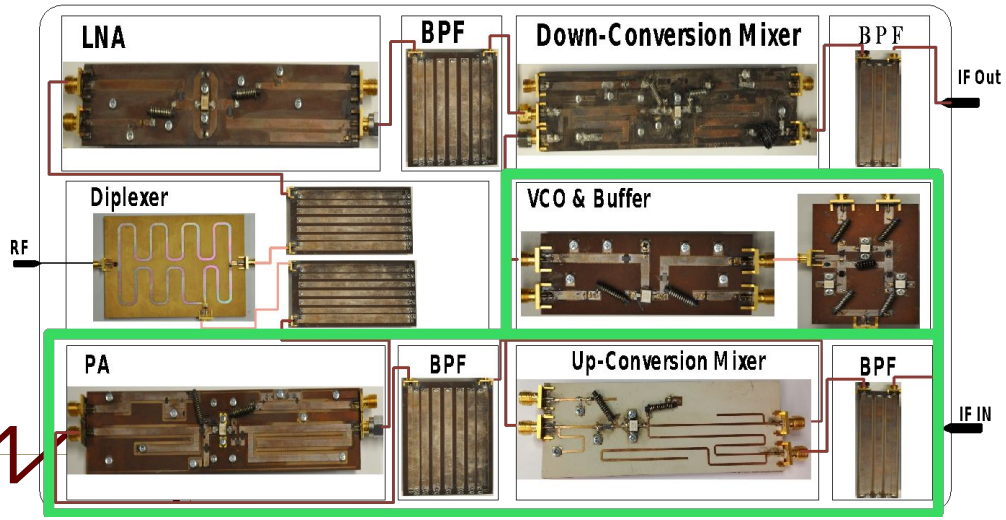


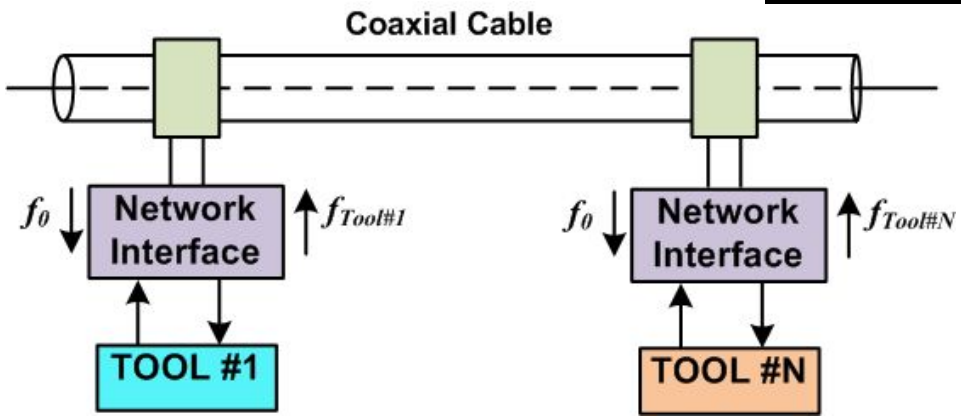


High Temperature RF Circuits

Sailing an uncharted water!

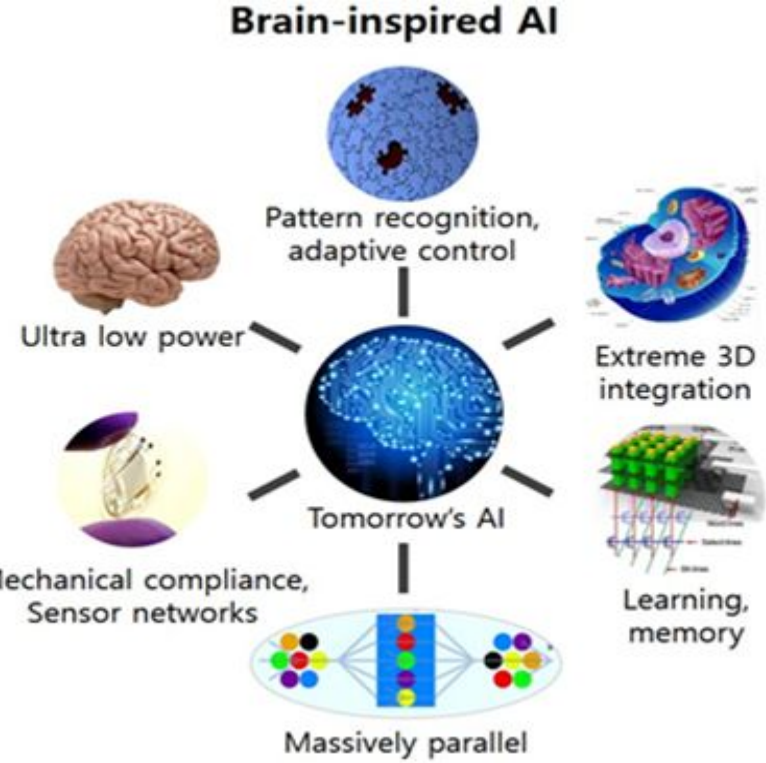
- Applications
  - Oil and gas exploration
  - Car / jet engine monitoring
  - Spacecraft
- RF front developed using GaN device for oil and gas exploration
  - Ambient temperature is 230 °C.
  - Increase the data rate by ten times.
- Second generation under development
  - Use bare FD SOI dies – in collaboration with MIT Lincoln Lab

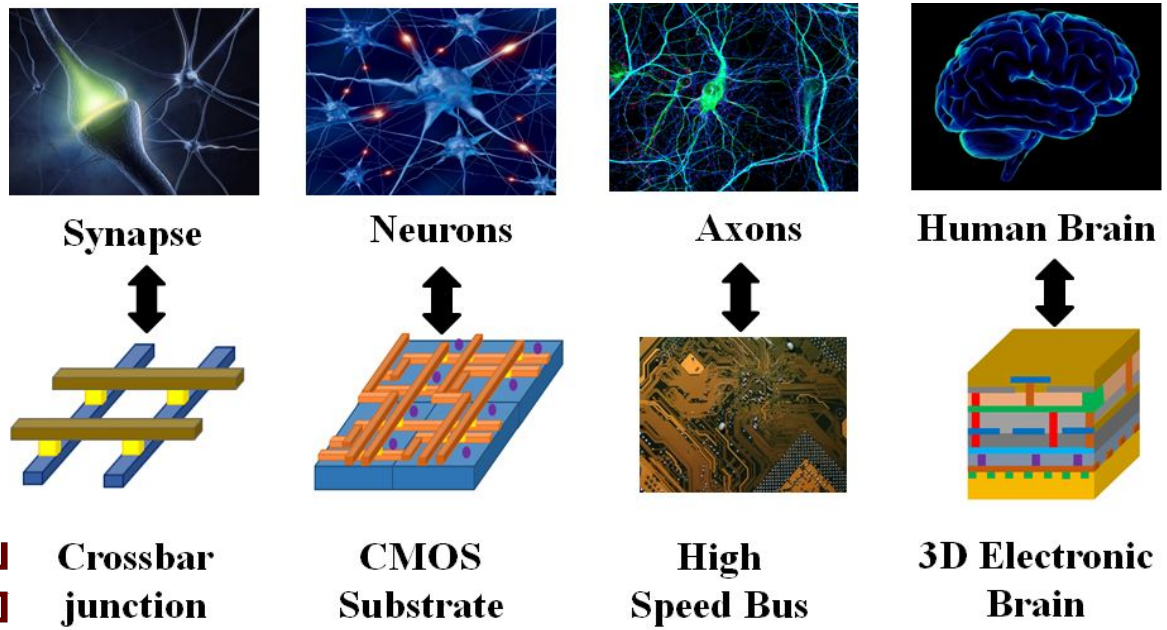


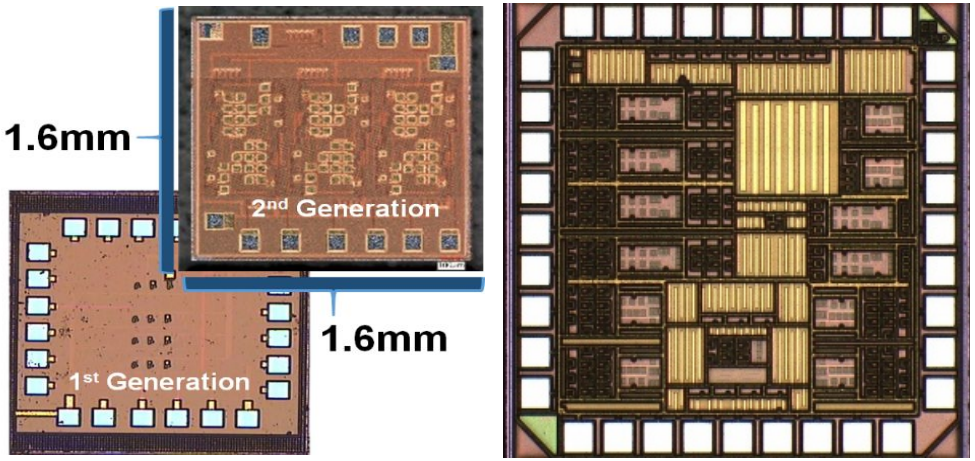


Neuromorphic Computing

- Analog & Mixed Signal IC Design for Brain-Inspired Computing
  - Time-dependent temporal neural encoder and decoder
  - Energy-efficient delayed feedback reservoir system
- Three Dimensional (3D) Neuromorphic Computing (NC) ICs
  - Adaption of through-silicon via as membrane capacitor
  - Monolithic 3D NC with CMOS and memristor

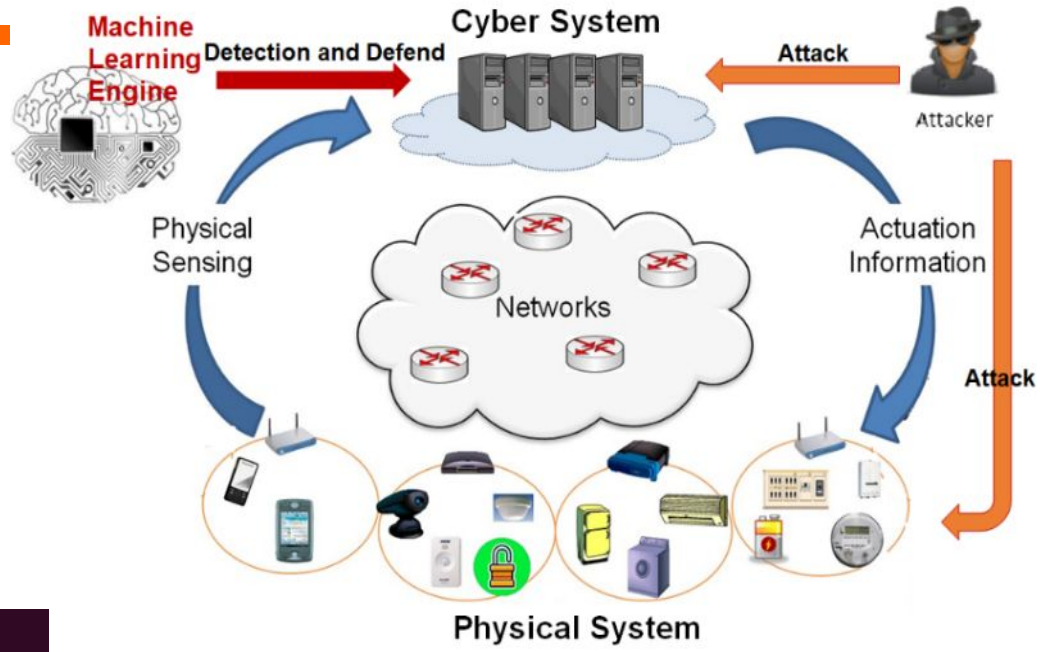


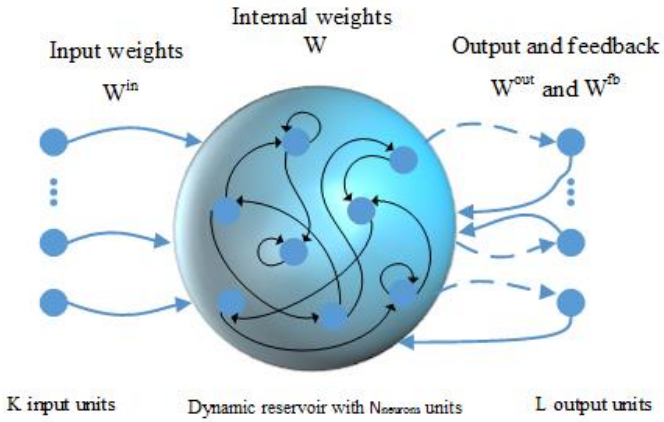




Artificial Intelligence in Big Data Analytics

- Emerging applications of neuromorphic computing and artificial intelligence for communication and security
  - Channel symbol detection scheme through ESN-based reservoir computing
  - DFR-based (DFN+MLP) false data injection detection for smart grids



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3
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[[ 0.01  0.    0.   ...,  0.01  0.    0.  ]]
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(1, 16000)
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NRMSE:  0.000193172559484
output weights:
       mean:  0.00786523119632         max:  0.498260792628

NRMSE:  1.59400860541e-05
output weights:
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NRMSE:  0.00125299719623
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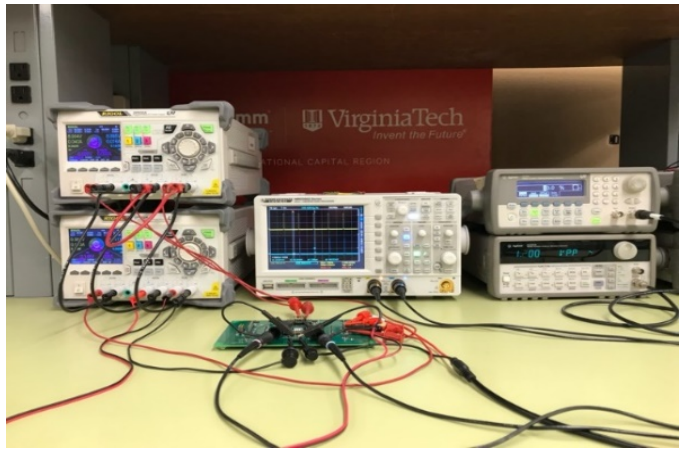
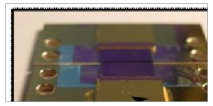
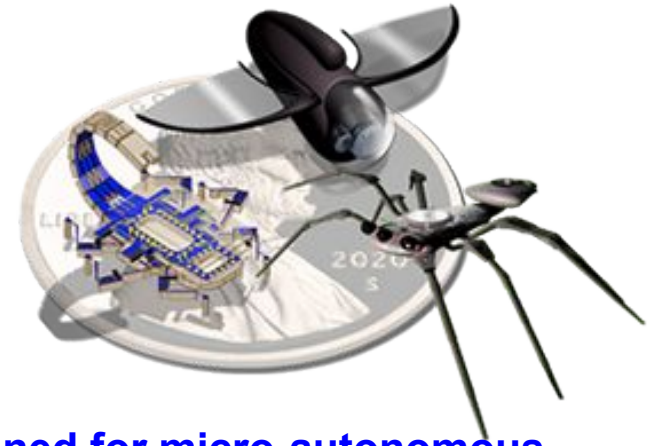


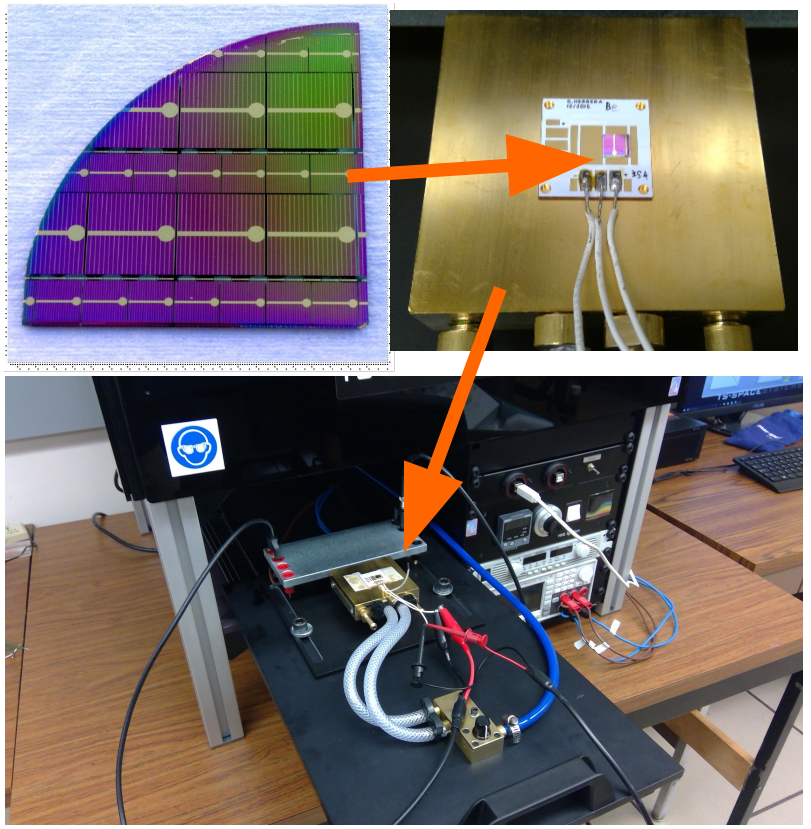
Thermophotovoltaic (TPV) Diodes

- Large area TPV diodes fabricated on GaSb substrate
  - Absorption of mid-IR radiation from a blackbody emitter
  - Potential fuel source for micro-autonomous vehicles
  - Epitaxial & non-epitaxial (implantation) fabrication.
- Characterization of TPV diodes
  - AM0 and AM1.5 spectrum-matched solar IV
  - 1200 K blackbody emission spectrum IV





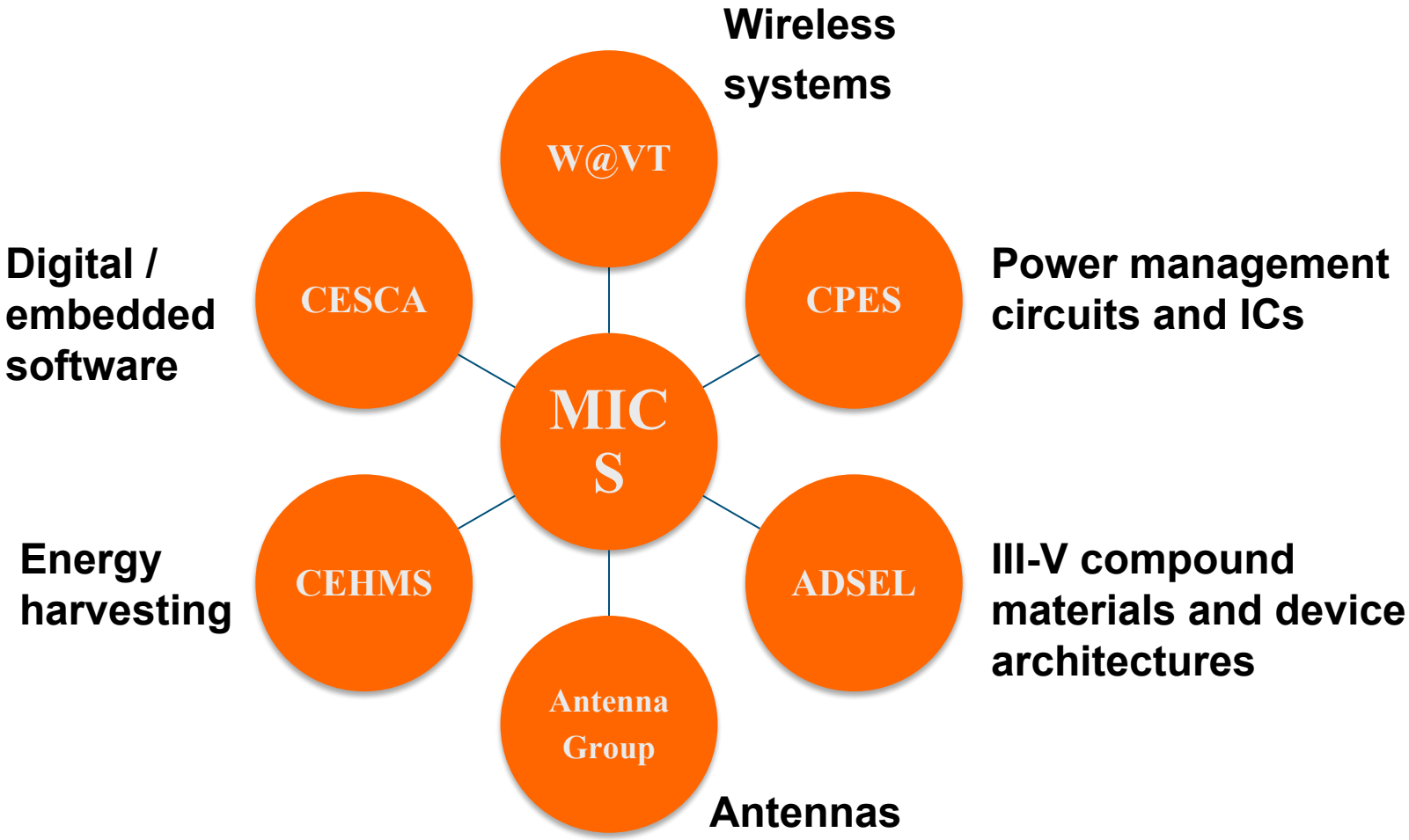
TPV diodes fabricated on GaSb substrate, packaged onto thermally-conductive backplate, for AM0-matched solar spectrum IV



Micro-TPV power system (left) designed for micro-autonomous systems & technologies (right)

Research Collaborations

- Seek inter-/multi-disciplinary research collaborations.



Industry Affiliate Program

- A great avenue to start collaboration with MICS
- Benefits:
  - Can support one graduate student to conduct specific research (principal member only).
  - Obtain non-exclusive, royalty free, internal use only licenses or exclusive royalty bearing commercial licenses.
- Membership: Principal ($40K) and Associate ($10K)

AMCOM COMMUNICATIONS
The RF Power House

BAE SYSTEMS

HUGHES
An EchoStar Company

LOCKHEED MARTIN

NORTHROP GRUMMAN

FSP-Group
POWERLAND

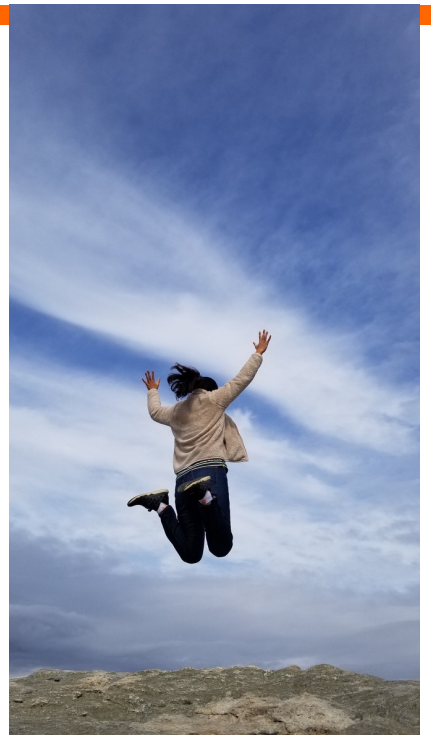
SAMSUNG

MICS

Life Outside of Work

- **Work hard**, but remember there is life outside of work.

MICS is a fun place to work!



Annual Events