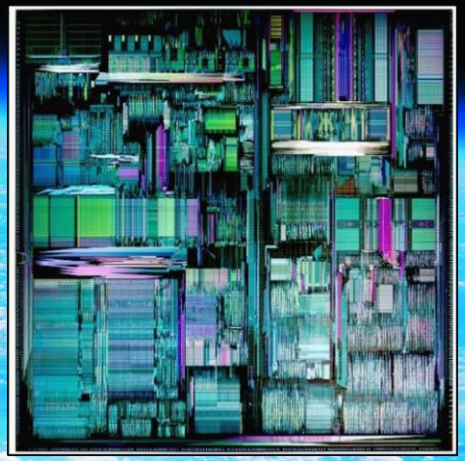
Tech & Space: A Symbiotic Relationship



SYNOPSYS
isQED
Symposium 2012

Rich Goldman
Vice President

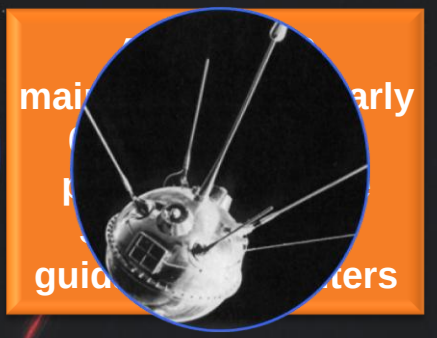
March 19-21, 2012
Techmart Center
Santa Clara, CA USA

Birth of the Industries

1940s & 1950s

Sputnik

1957



Luna 2

1959

Space

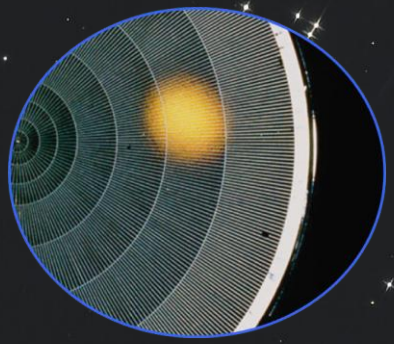
Technology

1947

Transistor

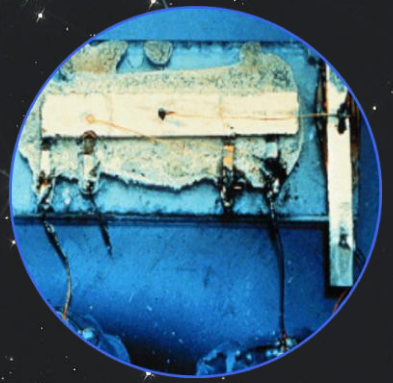
1954

Single Cell Silicon



1958

Integrated Circuit

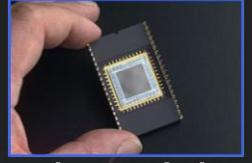


Competition Rules

1960s

Gagarin Orbits Earth

First Spacewalk

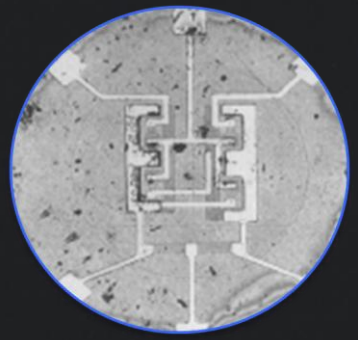


1969 — Invention of the CCD

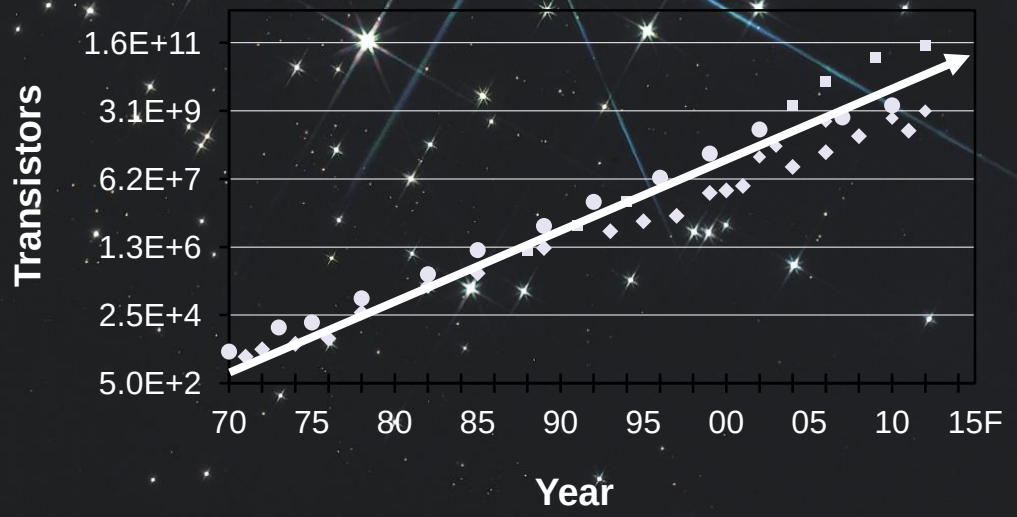
1969 — Man Lands on Moon

The space and defense market accounted for over 60 percent of all computer sales in the ’50s. but commercial sales overtook milareo in 1962.

First Silicon IC Chip



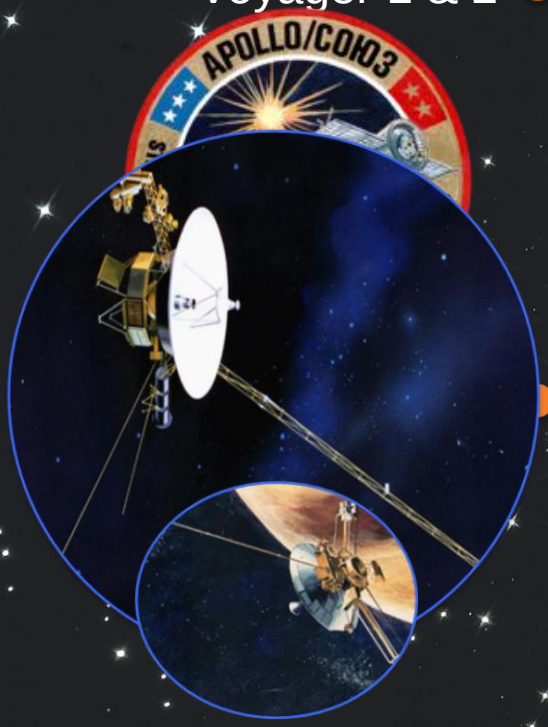
Moore’s Law



Giant Steps Forward

1970s

Voyager 1 & 2 — 1977



1975

Pioneer 10 Travels to Asteroid Belt — 1972

Mariner 9 Orbits Mars — 1971

Salyut Space Station — 1971

A 1982 Intel 80286 chip was 26x more powerful than the on board computers on Voyager 1 & 2

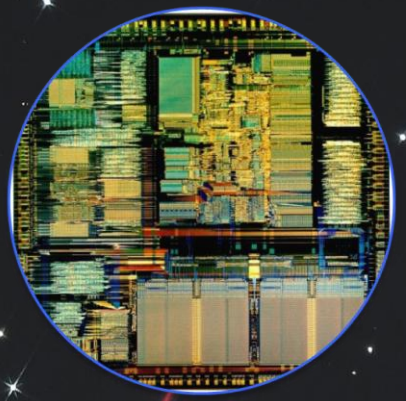
1976 — Supercomputer

1975 — Personal Computers

1971 — Intel 4004
1st Microprocessor
2,300 Transistors

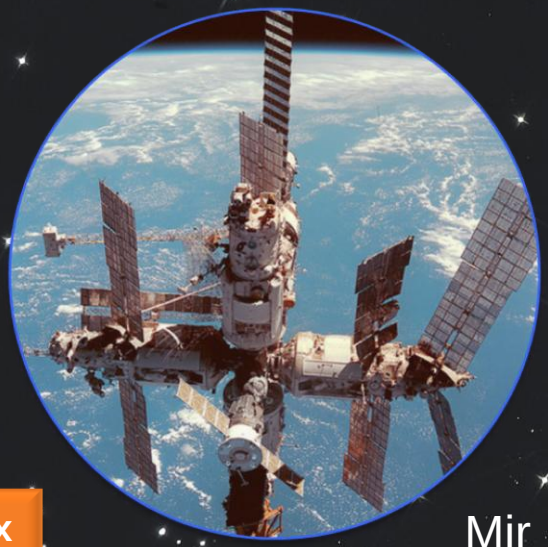
Setbacks & Solutions

1980s



Intel 80386 Microprocessor
275,000+ Transistors

1985



Mir Space Station — 1986

Challenger Explodes — 1986

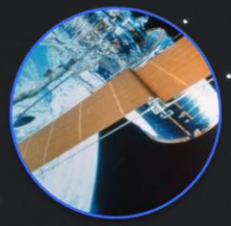
A 2010 iPhone is 689x more powerful than the on board computers on the Columbia

Columbia – 1st Manned Shuttle — 1981

1981 — IBM Personal Computer

Worldwide Achievements

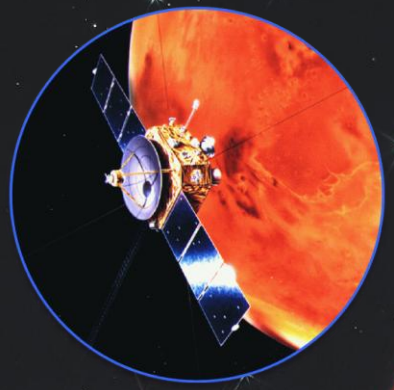
1990s



Hubble

1995

Longest Spaceflight



1998

Nozomi Probe to Mars

1999

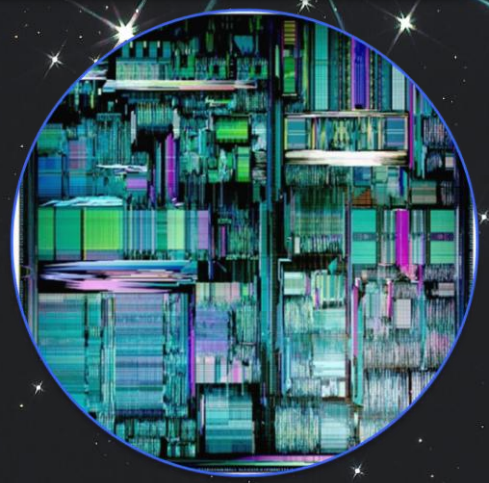
China's Launches Shenzhou 1

The digital imaging revolution was critical to the success of the Hubble project.

Commercial Digital Camera

1995

Intel Pentium Pro Microprocessor 5M+ Transistors



Light Years Ahead

2000 – 2010

China Launches taikonaut
Yang Liwei into Orbit

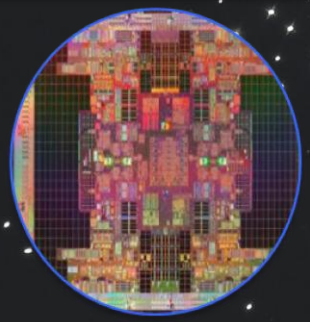
2003

First Private Spacecraft
Enters Space

2004

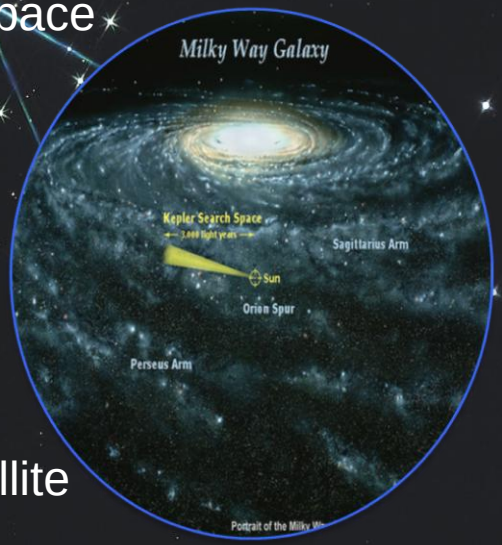
2000

USB
Flash Drives



Intel Core i5
Microprocessor
650M transistors

2010

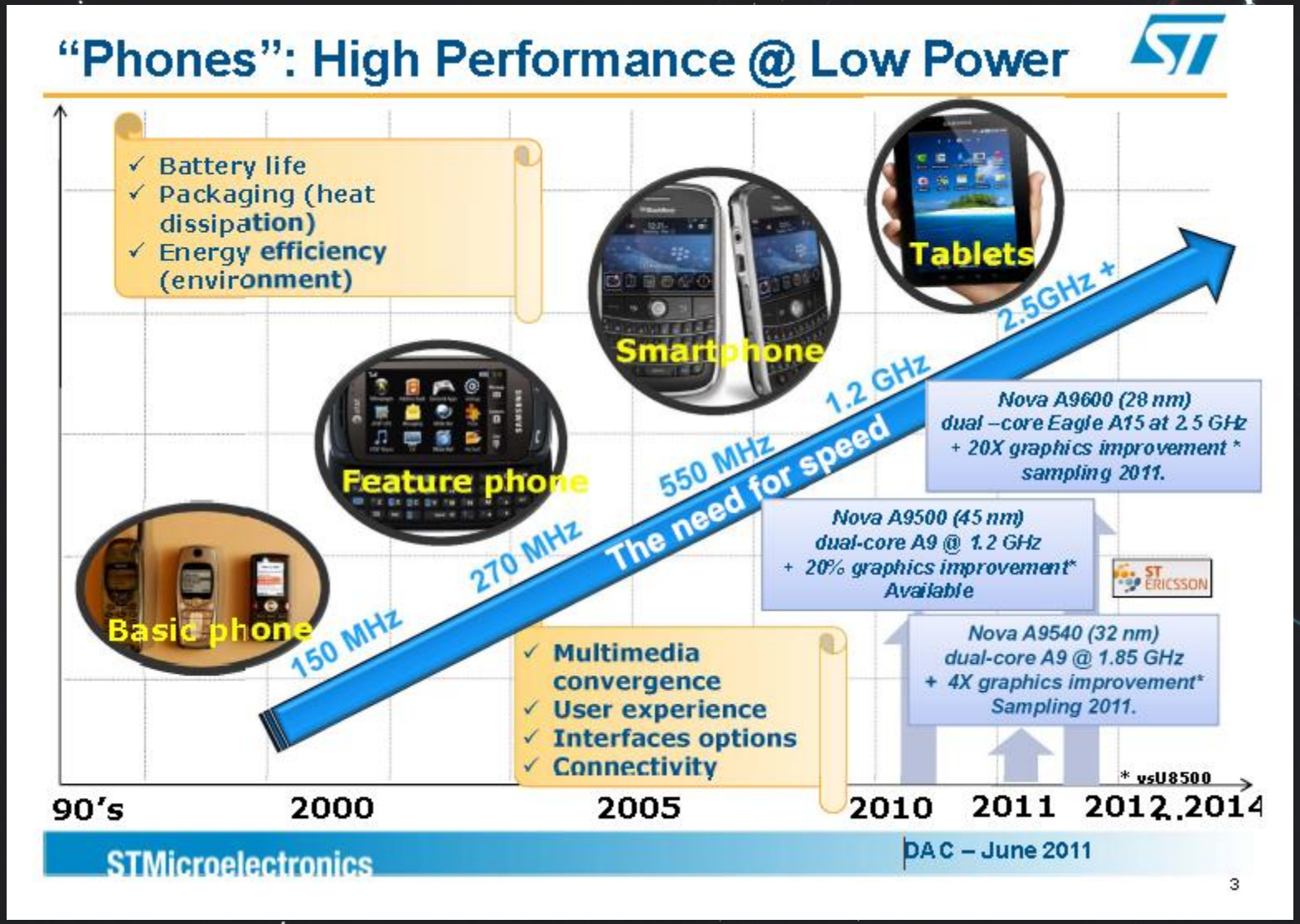


2009

Kepler Satellite

Today's Achievements

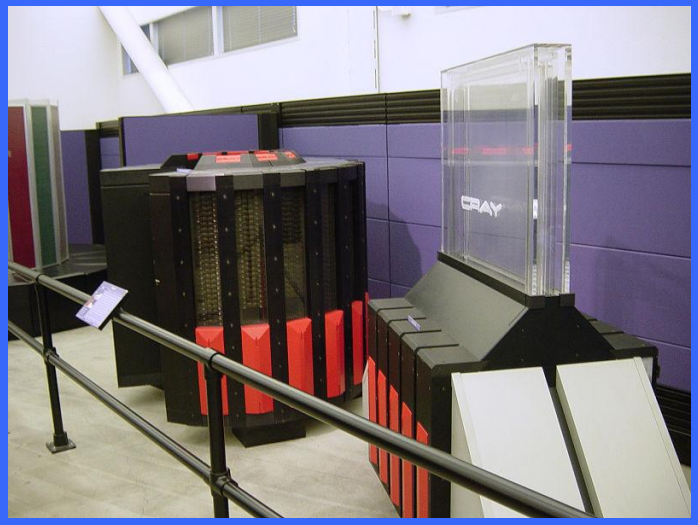
The phone becomes a computer



Today's Achievements

2011 in Technology: Compute Power

1985: Cray Super Computer



Comparable Size: VW Bug

Cooled By: Immersion in a liquid called Flourinert

Cost: $17M

End User: NASA, U.S. Dept. of Defense, major corporations

<

Today: iPad

Comparable Size: Notepad

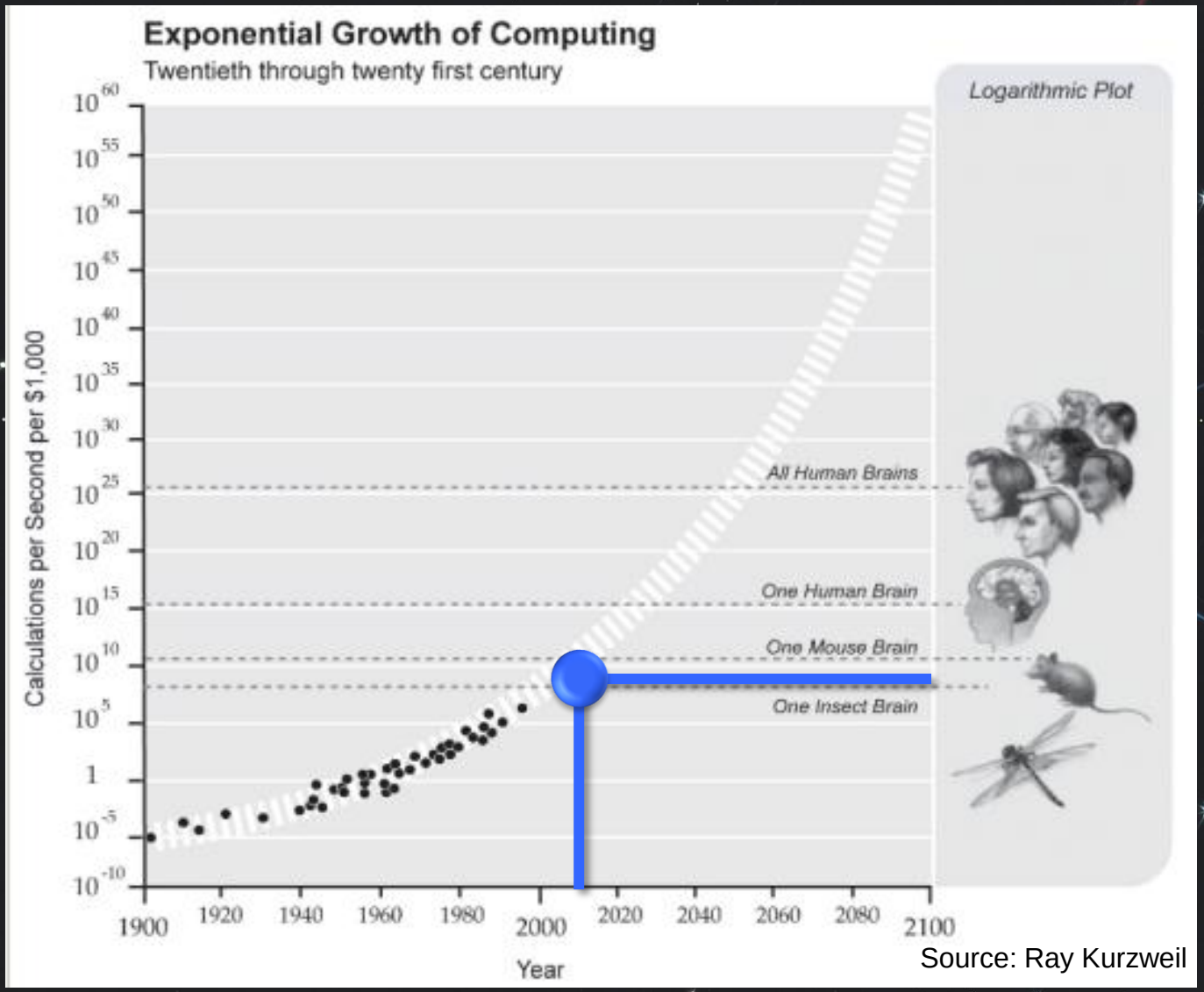
Cooled By: Runs off a battery and is air-cooled

Cost: $499

End Users: Millions of Consumers

Today's Achievements

2011 in Technology: Compute Power

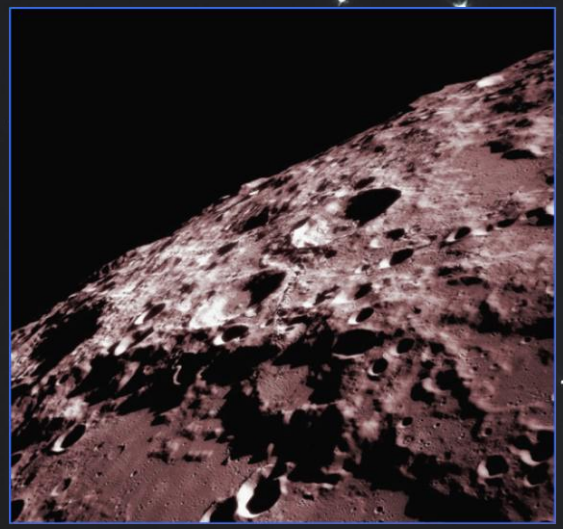


Source: Ray Kurzweil

Today's Achievements

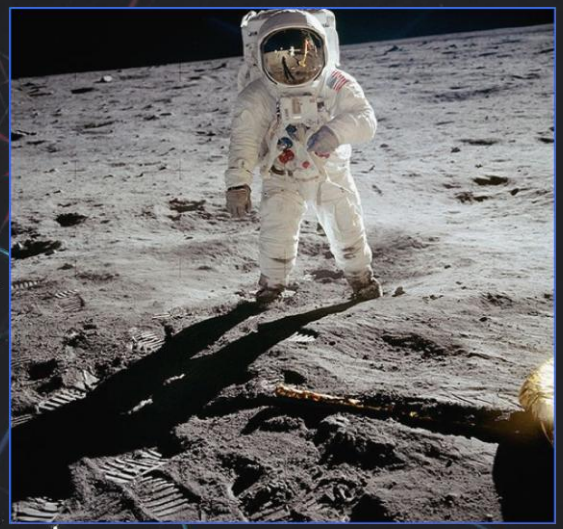
2011 in Space

Visiting Asteroids



Completion of International Space Station

700 People from 40 Countries Have Left the Planet



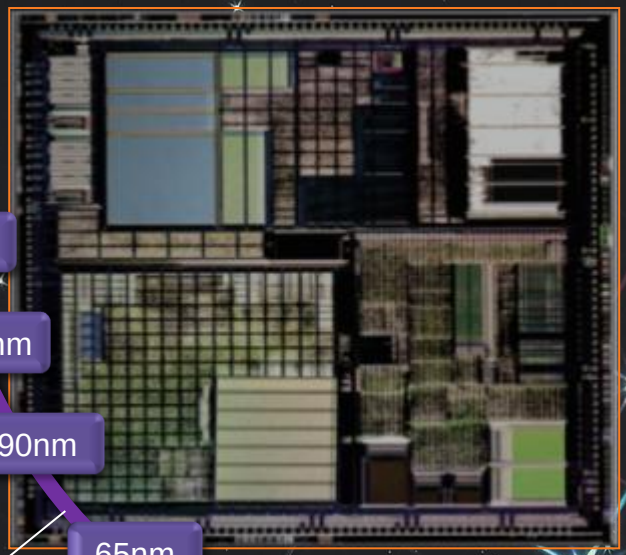
Computer Power Marches on at the Pace of Moore's Law

Year	Technology	Instructions per Second	vs. baseline	Original Data
1954	IBM 650	60	2.25564E-05	.06 kIPS
1960s	IBM 360 mainframe	500,000	0.187969925	500,000 calculations per second
1977	DEC Vax	1,000,000	0.37593985	1 Mflop
1982	Intel 80286	2,660,000	1	2.66 MIPS
1985	Cray Supercomputer	824,000,000	309.7744361	160 megaflops
1992	Intel 486 DX	54,000,000	20.3007518	54 MIPS
2003	Pentium 4 Extreme Edition	9,726,000,000	3656.390977	9,726 MIPS
2010	Intel Core i7 Extreme Edition i980EE	147,600,000,000	55488.7218	147,600 MIPS
2010	iPhone 4	2,000,000,000	751.8796992	33.35 Mflops, 2000000000 Instructions per second
2011	iPad2	20,000,000,000	7518.796992	

Incredible Accomplishments in Space with So Little Computing Power

Year	Technology	Instructions per Second	vs. baseline
1957	Sputnik		
	Strela (Sputnik ground guidance computer)	2,000	0.00075188
	M-1 (Sputnik ground guidance computer)	20,000	0.007518797
	BESM-1 (Sputnik ground guidance computer)	100,000	0.037593985
1959	Luna2		
	Ural1 (Luna ground guidance computer)	100	3.7594E-05
1977	Voyager 1 (on board)	100,000	0.037593985
1977	Voyager 2 (on board)	100,000	0.037593985
1981	Columbia (on board)	2,900,000	1.090225564

Moore's Law Doesn't Come For Free



350nm

250nm

Timing Closure!

180nm

Signal Integrity
Power
Verification

130nm

90nm

Power !
Verification!
Yield !

65nm

Clocks
Power !!
Verification !!
3D

45/40nm

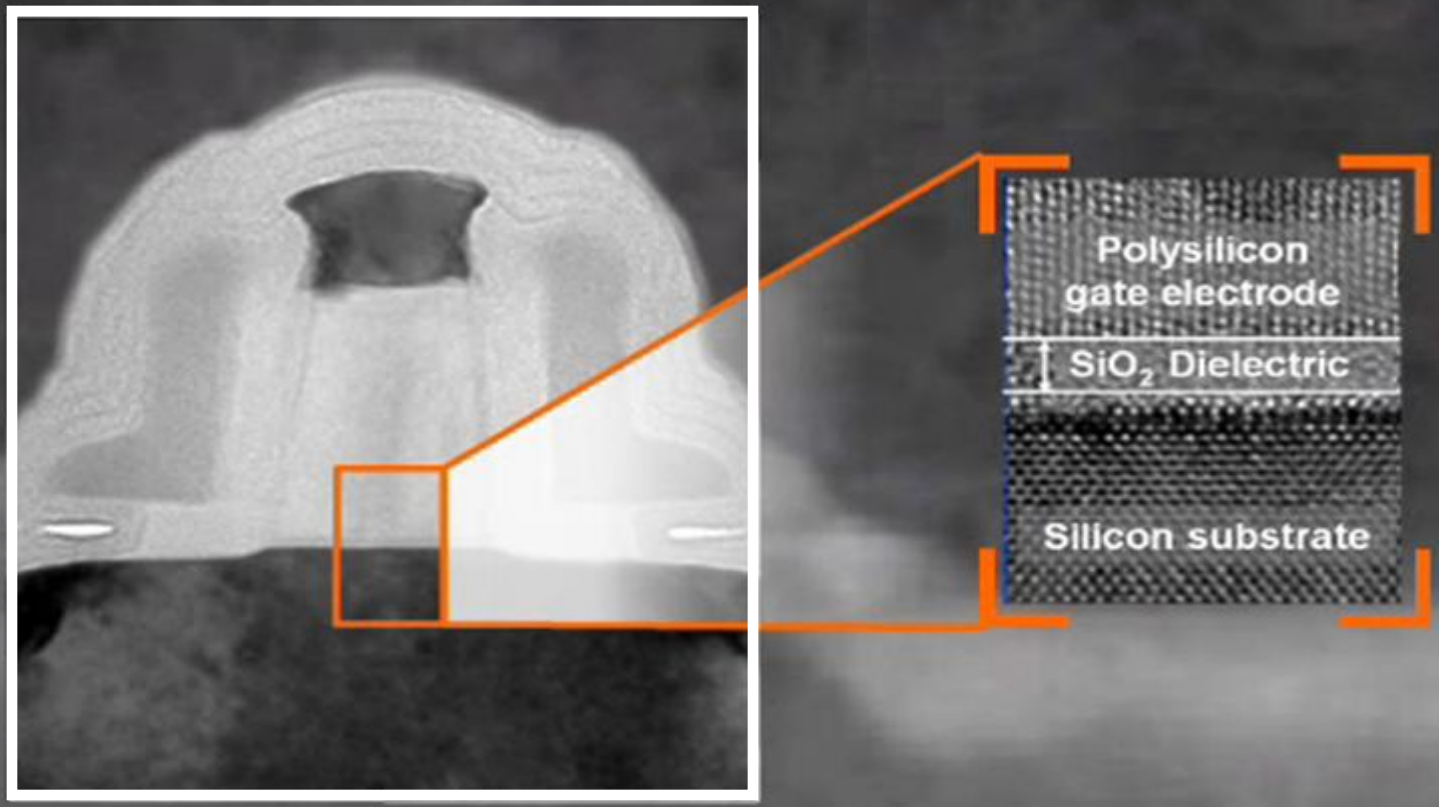
Power !!!
Verification !!!
Software
Yield

32/28nm

Power !!!
Verification !!!
Software !!
Variability
Yield !
3D!

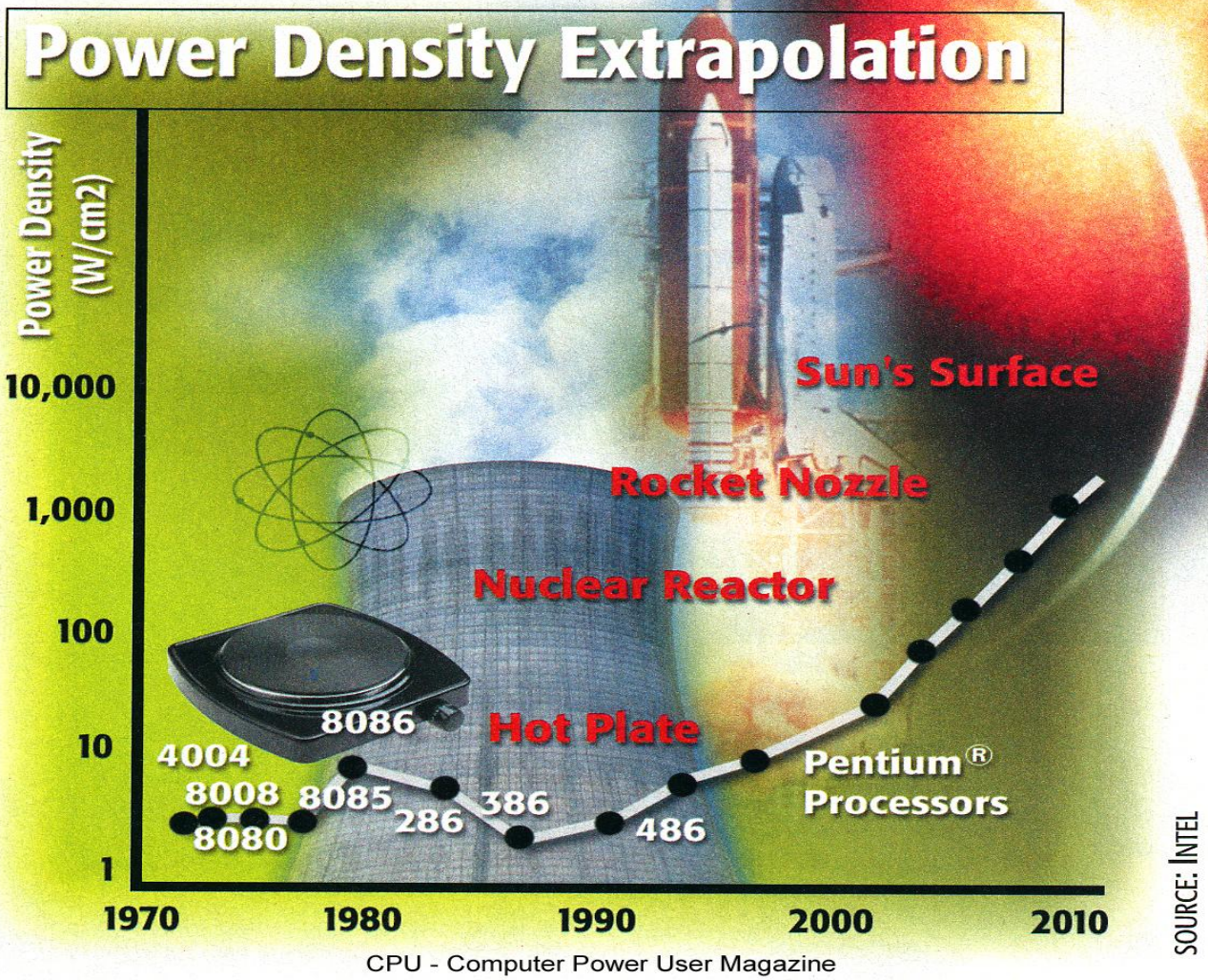
22/20nm

Power !!!
Verification !!!
Software !!!
Variability
Yield !!
3D!!



Source: R. Chau, Intel 2003, ITRS 2005

Intel realized:
Something must change!



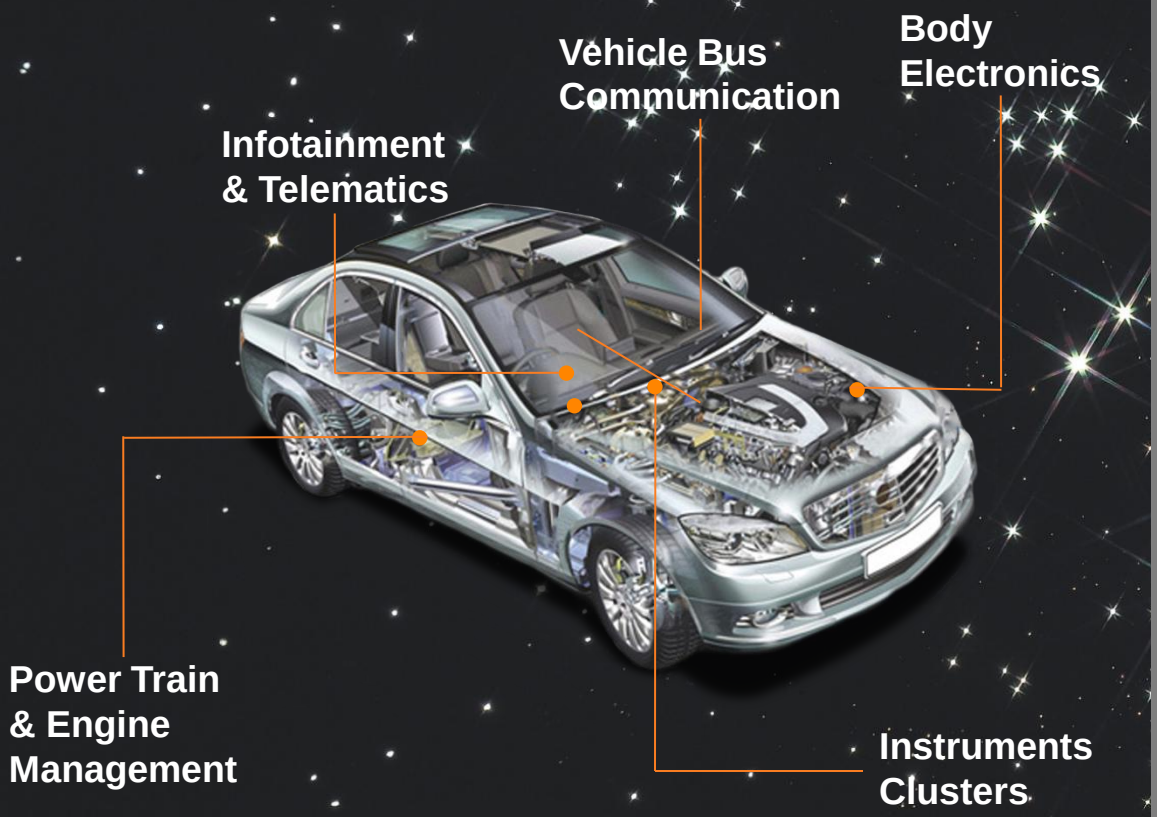
Today's Achievements

2011 in Technology: Smart Homes

- Increased convenience with centralized control of home systems
- Increased security with remote home management
- Increased energy and cost savings with automated lighting and temperature controls

Today's Achievements

2011 in Technology: Smart Cars



- Increased cost and energy savings with gasoline-electric hybrid structure
- Increased performance with sensor monitoring systems
- Increased convenience with GPS tracking and infotainment systems

Today's Achievements

2011 in Technology: Smart Communications

- Increased access to information with content streaming from internet and local storage devices
- Increased access to communication with email and instant messaging services
- Increased access to entertainment with video, music, and gaming applications

Today's Achievements

2011 in Space & Technology

The development of space exploration depends on the progress of semiconductor technologies.

Data is now collected from space by probes without the presence of man because of microelectronic technology.

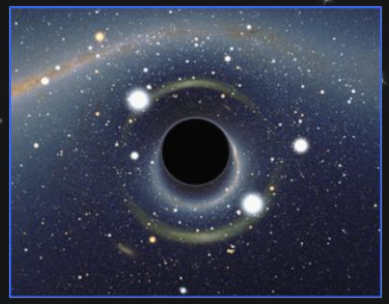
Sophisticated control systems allow us to operate equipment by remote control in hazardous situations, such as the handling of radioactive materials

We can remotely pilot aircraft from takeoff to landing. We can make course corrections to spacecraft millions of miles from Earth.

Future Potential

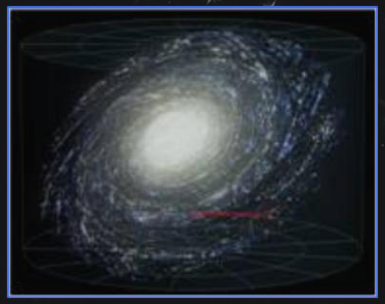
Going Where No One Has Gone Before: Space Industry

Dark Energy



- SDSS III BOSS project will explore the role of dark energy in the forming of galaxies

Outer Milky Way



- SDSS III SEGUE-2 project will uncover rare, primitive stars from the earliest generations of star formation

Extrasolar Planets

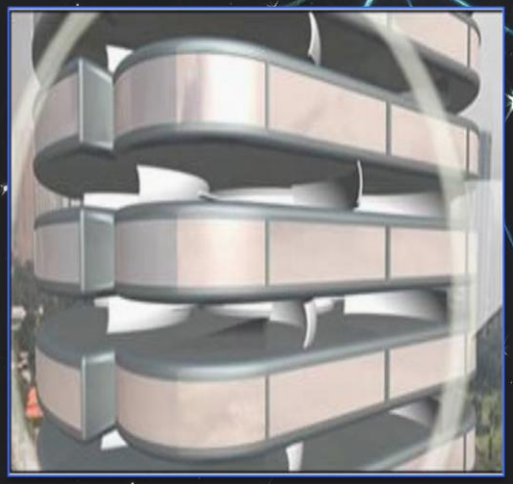
- SDSS III MARVELS project will monitor bright stars with the precision needed to detect extrasolar planets

Extraterrestrial Contact

- Search for planets that could support life
- Searching within our solar system: Mars, Europa, meteoroids
- Sending and receiving messages beyond our system

Future Potential

Going Where No One Has Gone Before: Technology Industries



Future Potential

Going Where No One Has Gone Before: Together we are better

We continue to move beyond our small planet into the wide universe beyond, and it will be thanks to the space programs and technology that sent us there.

Thank You!

Спасибо