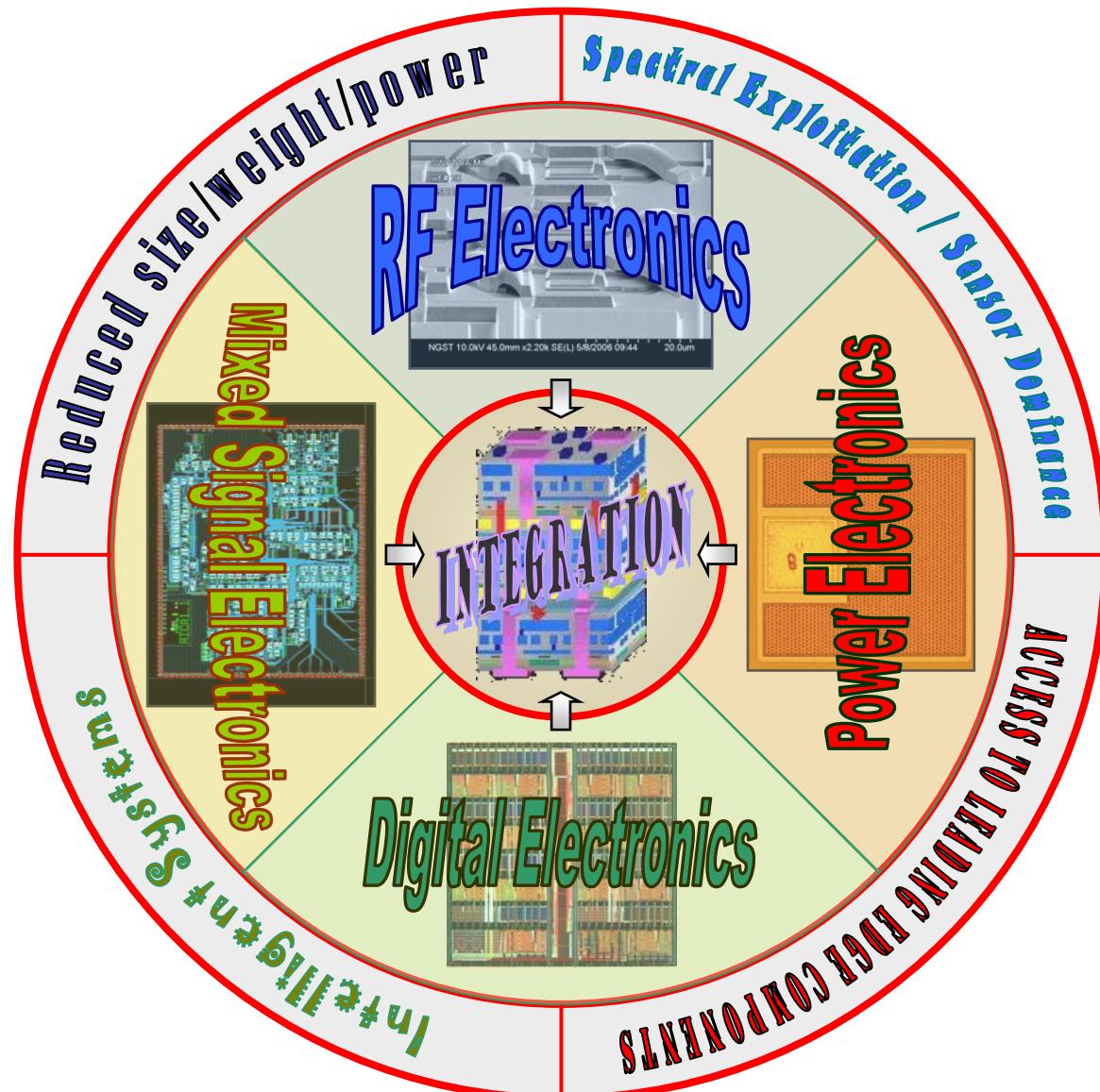
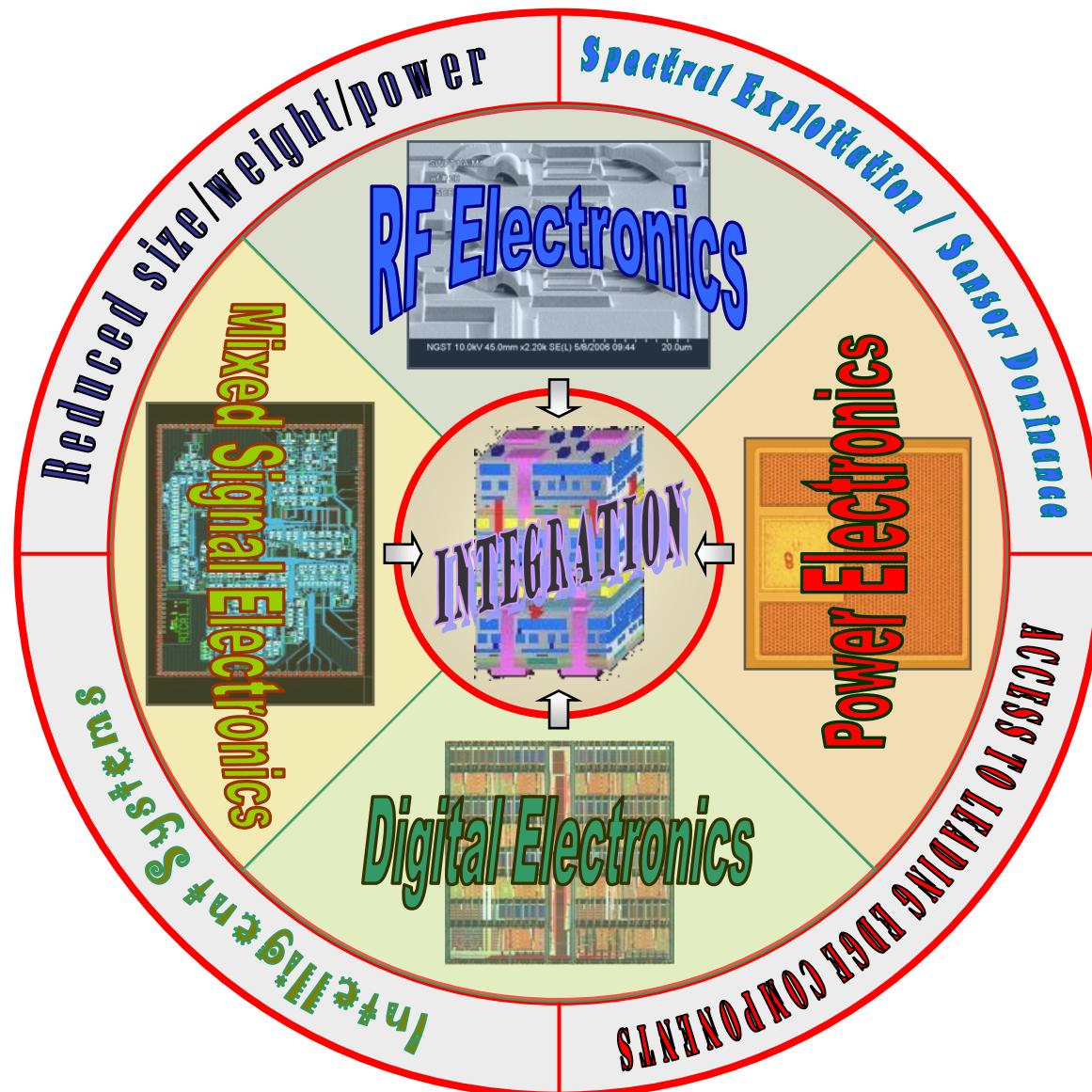


Introduction to MTO Electronics Programs



**Dr. Mark Rosker, PM
Young Faculty Award Workshop
16 Nov 2006**







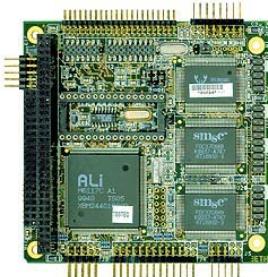
Digital Electronics



Reduced Power

Same performance, fewer batteries

ESE ENERGY STARVED ELECTRONICS



Faster Processing

More FLOPS

ALP ADVANCED LITHOGRAPHY



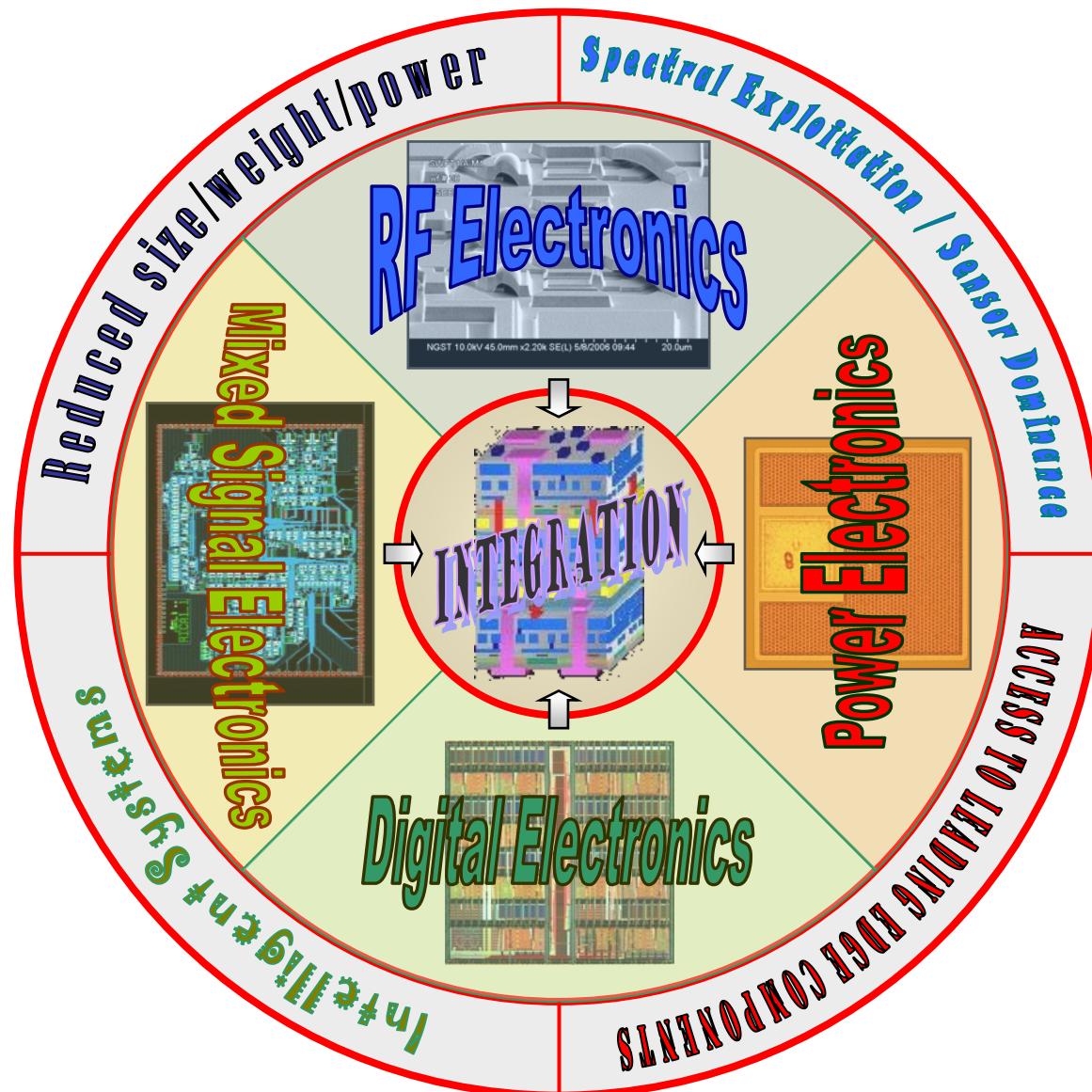
Advanced Architectures
Eliminate the requirement for a system clock



CLASS CLOCKLESS LOGIC



Mixed-Signal Electronics



Walden Chart



100000

10000

1000

100

10

0.01

0.10

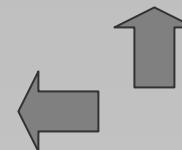
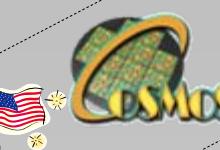
1.00

10.00

100.00

 $2^{\text{ENOB}} * 2 * F_{\text{signal}} (\text{GHz})$

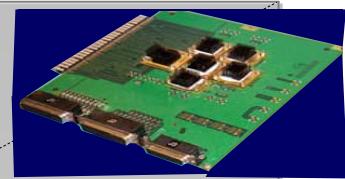
Power (w)

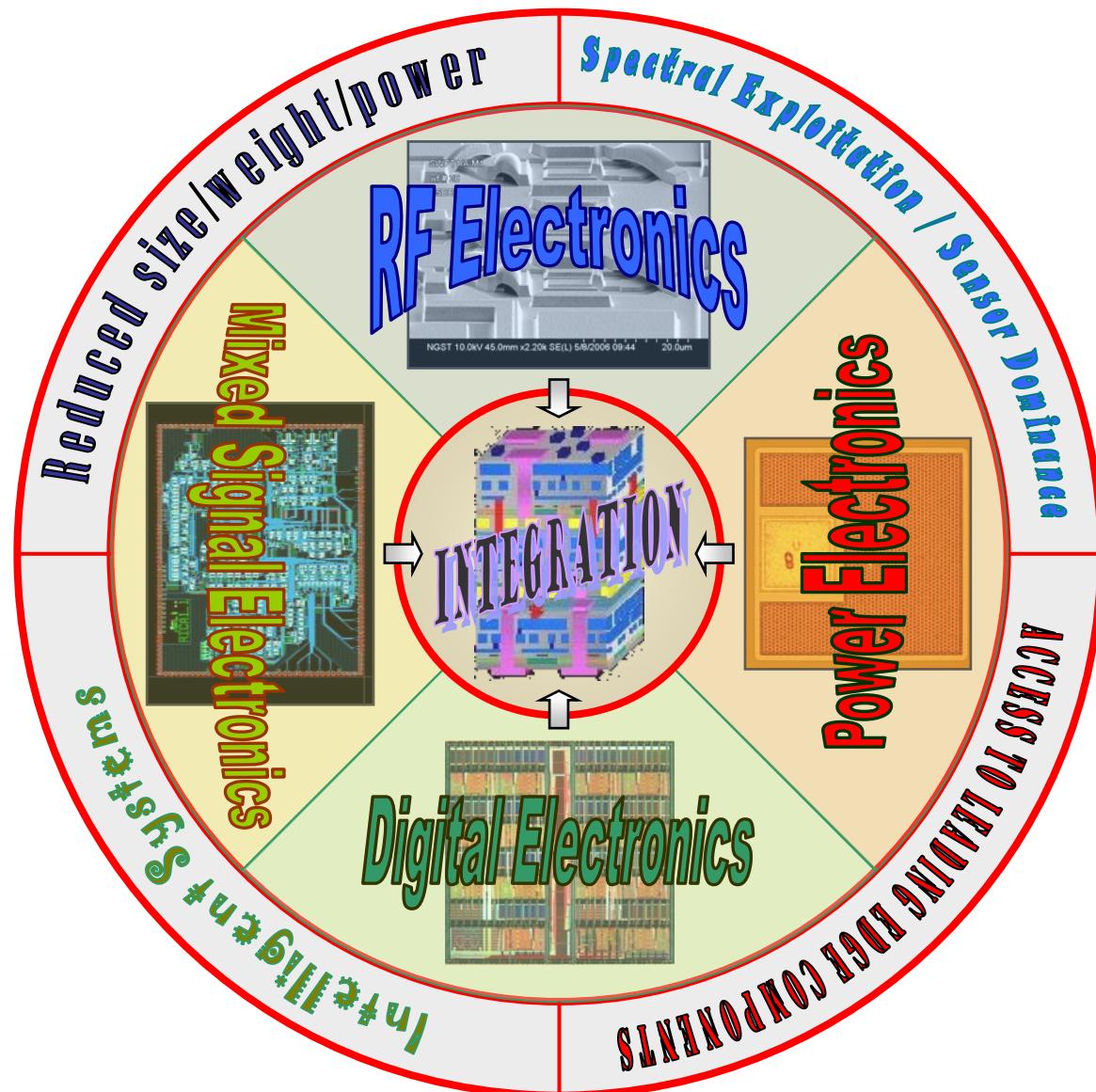
 $1 \times 10^{14} \text{ Hz/W}$
(10 fJ/step) $1 \times 10^{13} \text{ Hz/W}$
(100 fJ/step) $1 \times 10^{12} \text{ Hz/W}$
(1 pJ/step) $1 \times 10^{11} \text{ Hz/W}$
(10 pJ/step)

SOA ADCs

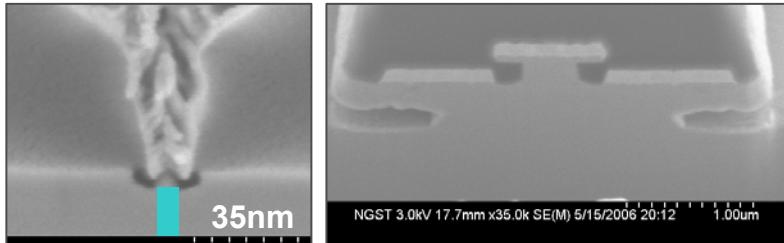
 $1 \times 10^{10} \text{ Hz/W}$
(100 pJ/step) $1 \times 10^9 \text{ Hz/W}$
(1 nJ/step)

ADRT

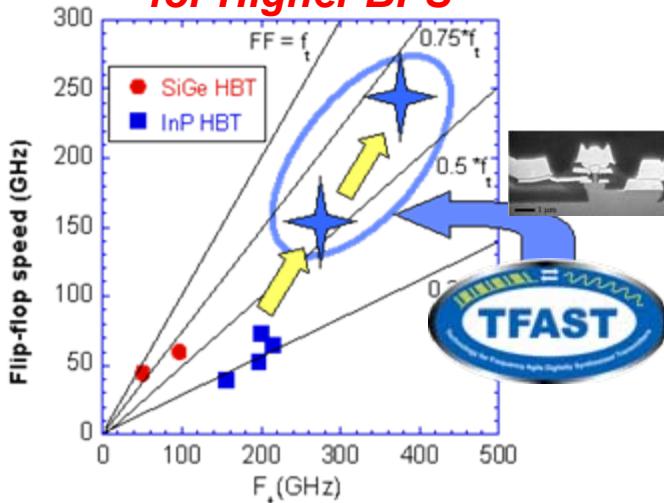




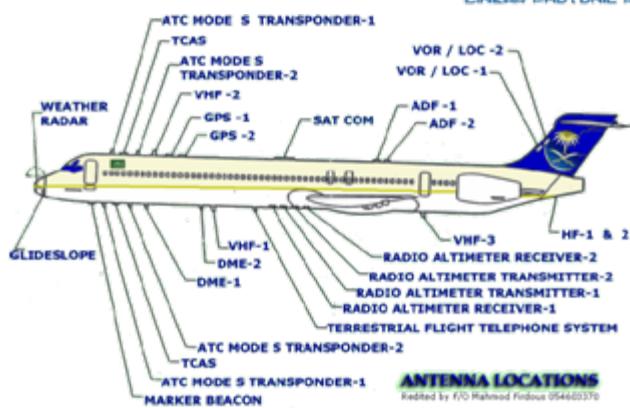
**High Frequency
for Spectral Dominance (GHz → THz)**



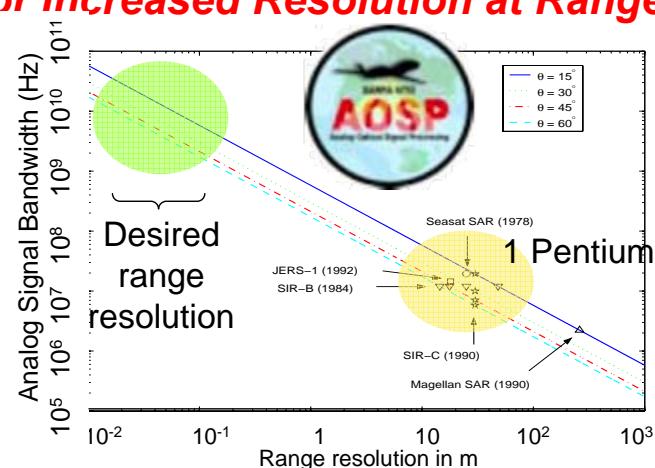
**Higher Throughput
for Higher BPS**



**Higher Dynamic Range
for Improved Signal Processing in Cluttered Environments**

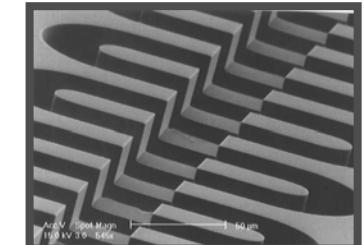
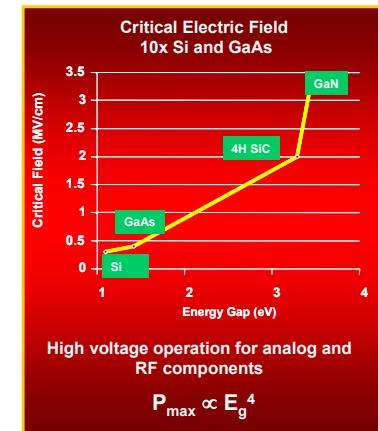
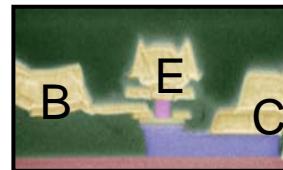
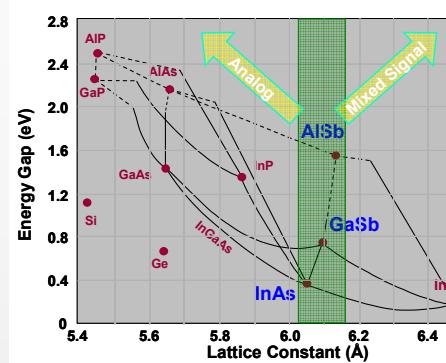
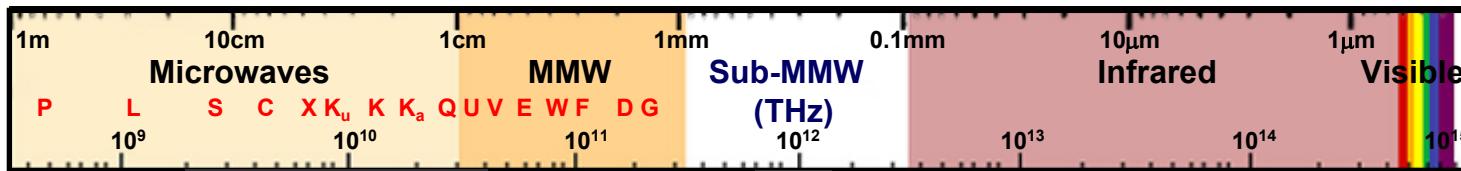


**Higher Bandwidth
for Increased Resolution at Range**

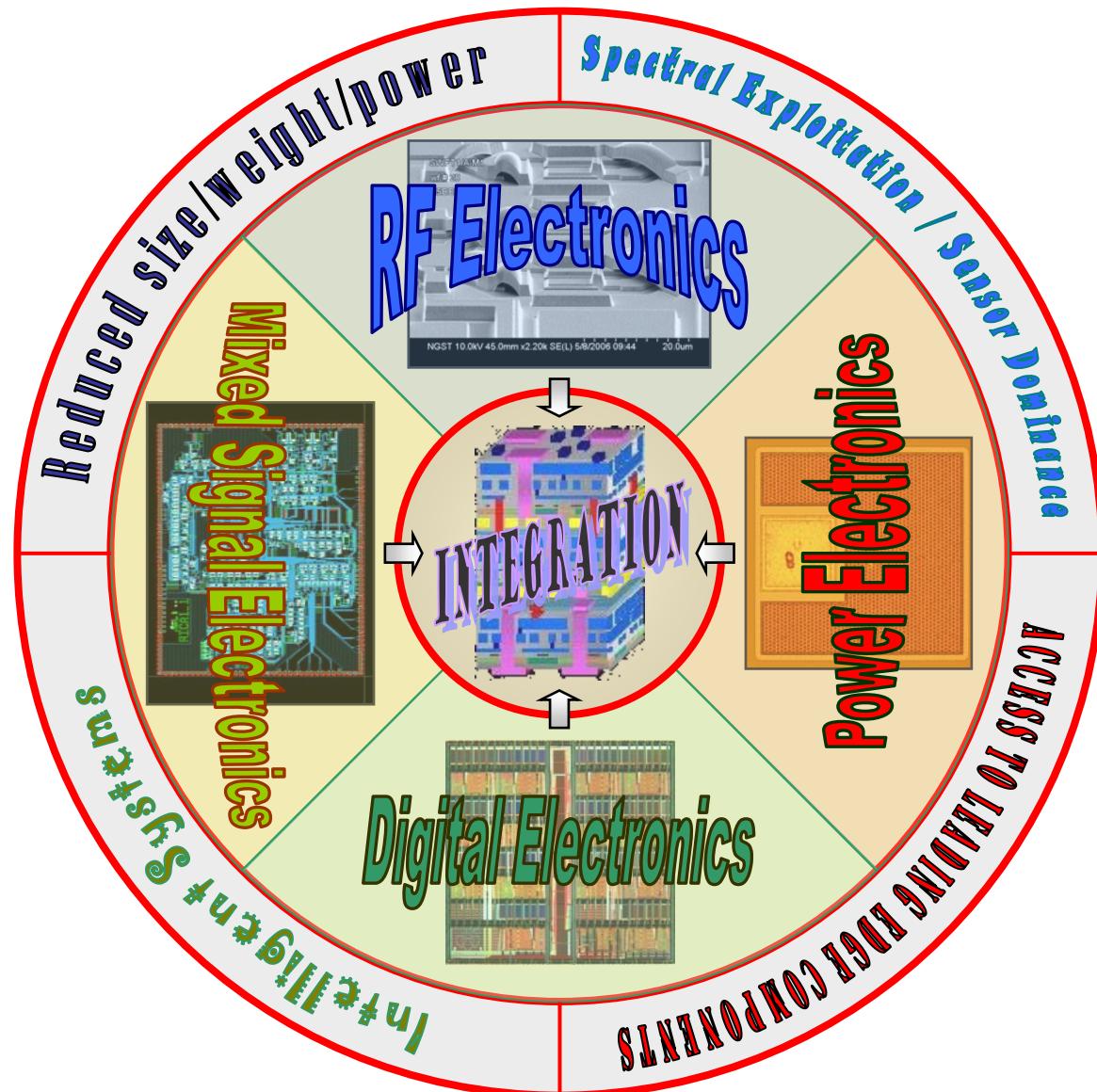




Rosker Programs in RF Electronics



Power Electronics

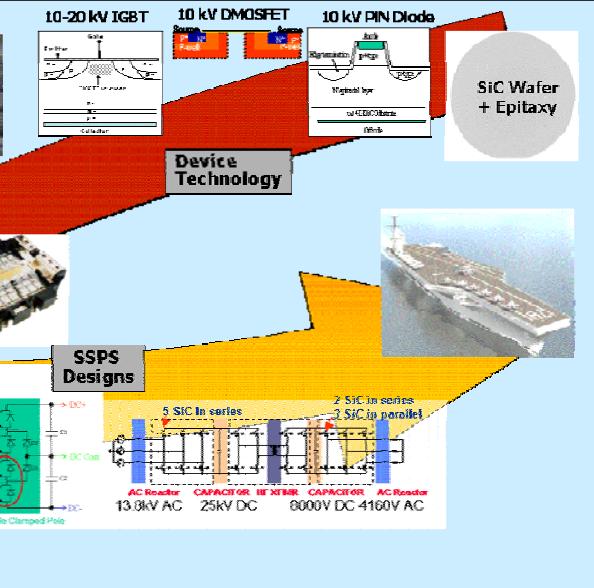




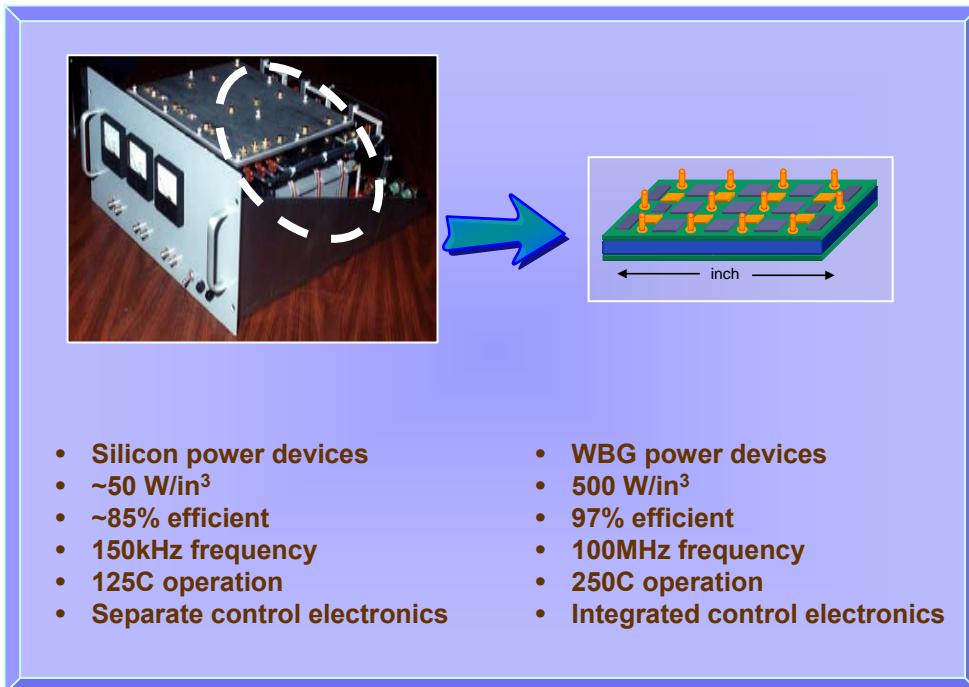
Power Electronics



**High Power Solid-State Devices
for efficient, compact, agile, high
power (MW-class) systems**

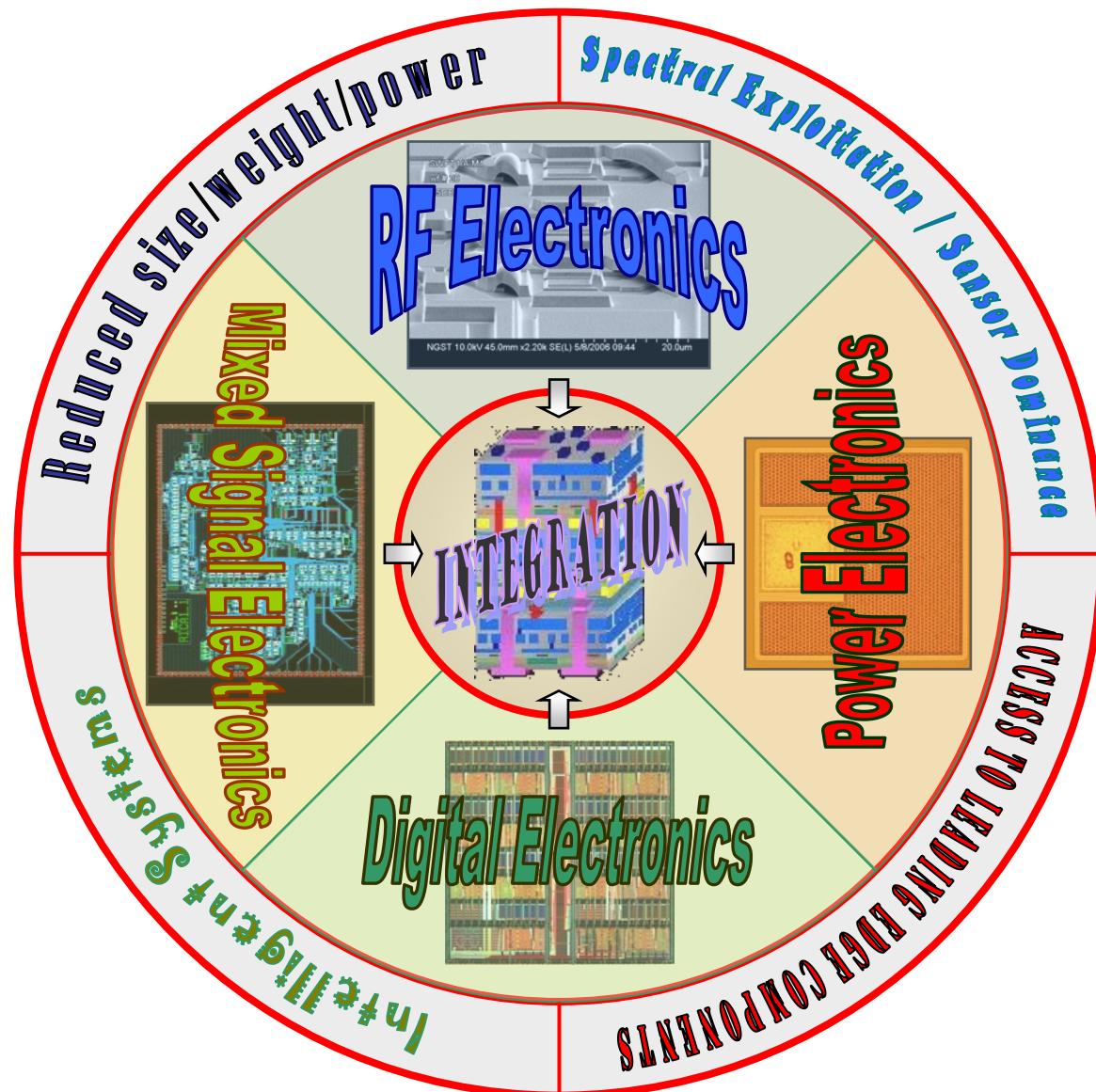


**Integrated Solid-State Converters
for compact, efficient medium-power
(~10kW) subsystems in harsh environments**



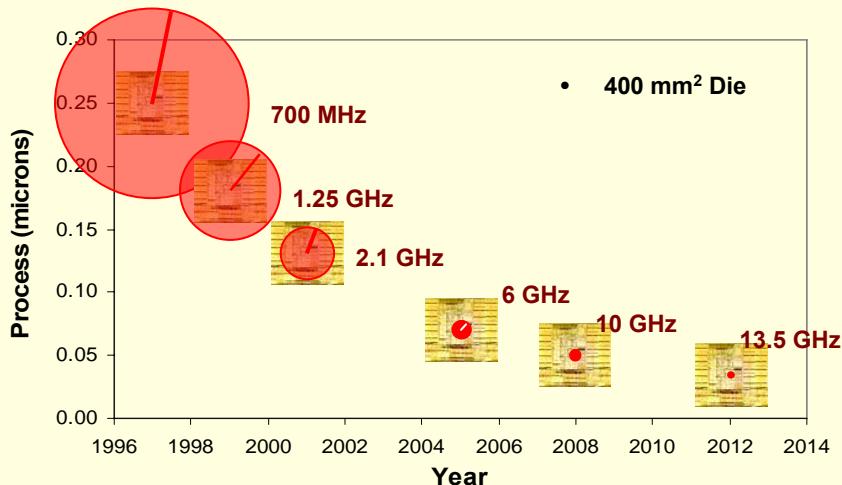
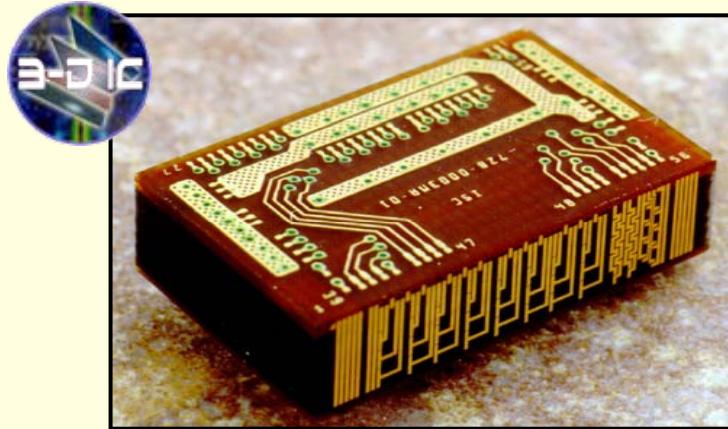


Electronic Integration



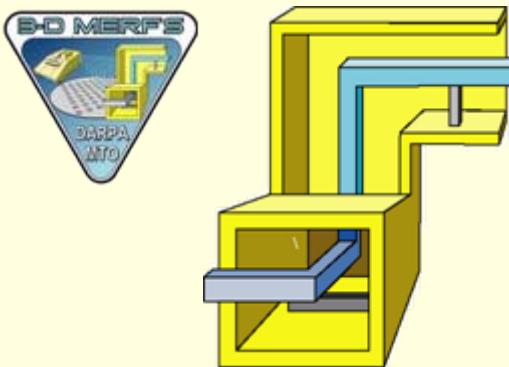
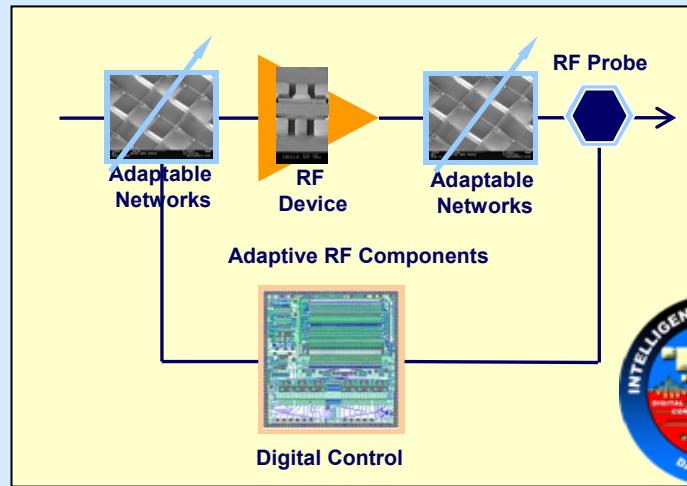
Electronic Integration

3D Integration For reduced interconnect lengths



Clock Synchronization

Heterogeneous Integration of Analog, Digital, and Mixed-Signal For intelligent microsystems



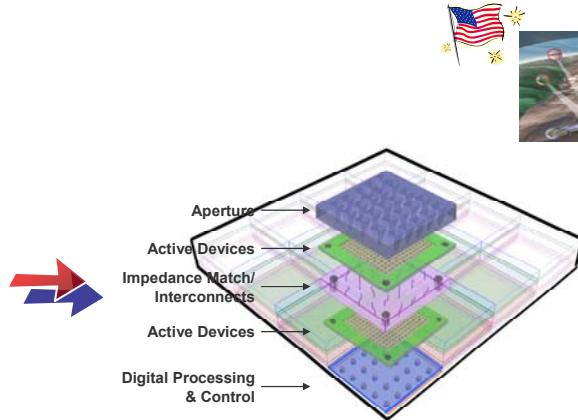


Rosker Programs in Electronic Integration



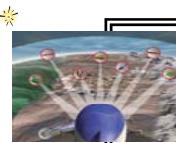
3D MMICs

For smaller, lower cost AESA arrays

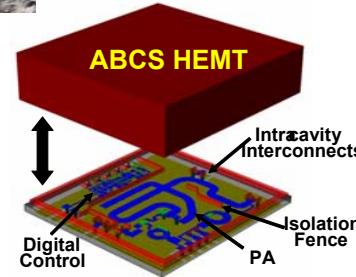


Integrated T/R Modules

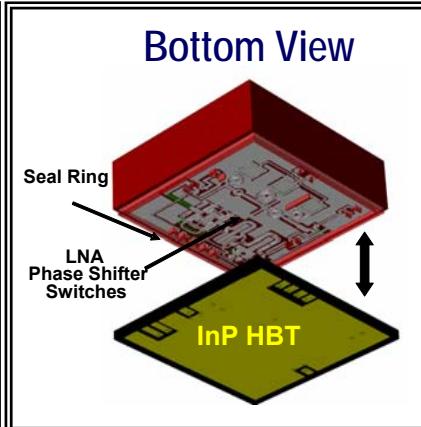
For extremely low power dissipation



Top View



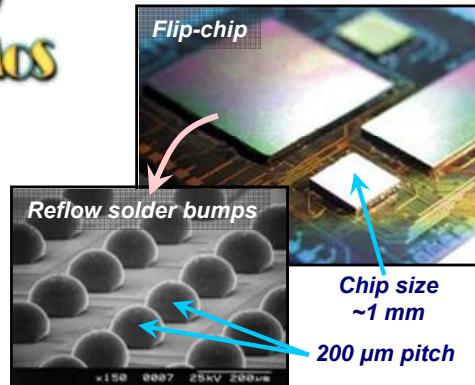
Bottom View



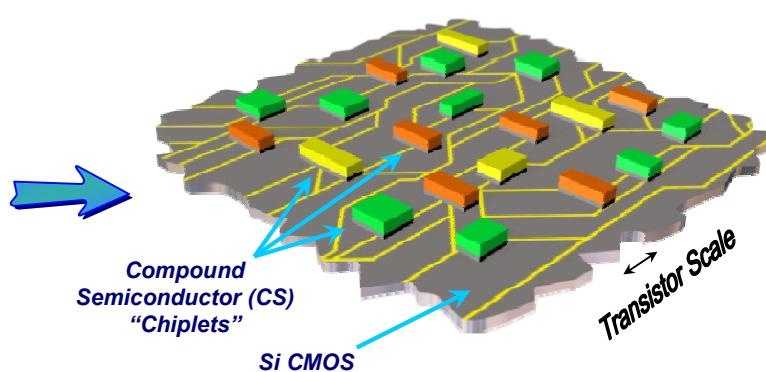
**“Device-Scale” Integration of CMOS with Compound Semiconductors
To enable circuits to use the “best junction for the function”**



Today



COSMOS Vision





Some Unsolicited Pontifications



- Think *programs*, not subject areas
 - Subject areas live forever, but a program is mortal
 - Program → technical challenges → metrics
 - PMs live to make *new* programs
 - Why does your YPA idea lead to one?
 - Go for the gray...
 - or the white...
 - but not the black
- What makes for a good program?
 - Program → technical challenges → metrics
 - Start with DARPA BIG...
 - but focus on MTO small!



Areas of Interest, or... My Crazy Idea List



Technologies for Heat Removal at the Device Scale (THREADS)	New methods to remove heat at length scales $< 10\mu\text{m}$ to achieve fundamental (“device-limited”) performance
COmpact Vacuum Electronics Rf Technology (COVERT)	Micromachined tube technology to achieve HPA ($\sim 100\text{W}$) in the upper MMW
“COSMOS II”	Sub-device scale heterogeneous integration
Ultralinear Amplifiers	Wide bandgap amplifiers to obtain extremely high dynamic ranges
Acoustic Phonons	Phononic equivalents of photonic band gap materials and their applications
Optical Phonons	“Phonon laser” concepts & cooling
EHF Optoelectronics	Merge optics with high frequency electronics; the optical gate transistor



