



Die Products Markets in the USA

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IC market definitions

- ❑ **World Semiconductor Trade Statistics (WSTS)**
 - Statistics provide by Semiconductor manufacturers
 - Available through SIA

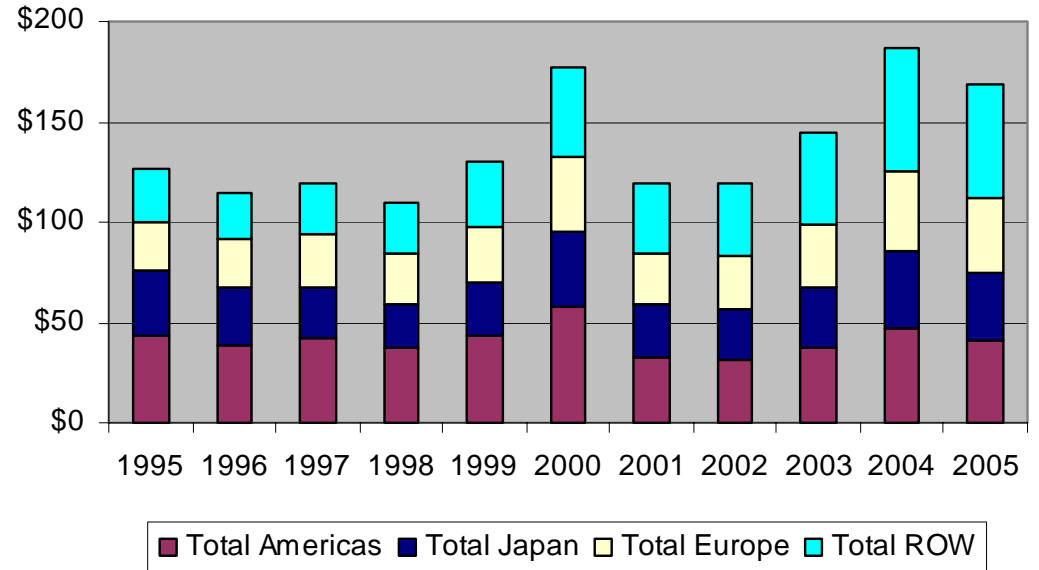
- ❑ **Six end-use market segments**
 - Consumer — entertainment, radio, TV, DVD, VCR, personal or home appliances, cameras, game consoles, etc.
 - Automotive — auto entertainment, engine controls, and all other auto applications.
 - Computer & Office — mainframe, peripheral office equipment, servers, and personal computers.
 - Industrial & Instrument — lab, test, robotics, medical, and control and measurements.
 - Communications — telecommunications, transmission, and two-way and cellular systems.
 - Government — military and government spec purchases, in Japan these components are sometimes referred to as "hi-rel" (for high reliability).



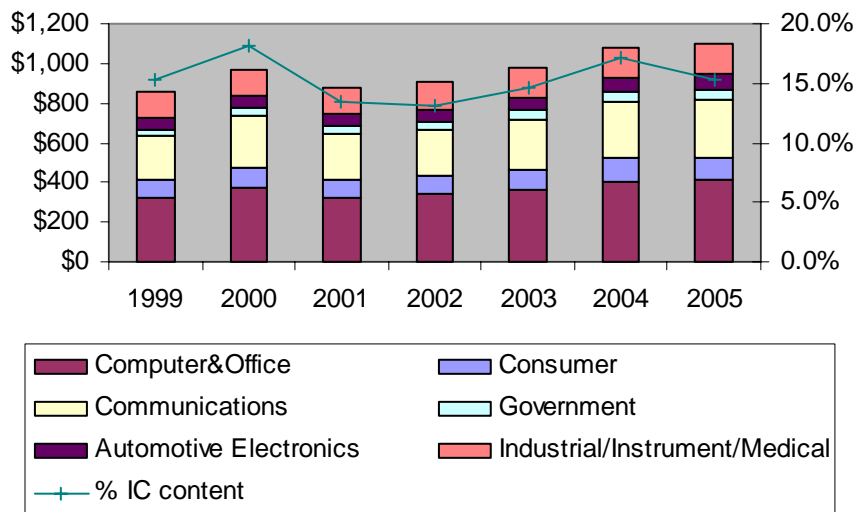
Electronics systems market sectors

- WSTS end use statistics
- Source: IC Insights

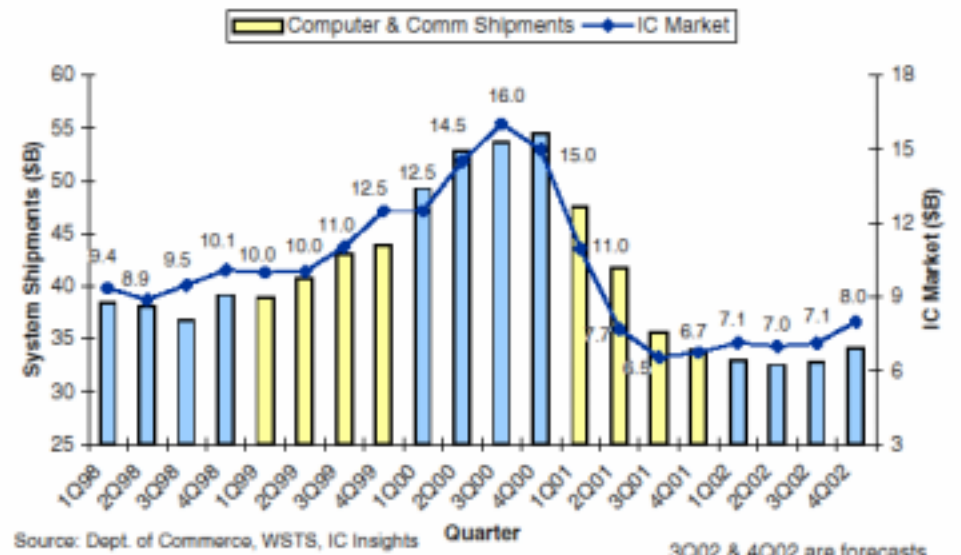
IC Market (\$B) Worldwide



Electronic Systems Market (\$B)



North American Computer & Communication System Shipments vs IC Market (\$B)

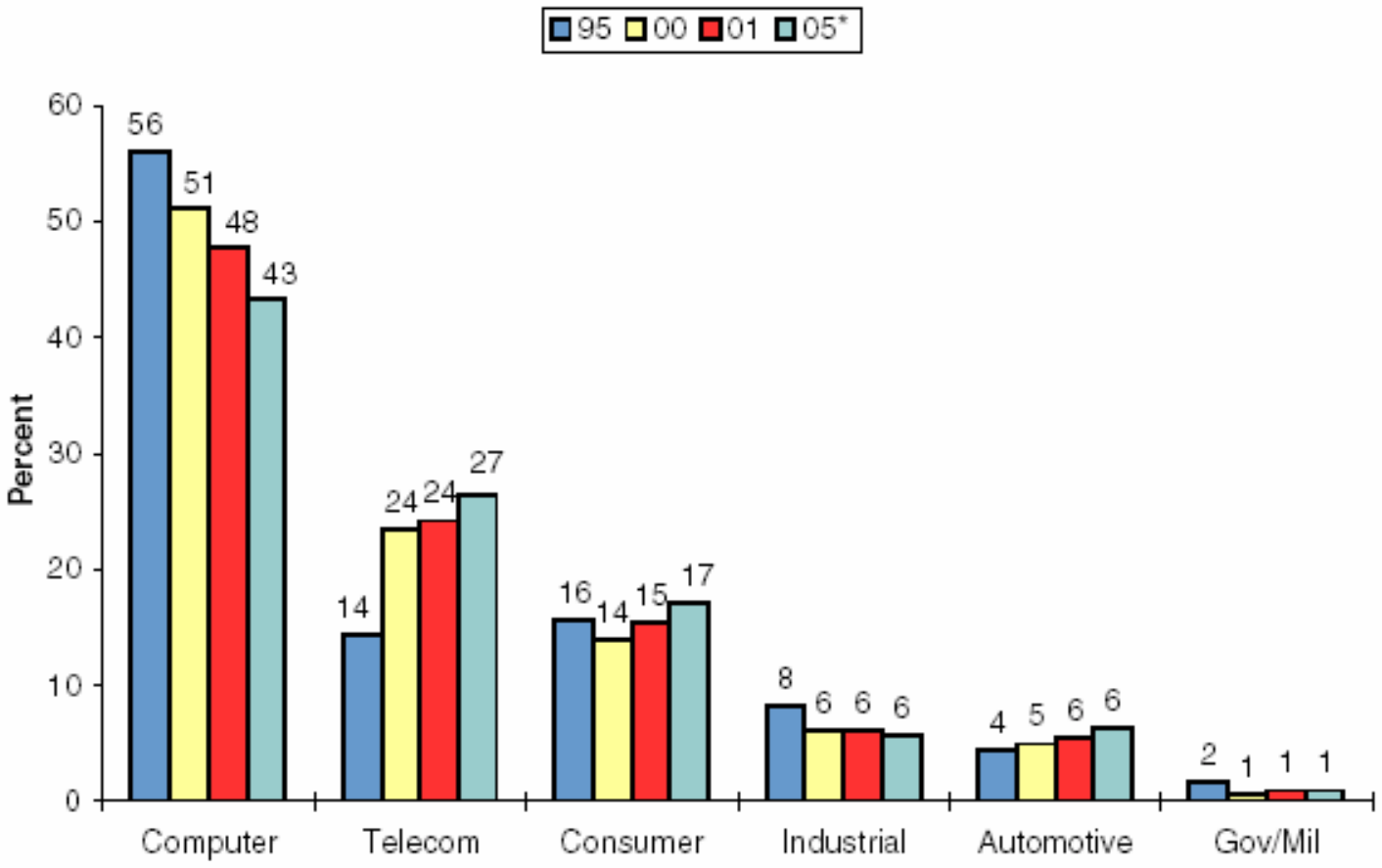


Source: Dept. of Commerce, WSTS, IC Insights. 3Q02 & 4Q02 are forecasts



Trends in ICs for systems

IC Marketshare by System Type

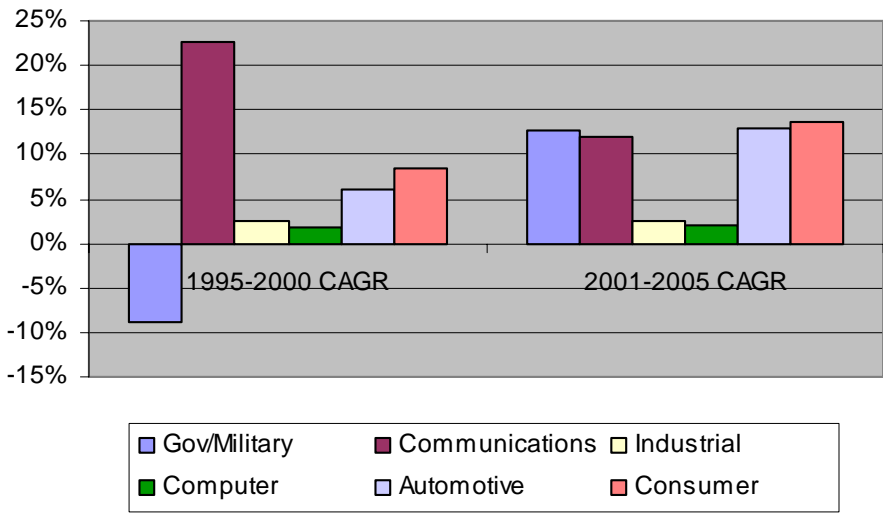


Source: SIA, IC Insights

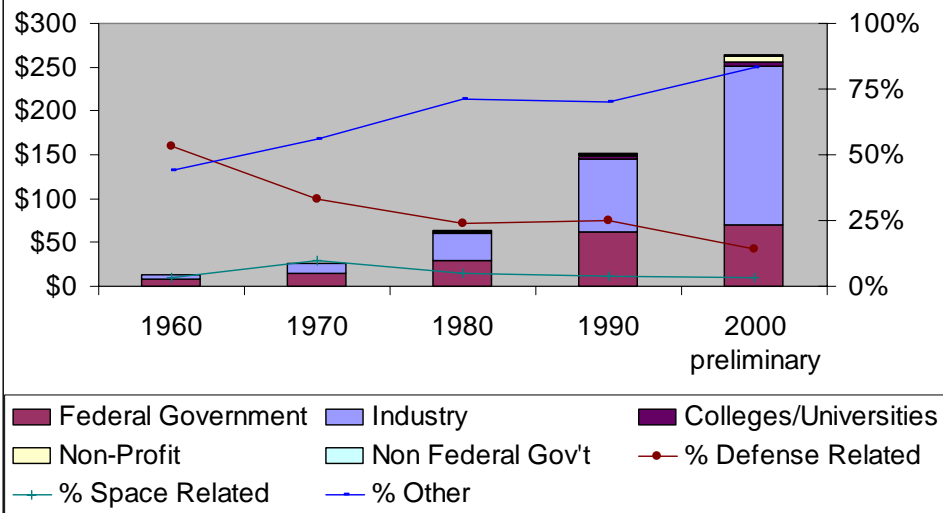
System Type

*Forecast

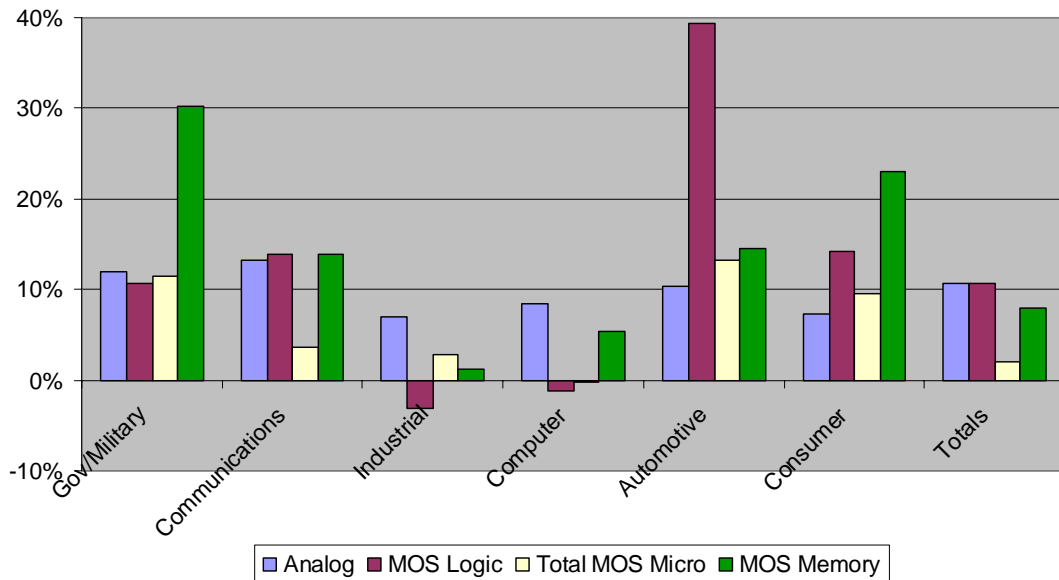
IC CAGR - Americas Markets



USA R&D Spending



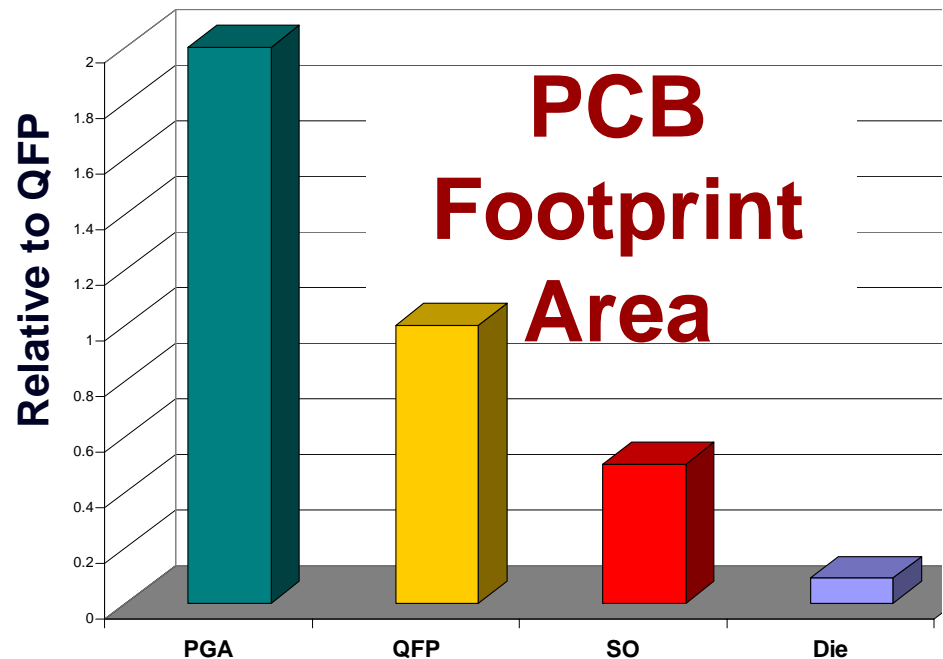
Americas market segments IC device type growth rate (CAGR 2005/2001)



Americas IC products growth rate by sector

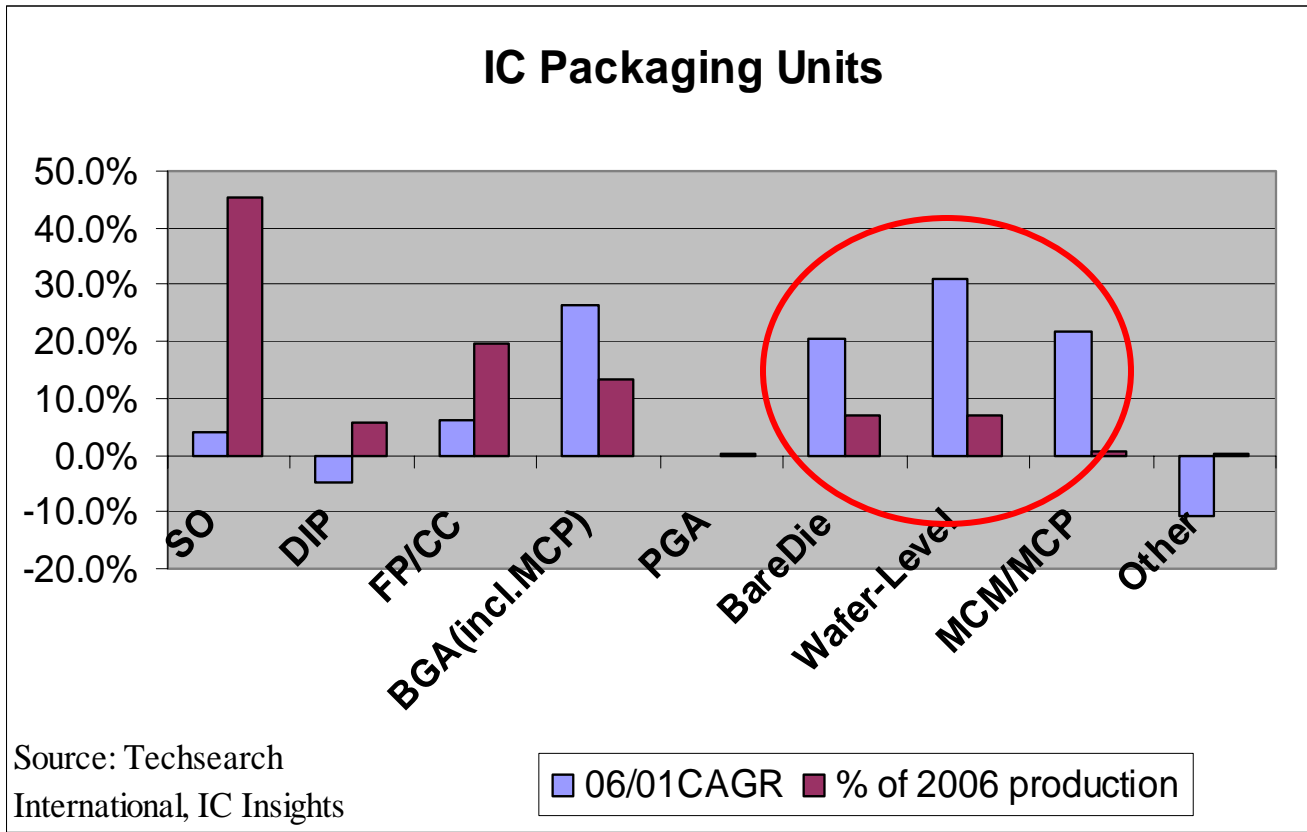
DPC Why Customers Prefer to Use Die Products

- ❑ Reduces size and weight of the traditional packaged product system by 90%
- ❑ Reduces overall system cost
- ❑ Provides higher performance systems
 - lower power consumption
 - decreased signal delay
 - can improve thermal performance
- ❑ Provides competitive edge
- ❑ Higher integration with standard functions





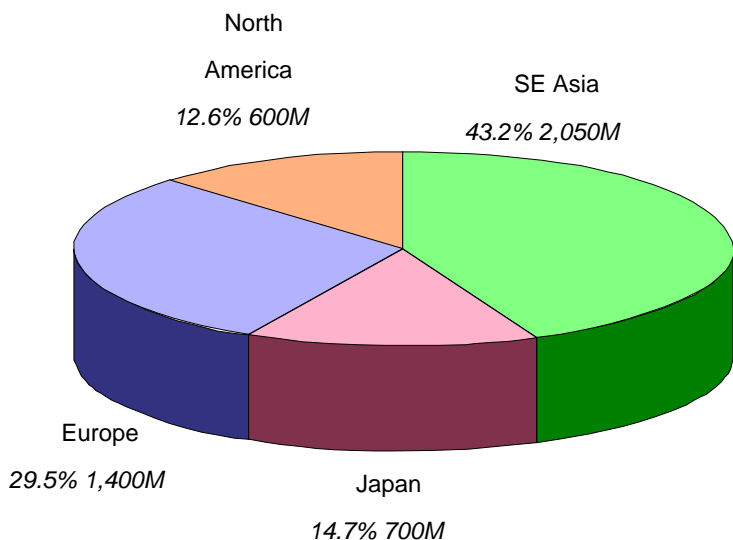
Die products dominates the predicted growth rates for packaged IC's





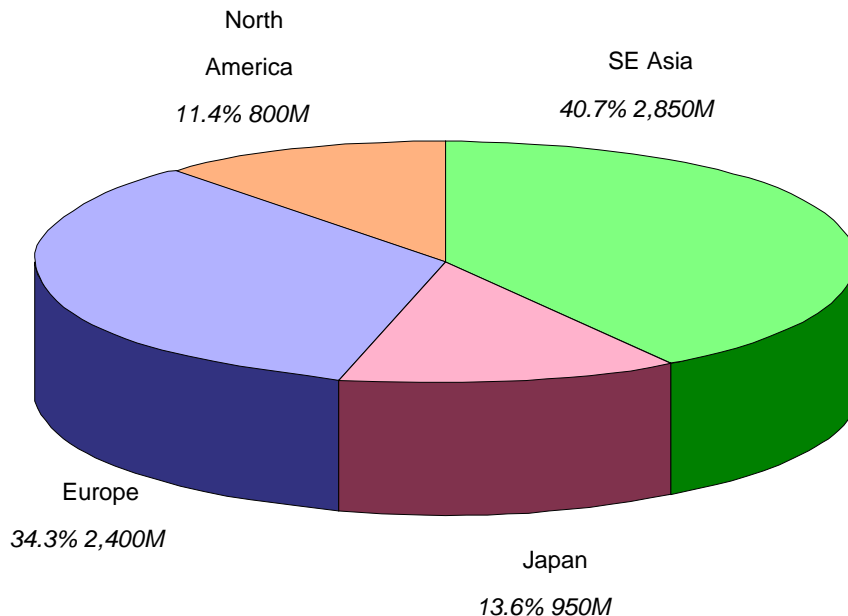
Chip On Board Market Growth by Region

2000



Total: 4,750M Units

2005

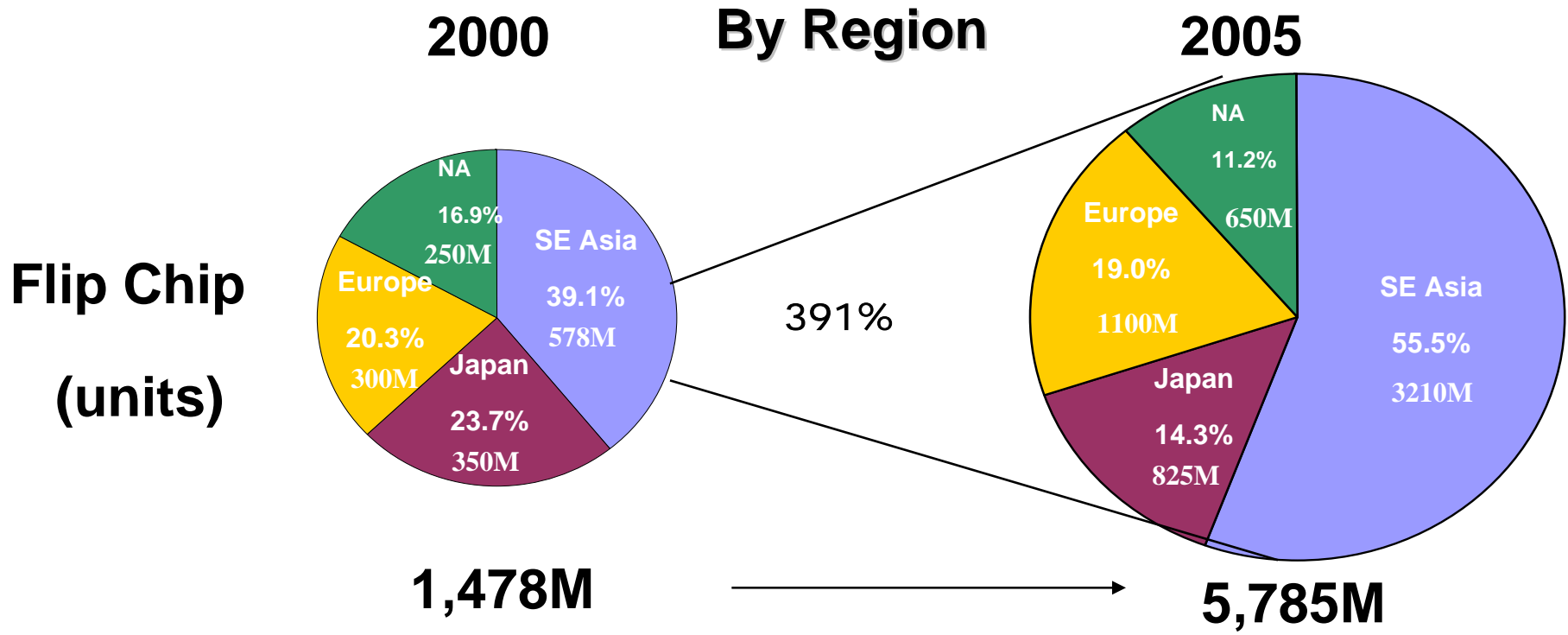


Total: 7,000M Units

150% Growth



Market Growth for Flip Chip Die Product Applications

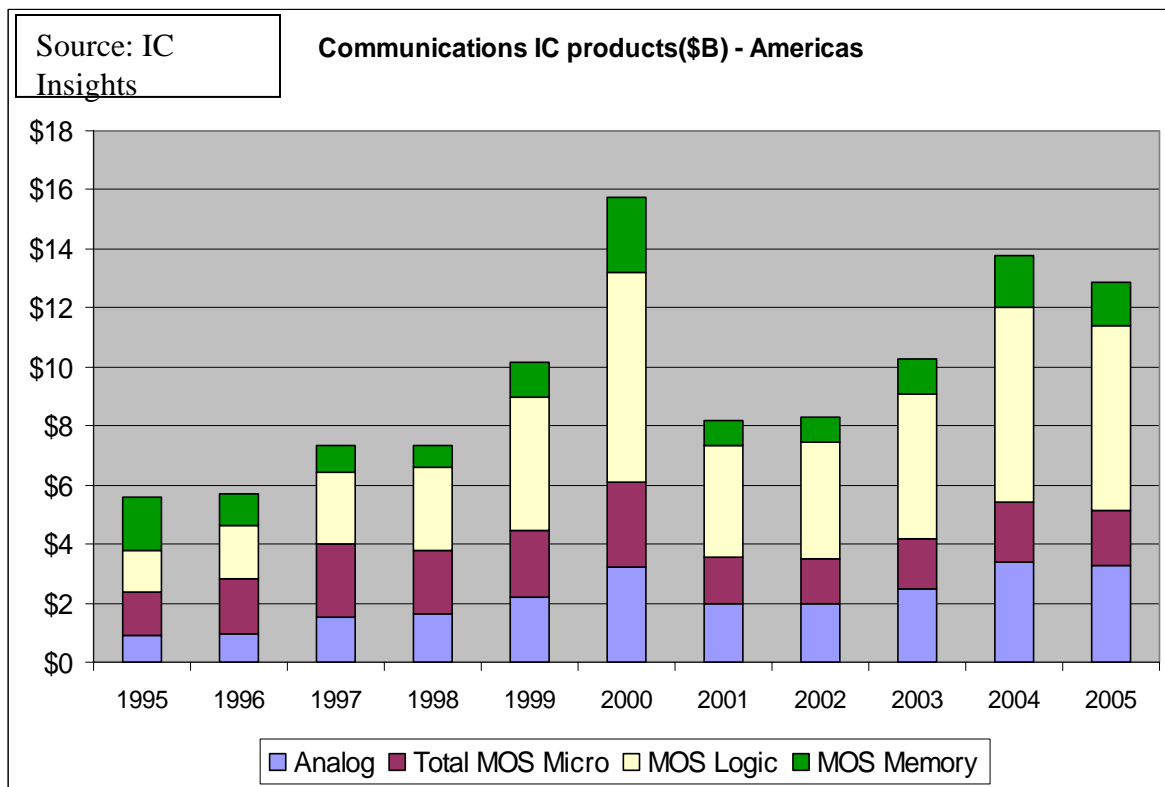


Note: Wafer CSP is expected to reach 3,440M units by 2005



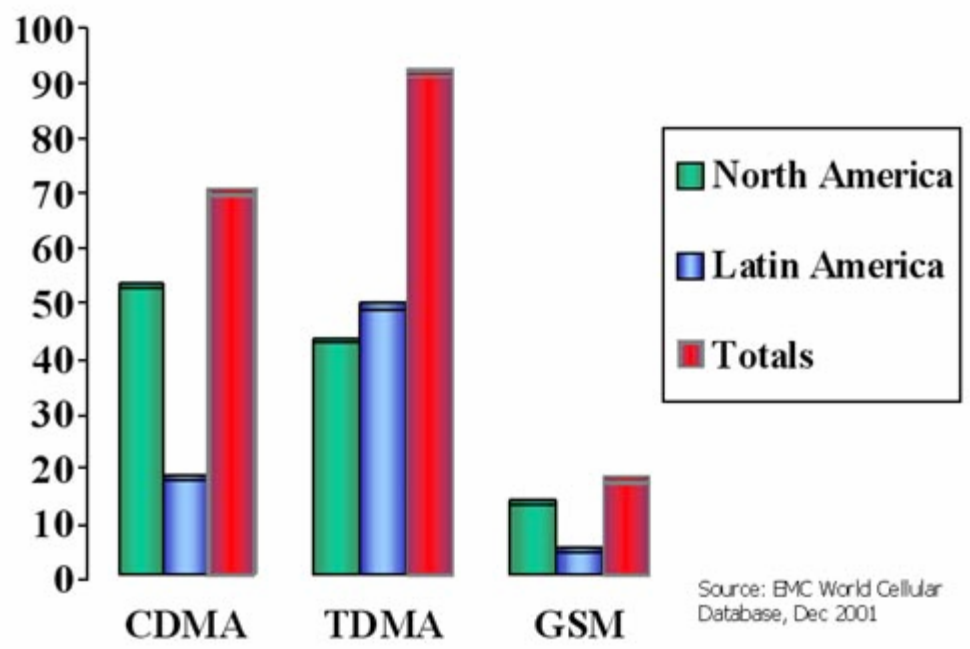
Communications Electronics Americas

- ❑ Market for Comm ICs lost 50% value in 2001
- ❑ Won't recover 2000 revenue levels in the forecast period





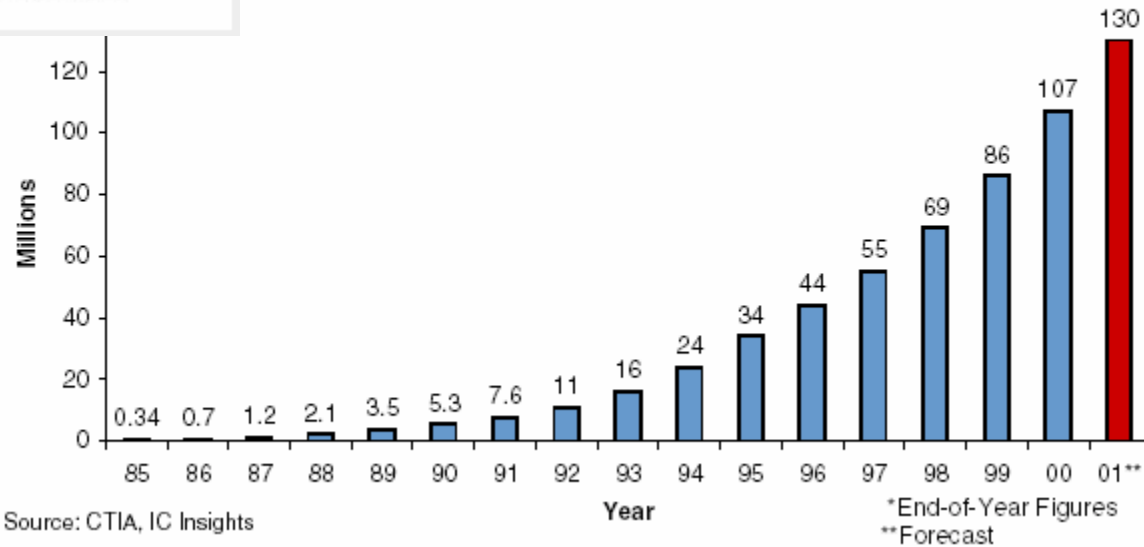
Communications Electronics Handsets - Americas



North American consumers **unlikely** to be at leading edge for 3G phones

Digital Cellular Subscribers in the Americas by Technology

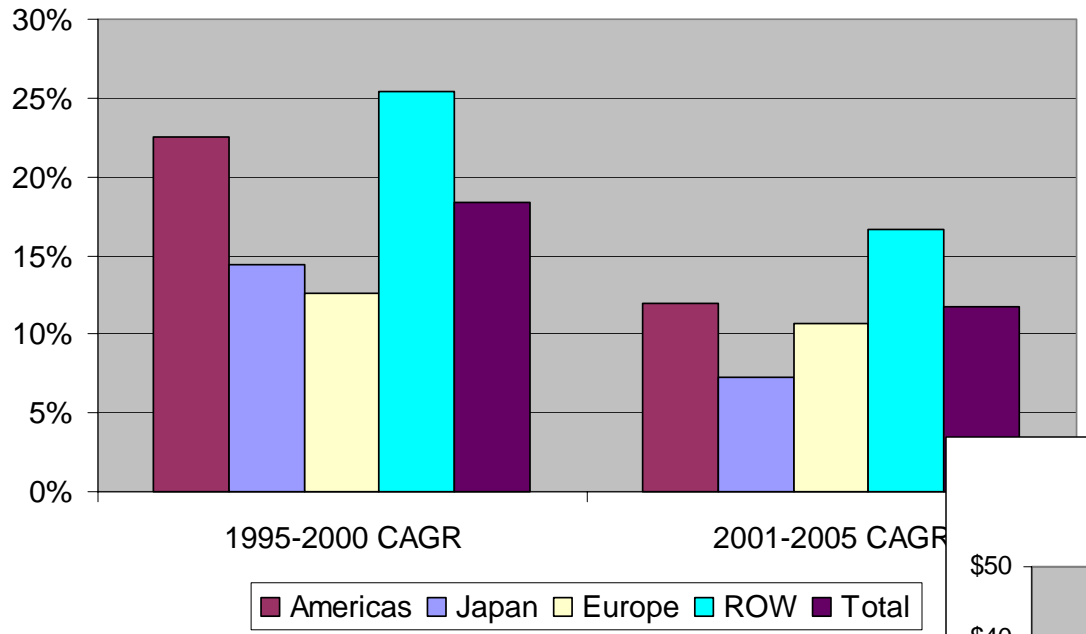
U.S. Cellular/PCS Telephone Subscribers*





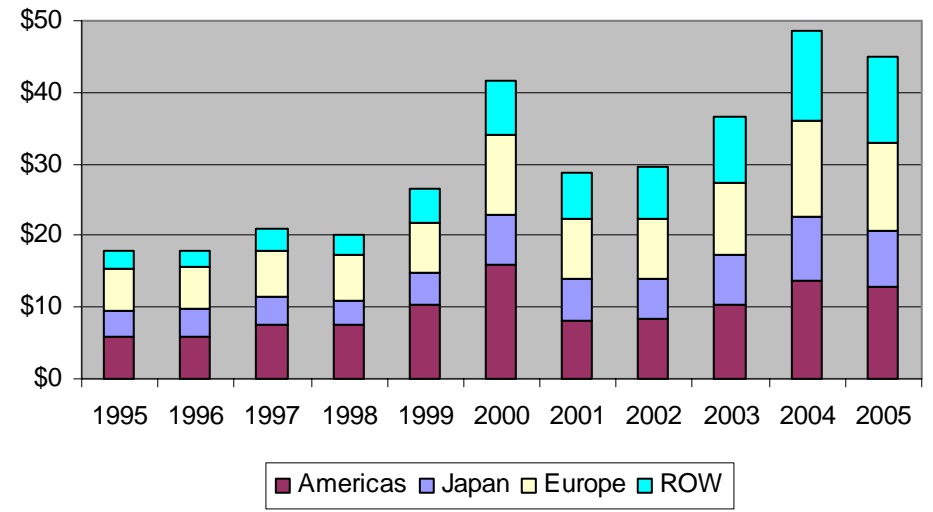
Communications electronics IC Market trend

Regional Communications IC Growth Rates



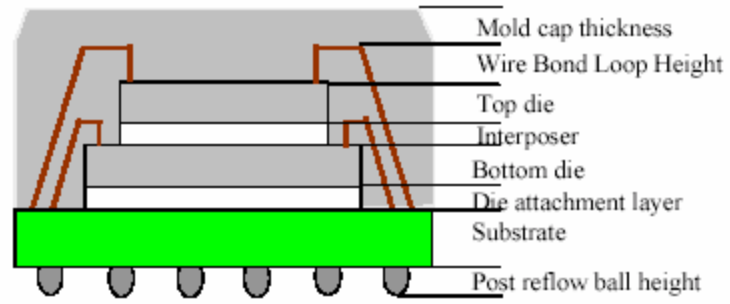
- Americas won't see 2000 levels until after 2005
- ROW continued strong growth forecast
- All regions will experience solid growth

Communications IC Market (\$B)

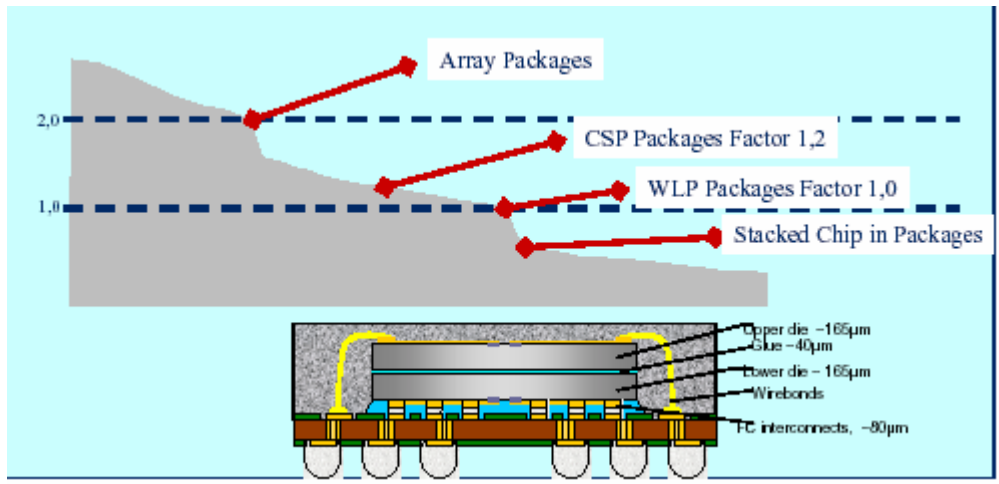
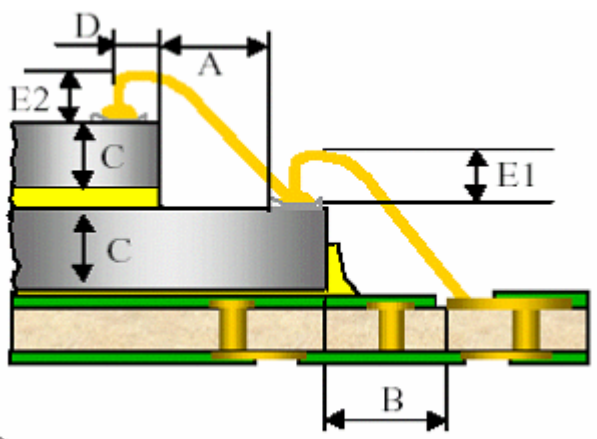
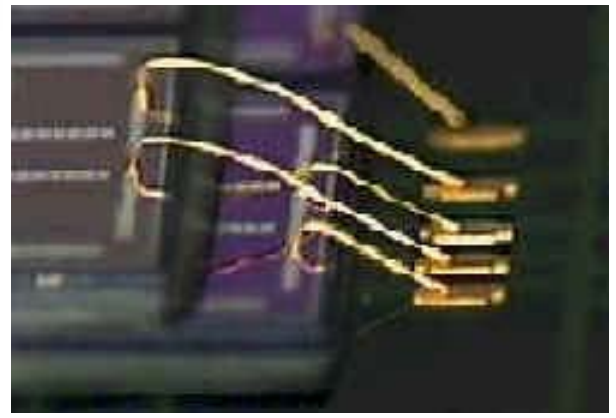


- All regions will experience solid growth in near term

Source: IC Insights



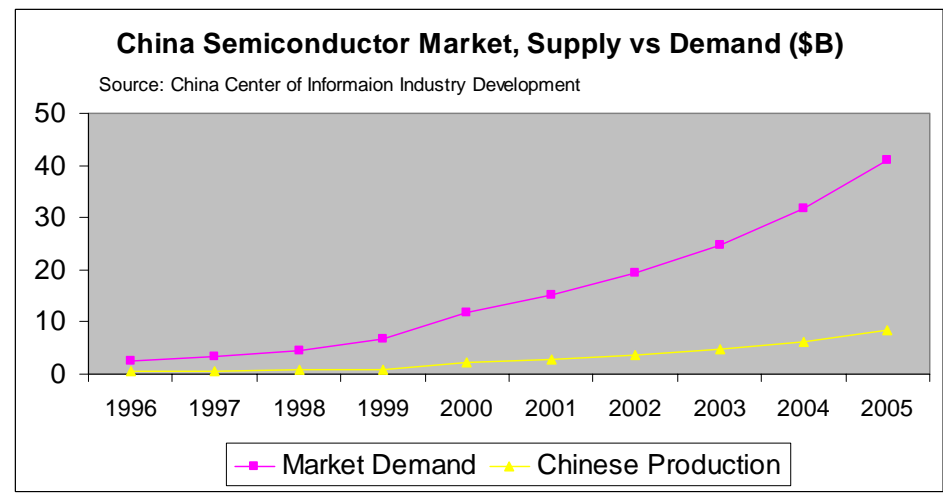
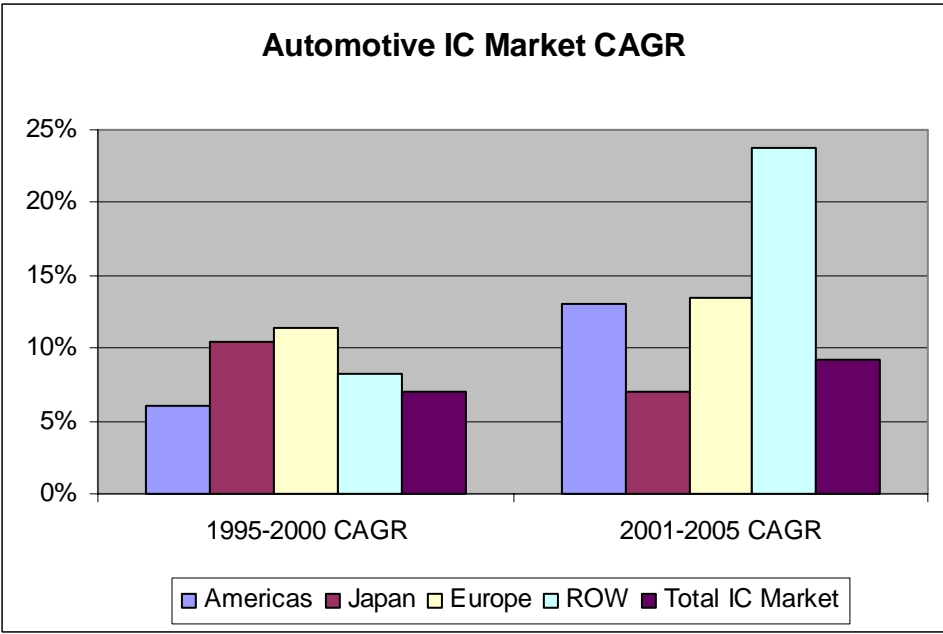
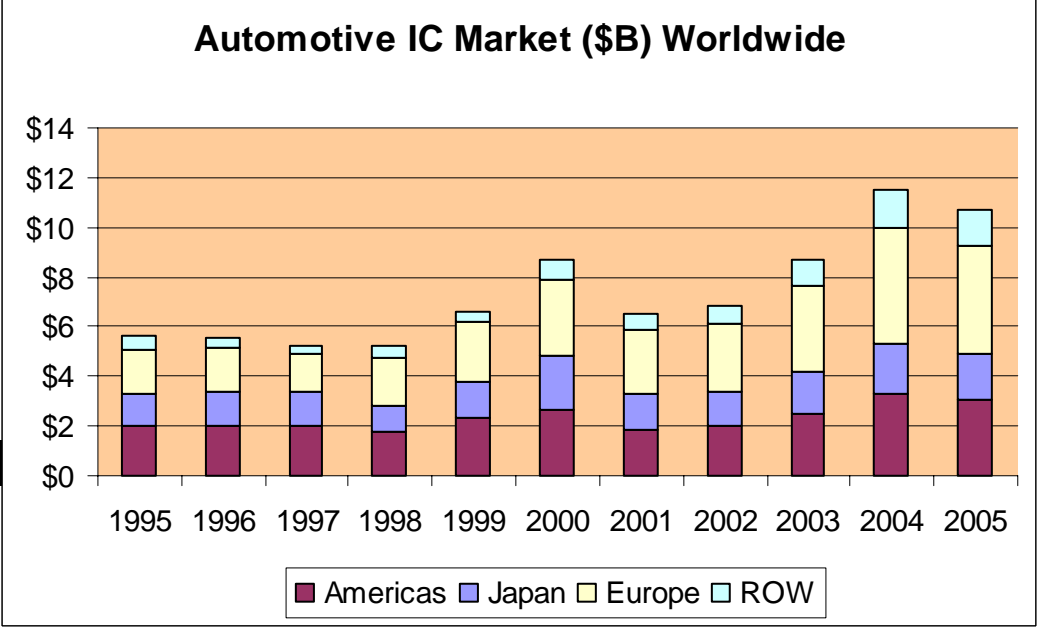
Stacked packages that combine Flash and SRAM are common place in today's cellular phones





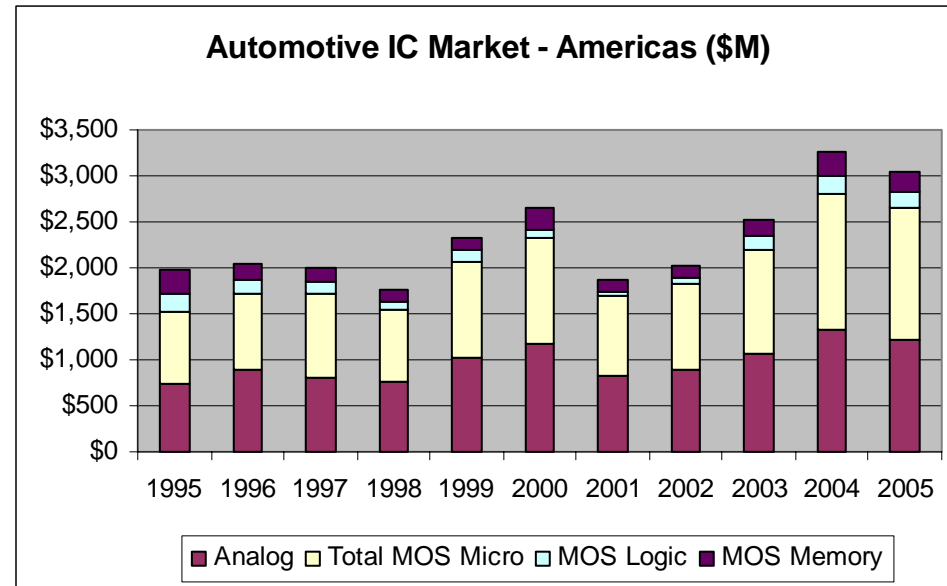
Automotive IC Market Geographical Distribution

- Europe holds the largest share of the Automotive IC market
- US is a close second



DPC Automotive Markets - Americas

- ❑ Largest, 2nd fastest growing region
- ❑ Poised for growth of “Intelligent Automotive Technologies*”
 - manufacturer revenues totaled \$196.0 million in 2000
 - 65 percent from the previous year.



- ❑ Market revenues for IAT forecast to increase considerably
 - The greatest increases are estimated to occur towards 2004-2005 when new cars equipped with intelligent technologies are expected to increase.

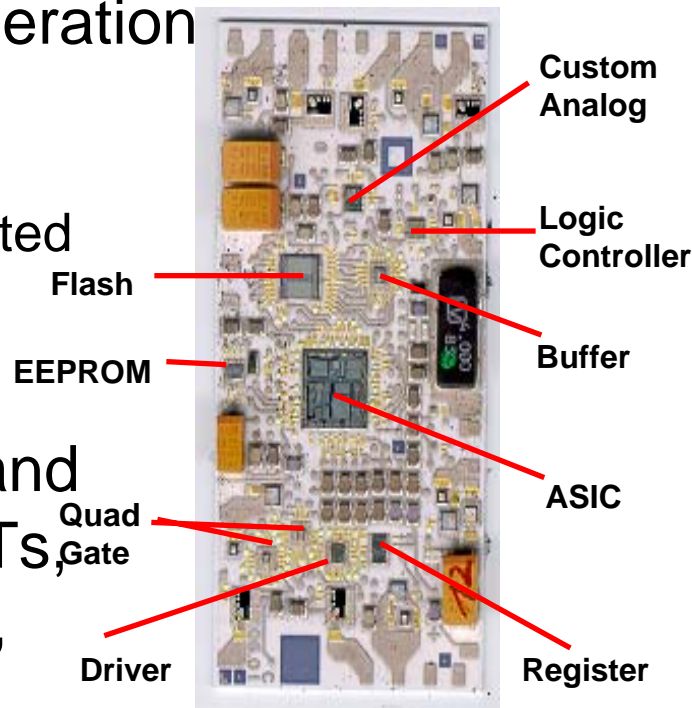
*Intelligent Automotive Technologies

- ✓ park assist technology
- ✓ adaptive cruise control technology
- ✓ night vision technology
- ✓ head-up display technology
- ✓ tire pressure monitoring technology



Intelligent Automotive Technology ICs

- ❑ 32-bit MCUs needed for applications within forthcoming “intelligent” cars.
- ❑ digital signal processors will become increasingly significant in next-generation cars
 - Applications like digital radios, driver information systems, and voice-activated communications solutions will require digital signal processors.
- ❑ Sensors, power semiconductors, and solid-state switches including IGBTs, bipolar transistors, and MOSFETs,

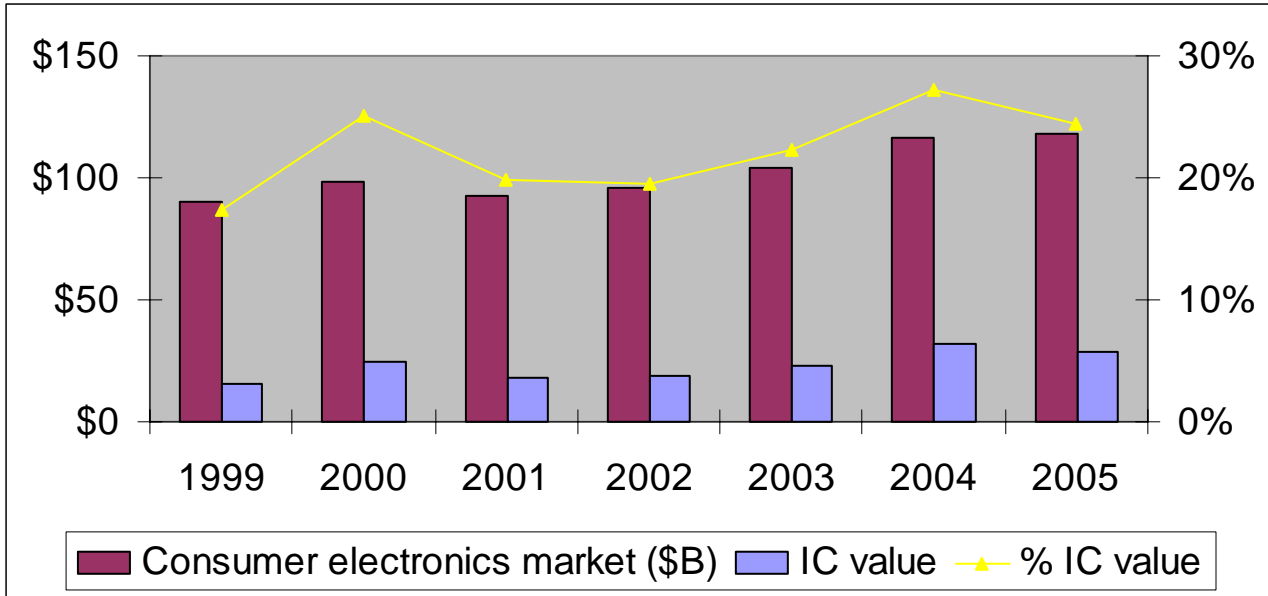


**Automotive System
LTCC**

Courtesy: National Semiconductor



Consumer Markets





Smart Cards



Source: UBIQ

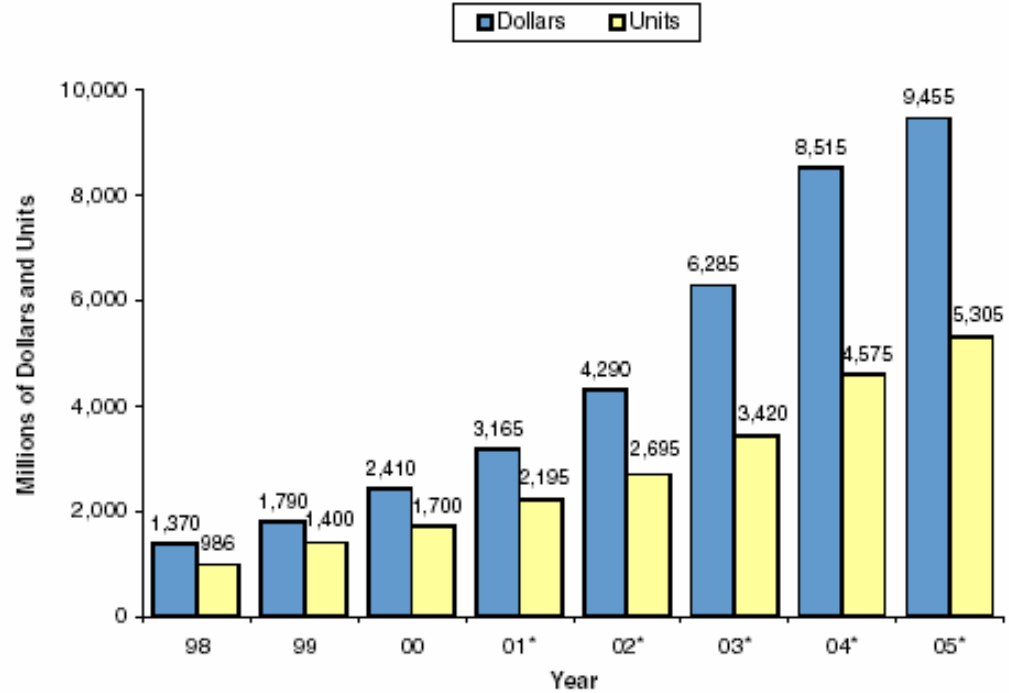
- ❑ US Market expected to grow from 9% of total (2000) to 17% in 2005
- ❑ ASP's < \$1

Smartcard IC Sales Leaders

Company	2000 (\$M)
1 Infineon Technologies	515
2 STMicroelectronics	465
3 Atmel	110
4 Philips	75
— Other	105
Total	1,270

Source: IC Insights

Smartcard Market (1998-2005)



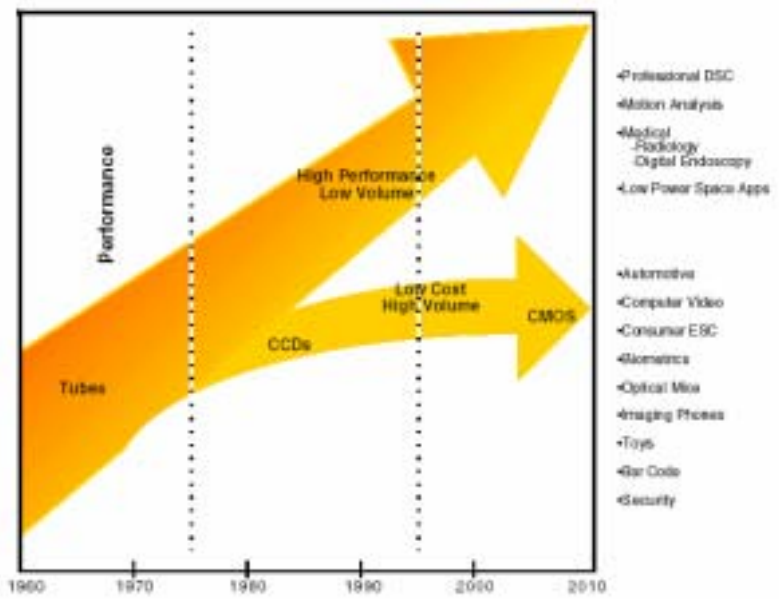
Source: IC Insights

*Forecast



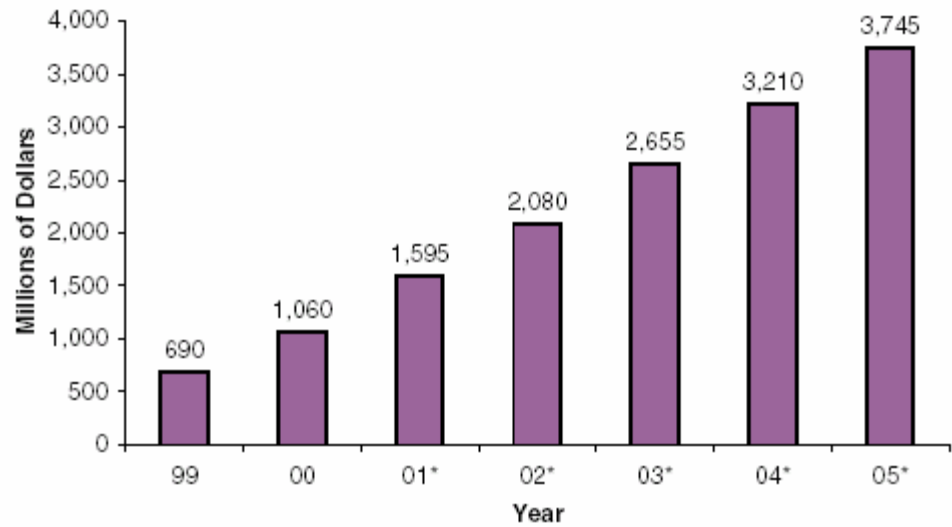
Digital Camera

Image Sensor Technical Migration Trends



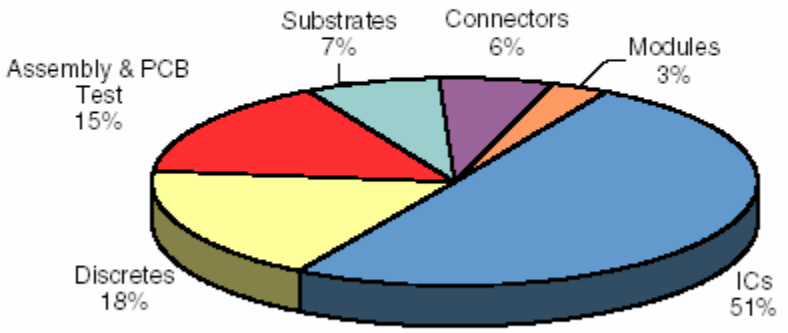
Source: Bantors

IC Market for Digital Cameras



Source: IC Insights

*Forecast

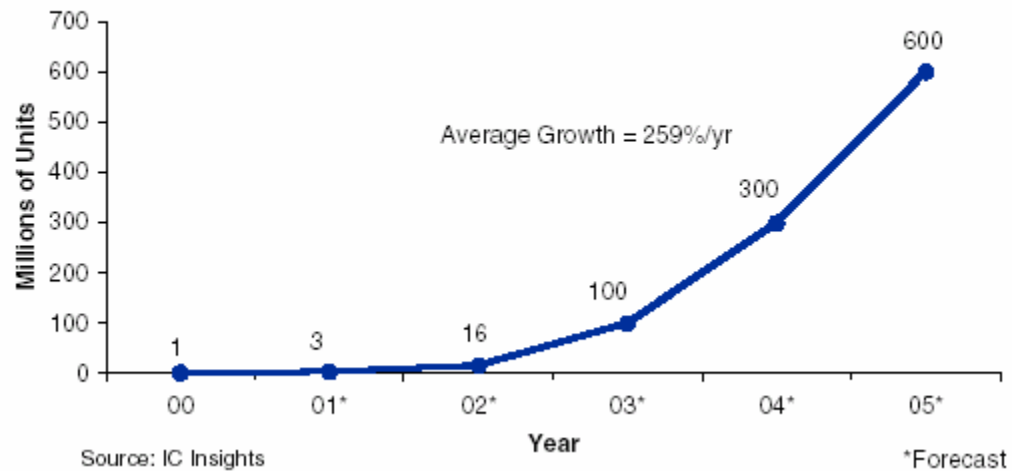


Source: Portelligent, Inc.



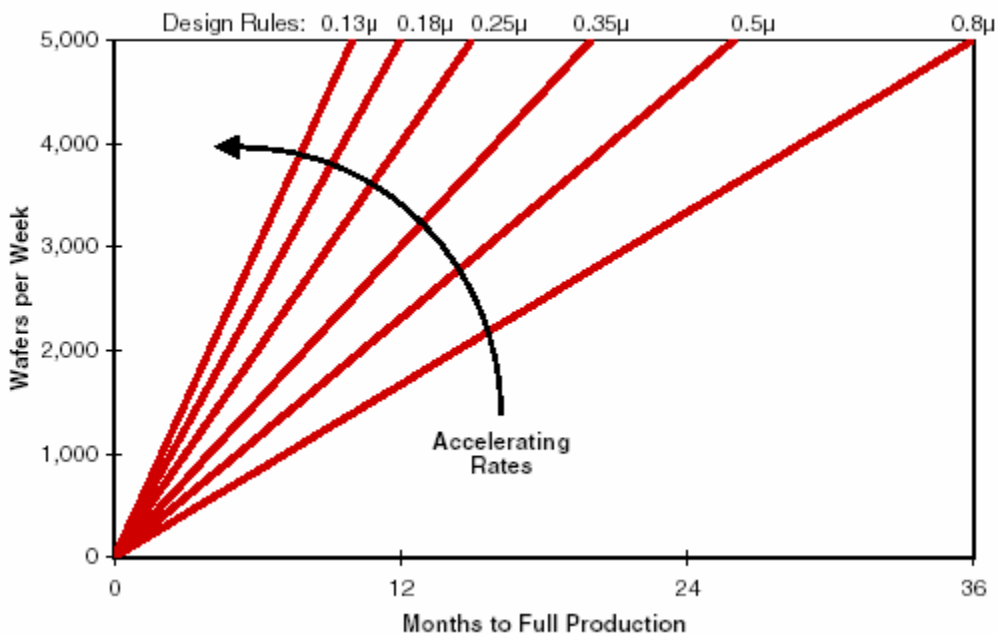
Wireless networks

Bluetooth Module Unit Shipment Forecast





Fab Ramp-Up Rates Are Accelerating



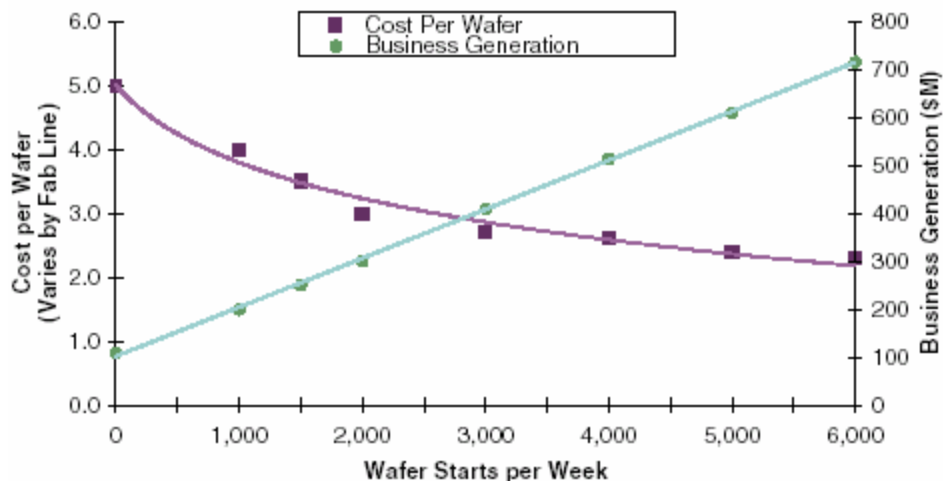
Source: Rose Associates, IC Insights

Time to market is critical for optimum utilization of equipment and to insure maximum market penetration

Die products have a distinct advantage in time to market

- FAB ramp rates shorter than design cycles for SOC

Importance of Reaching High Yield Quickly



Source: Lucent Technologies, WaferNews



Multi chip packaging is on the horizon - NOW!

❑ ITRS 2001 - . . . Shift in multichip packaging where SIP is becoming the fastest growing area of packaging

- Integration benefits
- Passives included
- Utilizes low-cost packaging infrastructure
- COB, FC, and TAB

❑ The multichip BGAs (SIPs) of today are similar to conventional MCMs,

- Conventional MCMs are fully custom designed, large sized, high-density substrates on which tens or hundreds of components are mounted
 - These types of MCMs will continue to serve their very high-performance, low-volume niche
- SIPs feature a few chips (less than five) on a low-cost laminate substrate, are typically targeted at medium- to high volume markets, and are indistinguishable from single-chip BGAs both visually and with regard to mounting/handling.

Example of a Multichip BGA with Three Different Dice



Source: Amkor Technology

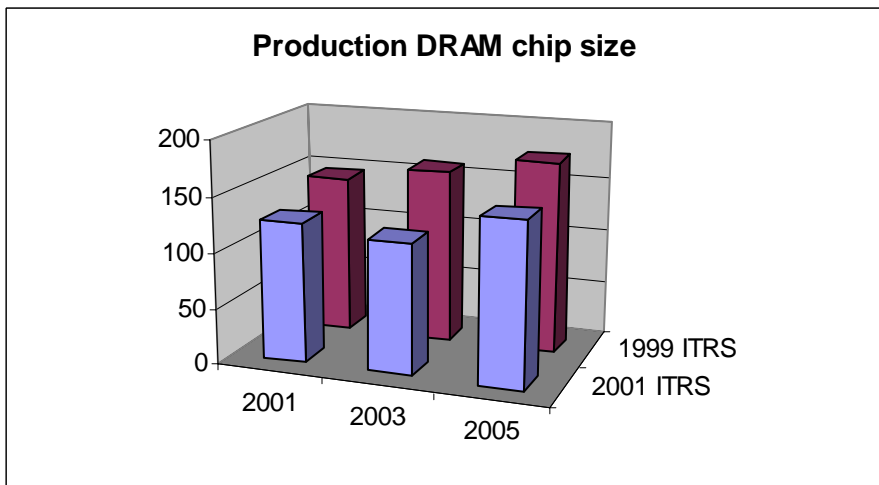
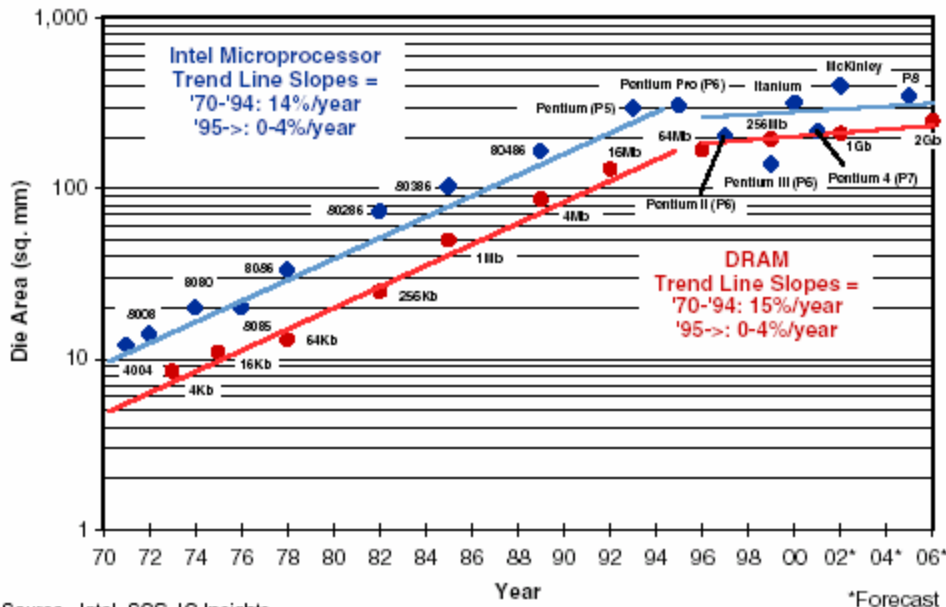
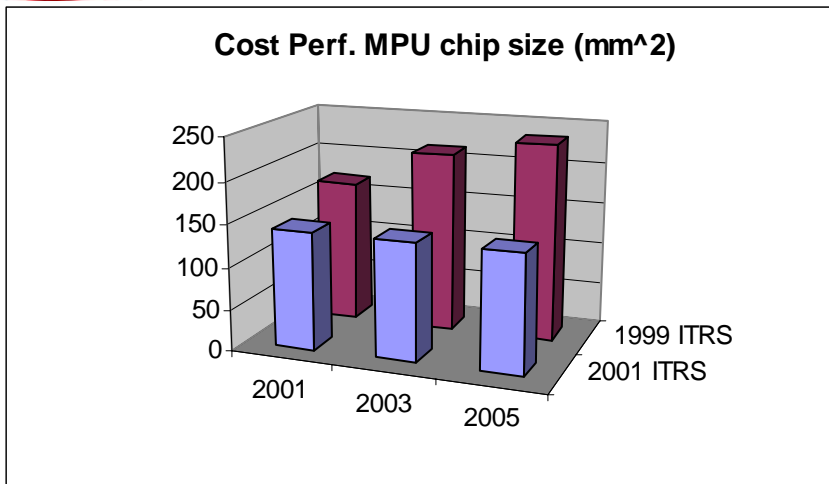


Die Products is recognized as the 4th Wave of packaging Innovation in the ITRS 2001

- Different die technologies and/or functions can be assembled in the same package**
- Dissimilar die geometries can be assembled**
 - Latest die technology can be used for each function
 - Reduce cost
 - Increase performance
- MEMS, optical, vision may be included in package**
- Different interconnection technologies in same package**
 - Wirebond, flip-chip, TAB, ?
- Passives, antennas, filters, shields, etc can be incorporated into package**
- Revisions/upgrades to OEM product are easily accomplished**
- Simplify BOM for OEMs**



ITRS predictions “bending” Moore’s Law?



- ❑ **2001 ITRS “reflects additional competitive requirements for affordability and power management by targeting flat chip size trends for both high perf and cost per MPU”!**
- ❑ **Design/process improvements must supplement litho-based scaling trends or MPUs will slow the Moore’s law rate.**

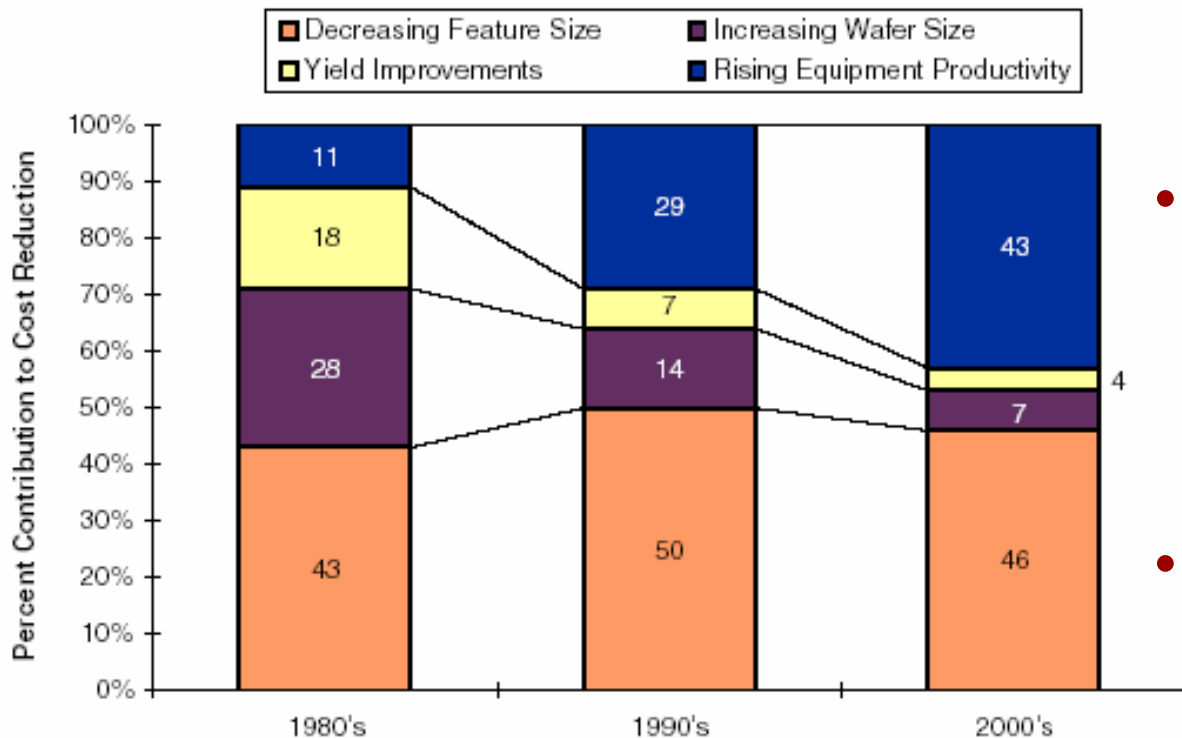


Die Products Grand Challenge –drive current generation of productivity improvement

Relevant Tasks

- Value added test methods
- Effective standardization
 - EDX
 - “Narrow the choices”
- Encourage development of infrastructure
 - MCP equipment
 - Additional die suppliers
- Industry Resources
 - Web
 - Workshop(s)
 - Consultant network

How Costs Continue to be Reduced



Source: Sematech, IC Insights