Figure from "Fundamentals of Microelectronics Sys Packaging" Rao Tummala
Computers and Business Equipment
Representative products

- Calculators
- Desktop PCs
- Printers
- Notebooks
- Photocopiers
- Personal digital assistants
- Workstations
- Servers
- High performance computers
Communication
Representative products

- Cellular/PCShandsets
- Linecards
- LANcards
- Pagers
- Modems
- Faxmachines
- LANswitches
- Routers
- Mainswitches
- Cellular and PCS base stations

Cellular phone is the mascot of this wireless revolution
Automotive Electronics

- All on-board electronic modules, systems, and sub-systems that have electronics content.

Automotive Electronic Systems:

- Engine control and management systems
- Transmission controllers
- Cruise controllers
- Braking controllers
- Traction controllers
- Suspension controllers
- Steering controllers
Automotive Electronic Systems…

- Lighting, wipers and air conditioning/heating systems
- Electronic dashboard and mirrors
- Safety, convenience and entertainment systems
Figure from "Fundamentals of Microelectronics Sys Packaging" Rao Tummala
Figure from "Fundamentals of Microelectronics Sys Packaging" Rao Tummala
Consumer Electronics
Representative products

- VCR
- Compact audio systems
- Music CD players
- Game systems
- Game cartridges
- Watches
- Portable audio players
- Camcorders
Consumer Electronics
Representative products…

- Smart cards
- Microwave ovens
- TV sets

Performance is typically not leading edge, and reliability requirements are relaxed
Cost is usually the overriding criteria
Produced in high volumes
Industrial and Medical systems

**INDUSTRIAL & MEDICAL**
$105B 10.6%$
- Instruments
- Process Control
- Oscilloscopes
- Motor Control
- Power Supplies
- Hearing Aids
- Transaction Terminals

**COMMUNICATIONS**
$259B 26.1%$
- Handsets
- Wireless Phones
- Line Cards
- LAN Cards
- Pagers
- Modems
- Fax Machines
- Switches & Routers
- Wireless Base Stations
- Switching & Transmission

**CONSUMER**
$112B 11.3%$
- Smart Cards
- Clocks & Watches
- Portable Audio
- CD Players
- VCR's
- Game Systems
- Cameras
- Set Top Boxes
- Satellite TV
- Camcorders

**AUTOMOTIVE**
$48B 4.8%$
- Entertainment
- Engine Control
- Safety
- Body Control
- Navigation
- Instrumentation

**COMPUTER & BUSINESS EQUIPMENT**
$383B 38.6%$
- Desktop PC's
- Low Cost PC's
- Printers/ Scanners
- Notebooks
- Photocopiers
- PDA's
- Servers & Workstations
- Point of Sale Terminals
- Calculators/ Organizers

*Figure from "Fundamentals of Microelectronics Sys Packaging" Rao Tummala*
Industrial and Medical systems…

Representative products

- Test and measuring devices and instruments
- Calibrators
- Process control systems
- Motor controls
- Uninterruptible power systems
- NC controls
Representative products…

- Vision systems
- Robotics
- Hearing aids
- ECGs
- Implants
- Medical imaging systems
Military Electronics Systems

- **Automotive**
  - $48B (4.8%)
  - Entertainment
  - Engine Control
  - Safety
  - Body Control
  - Navigation
  - Instrumentation

- **Industrial & Medical**
  - $105B (10.6%)
  - Instruments
  - Process Control
  - Oscilloscopes
  - Motor Control
  - Power Supplies
  - Hearing Aids
  - Transaction Terminals

- **Consumer**
  - $112B (11.3%)
  - Smart Cards
  - Clocks & Watches
  - Portable Audio
  - CD Players
  - VCR's
  - Game Systems
  - Cameras
  - Set Top Boxes
  - Satellite TV
  - Camcorders

- **Communications**
  - $259B (26.1%)
  - Handsets
  - Wireless Phones
  - Line Cards
  - LAN Cards
  - Pagers
  - Modems
  - Fax Machines
  - Switches & Routers
  - Wireless Base Stations
  - Switching & Transmission

- **Computer & Business Equipment**
  - $383B (38.6%)
  - Desktop PC's
  - Low Cost PC's
  - Printers/Scanners
  - Notebooks
  - Photocopiers
  - PDA's
  - Servers & Workstations
  - Point of Sale Terminals
  - Calculators/Organizers

Figure from "Fundamentals of Microelectronics Sys Packaging" Rao Tummala
Military Electronics Systems

- Market depends on very complex relationships between global political scenarios, strategic interests of Western nations

Important products of this category

- Mobile communications
- Fire control systems
- Missiles
- Avionics radar
- Satellite links
- Land-based radar and communication systems
PRODUCTS
The users are the reason for products.

Users are not concerned
- with the internal details of the product
- how it is designed
- how it is manufactured etc.

Users
Want to use products effectively
Use them for a long time
(But this is the utmost concern for engineers and industry)
Main interests of a user in a product

- Function and features
- Simplicity in understanding its use
- Ease of use and taking care of the product
- Reliability
- Its features in comparison to the competing products
- After sales service
- Happiness and pride in owning, and using the product
- Cost
A simple view of an electronic product

- System Functions
- System Architecture
- ICs and Components
- System Level Packages (Boards, rocks and enclosures)
- User Interface
- Software
Examples of System Functions

- MIPs or FLOPS of a computer
- Power capacity, efficiency of power conversion, cleanliness of its output, and power density (footprint) of an SMPS
- Extended battery life of portable products
- A cell phone has to provide reliable communication
- Automobile engine controller: operating reliably under the adverse environmental conditions
Integrated Circuits (ICs)

- Main elements of an electronic product
- Enable us to build the required functionality into the product
- Available off the shelf or as ASICs

A product also requires

- Passive components (resistors, capacitors and inductors)
- Electrical/electromechanical components (switches, connectors, cables, jumpers etc.)
A product also requires…

- Cooling components (fans and heat sinks),
- Magnetic/optic storage components
- Optical interconnects
- Batteries
- Display components (LEDs, LCDs, CRTs and plasma displays)
What is Electronics Packaging?

“Science and art of providing a suitable environment to the electronic product as a whole to perform reliably over a period of time”

Major functions of Electronics Packaging

- Signal distribution
- Power distribution
- Heat dissipation (cooling)
- Protection (mechanical, chemical, electromagnetic)

The package must function at its specified performance level
Other definitions for ‘electronics packaging’

- The process of assembling a group of discrete electronic circuit elements into an electronic assembled device.

- Specifically, the grouping or combining of components, integrated circuits or chips into a unit and through holes on a multilayer circuit board with subsequent soldering of the above items onto the printed wiring of the board. Electronic packaging generally involves taking a concept of circuit design and making a finished circuit.
Other definitions for ‘electronics packaging’ …

(Synonyms: electronic component packaging, electronic systems packaging, electronics assembling, electronics assembly process, electronics packaging)

- The process of converting a circuit schematic design into a working (prototype) manufacturable assembly unit, which should be of high performance, cost-effective, highly reliable, easily testable and one that can sustain the external environment (temperature, moisture, dust, IR, vibration shock, fatigue failure etc) for a reasonable period of time. The process shall follow the principles of ‘Design for Manufacturability’, ‘Design for Reliability’, and ‘Design for Testing’.
Levels of Packaging

Level 0: Interconnections on a monolithic silicon die
Level 1: Packaging silicon dies into single chip packages
Level 2: Multi chip modules based on chip-set technologies
Level 3: Printed wiring cards and boards
Level 4: Complete electronic systems consisting of several subassemblies (boards, racks and frames)
Die size?
Technology?

Wafer size?
Wafer fab cost?

Level 1
Integrated Circuit

Level 2
Multichip Module

Level 3
Printed Circuit Board (PCB)
   Through hole
   Surface Mount
   Bare die-direct
   chip attach (DCA)

Level 4
System

Level 3
Motherboard