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FUTURES INC.
Your Bridge to the Future

Digital Convergence: What The Future Holds

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World Current Status Drivers

- We live in an information age, driven by needs for precision, accuracy, and timeliness in all of our endeavors—personal, commercial, and governmental.
- As society becomes increasingly mobile and global, reliance on the worldwide availability of information will increase.

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Information Avalanche

- **The Situation**
  - We can record everything
  - Everything is a LOT!
- **The Good News**
  - Changes science, education, medicine, entertainment…
  - Shrinks time and space
  - Can augment human intelligence
- **The Bad News**
  - The end of privacy
  - Cyber crime/cyber terrorism
  - Monoculture
- **The Technical Challenges**
  - Amplify human intellect
  - Organize, summarize, and prioritize information
  - Make discovery and analysis easy

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How the World Has Changed

- Most businesses are global *at launch*
- Businesses are increasingly real time
- Convergence has become a way of life
- Science, product development, and product cycles are compressing
- The source of value has shifted for manufacturing
- Competencies, future capabilities, and "ultra tech" are the prime driver
- The traditional value chain is forever dead

The World We Live In Global Changes

Examples:

Education

Reduced foreigners in U.S. academia

Economics

Integration of IT based global markets

Connectivity

Connectivity all the time, everyplace

Societal

Commercialization of government services

Conflicts

Conflicts over Resources

Physical Environment

Geospatial changes affect current databases

Biotechnology

Global Destabilization due to AIDS

Energy

Switch to hydrogen economy

Resources

Resource shortages from growth

Geopolitical

"Meaning communities" confuse concept of national loyalty

Knowledge

Exponential data explosion

Demographics

Most growth at poorest/unstable spots

Technology

Nanorobotics

Extraterrestrial Event

Extraterrestrialization of civilization

… and alternative scenarios

Source: Technology Futures, Inc.
Data Source: NIMA Understanding Global Change Workshop (November 2002)

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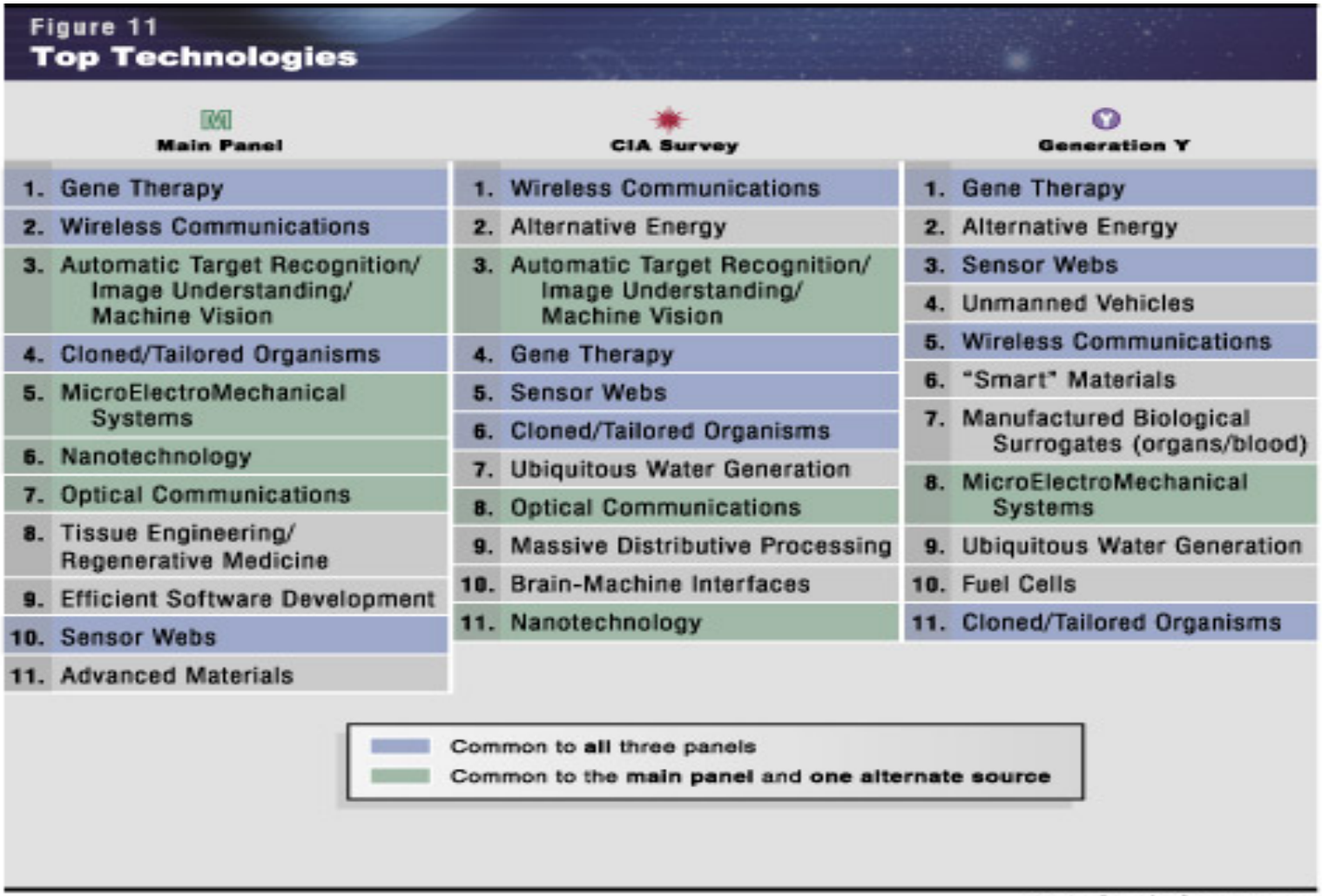
IC Technology List



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Technology Webster's

- The science of the practical or industrial arts
- Applied science
- A method of achieving a practical purpose
- The totality of the means employed to provide objects necessary for human sustenance and comfort

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What is Technology?

"Application of knowledge to objectives"

—J. P. McTague, "Wielding a Three-Edged Sword," *Federal Lab Technology Transfer: Issues and Policies* (1988)

America gets more than half its economic growth from industries that barely existed a decade ago—such is the power of innovation, especially in the information and biotechnology industries.

—The Economist

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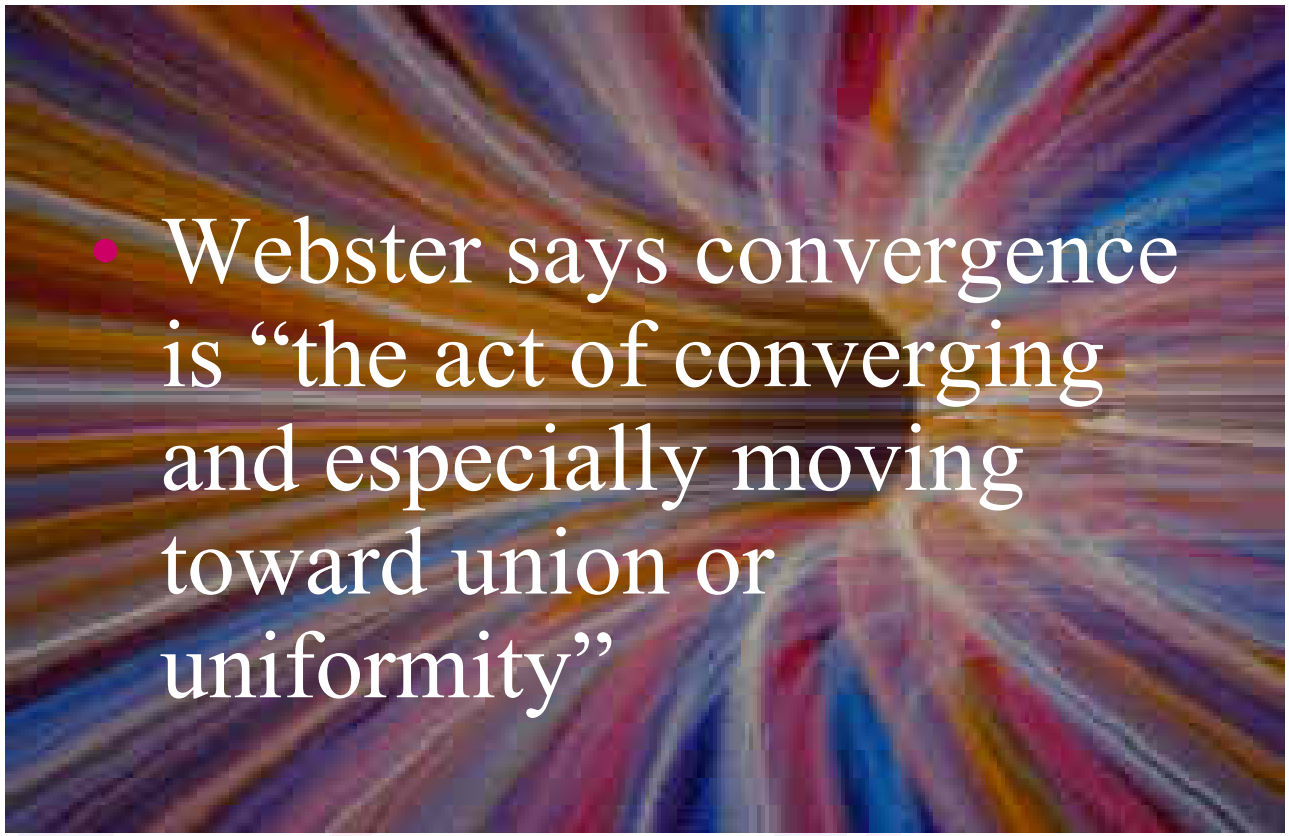
Being Convergent



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Being Digital

- Something is digital when all of its properties and information are stored as a string of zeros and ones
- Each zero and each one is called a bit
  - A bit is a single piece of information
  - "A bit has no color, size, or weight, and it can travel at the speed of light." Nicholas Negroponte - MIT Media Lab

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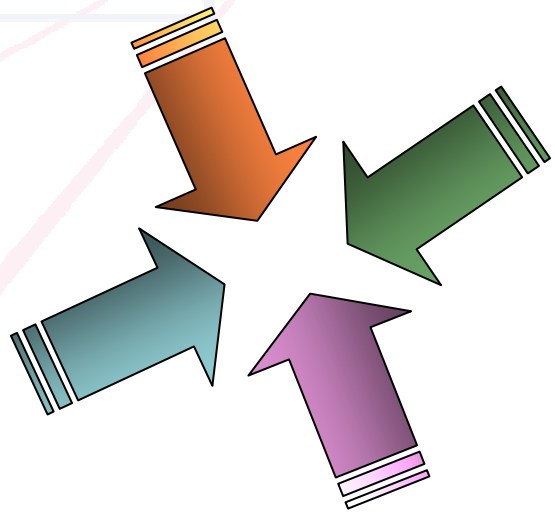
Digital Convergence Defined

- Media industry: coming together of voice, print, video and data formats brought upon by digital technology
  - *de Sola Pool "The Technologies of Freedom", 1983*
- IT industry: Integration of disparate hardware into a network, such as routers, wireless access points, voice over IP technology



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Digital Convergence is the coming together of the underlying digital technology components and features such as voice, texts, video, pictures, broadcasts, presentation, streaming media, global connectivity and personalized services; the combination of all of theses features and abilities from multiple electronic systems into a simplified, converged digital communication system to enable individuals to interact, play, communicate, collaborate and share information in many new and different ways. This convergence includes the infrastructure, base elements, devices, services, and content.

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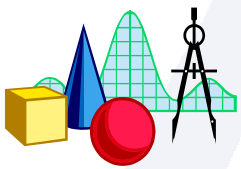
What is Convergence?

- **Of Network:**
  - Audio (voice, music), data (text, transactions, messages, sensors), images (still, video, movies)
  - Wireline, wireless

- **Of Industry:**
  - Telecom, information technology, broadcast
  - Business systems, PCs, consumer electronics
  - Movies, publication, Internet services

- **Of Content:**
  - Image production for games, Internet, TV, movies



- **Of Research:**
  - Business, government, academia

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Digital Convergence Happens Both Vertically and Horizontally:

- Vertically – within one industry sector
- Horizontally – across many different industry sectors

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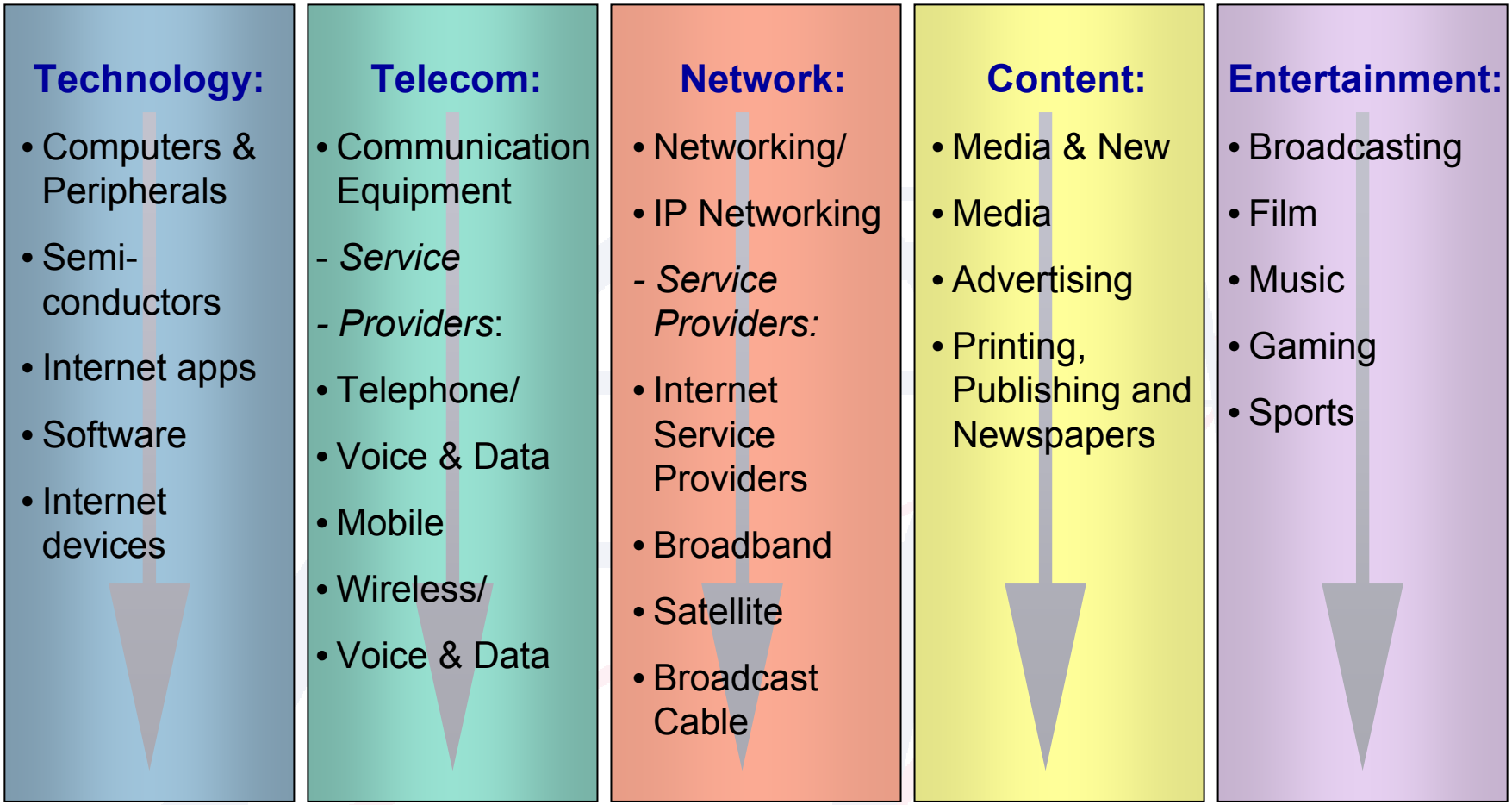
Vertical Convergence with an Industry



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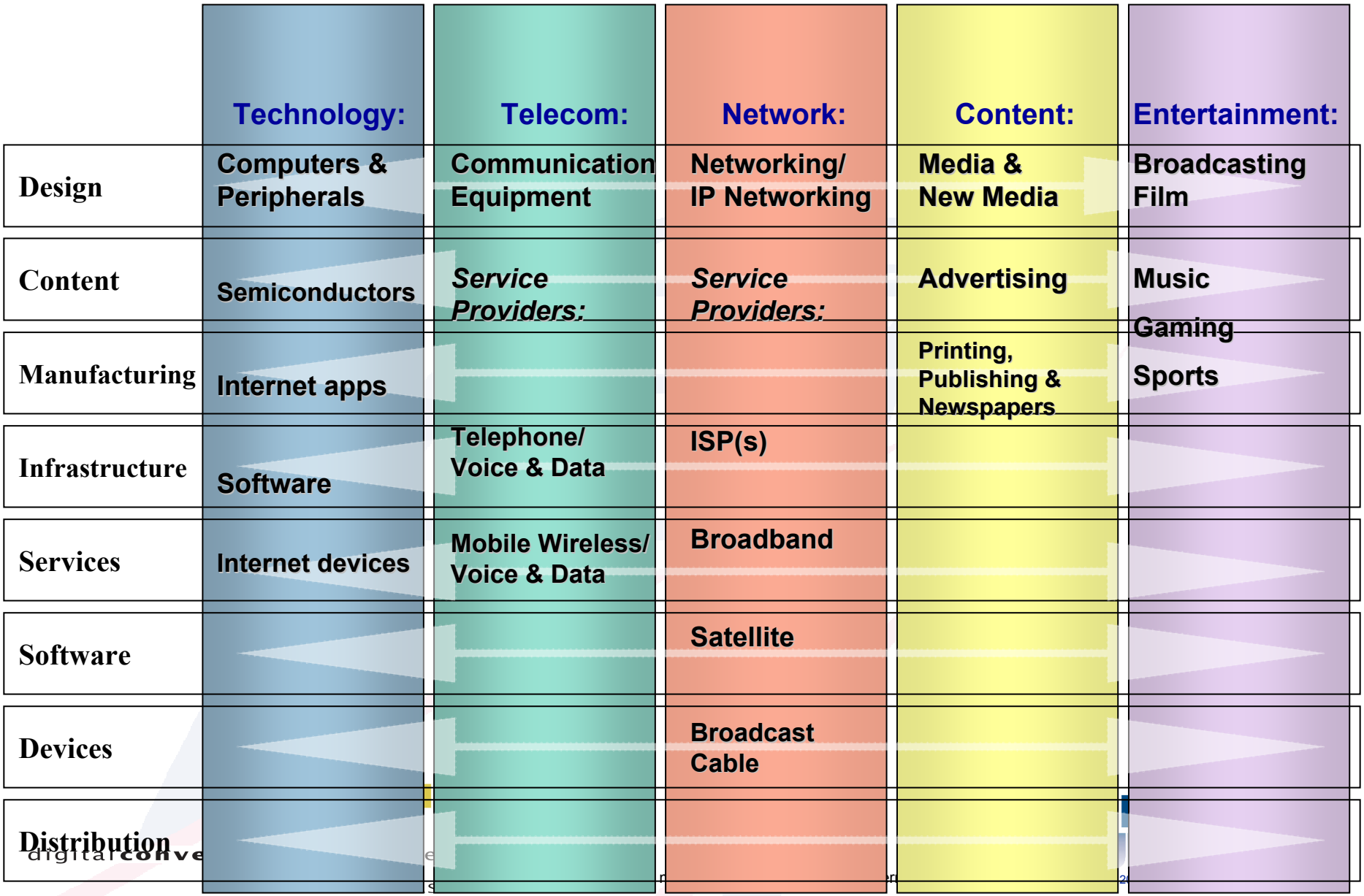
Horizontally across different industry sectors:



Global Convergence

- A second point of convergence is global convergence. The point of convergence here is at least fourfold:

  1) The world is getting smaller due to technology

  2) A consensus is emerging about markets

  3) The world is becoming real-time

  4) Every device is a server

Why is Digital Convergence Possible?

- The movement to real time, The growth of computing and networks and their performance enables the movement to real time
- The fact that every device is becoming a server will further drive real-time and new approaches
- The digitalization of content and delivery makes the ability to cross industries and markets easy
- The world is truly a global market, even the most basic products must be global.

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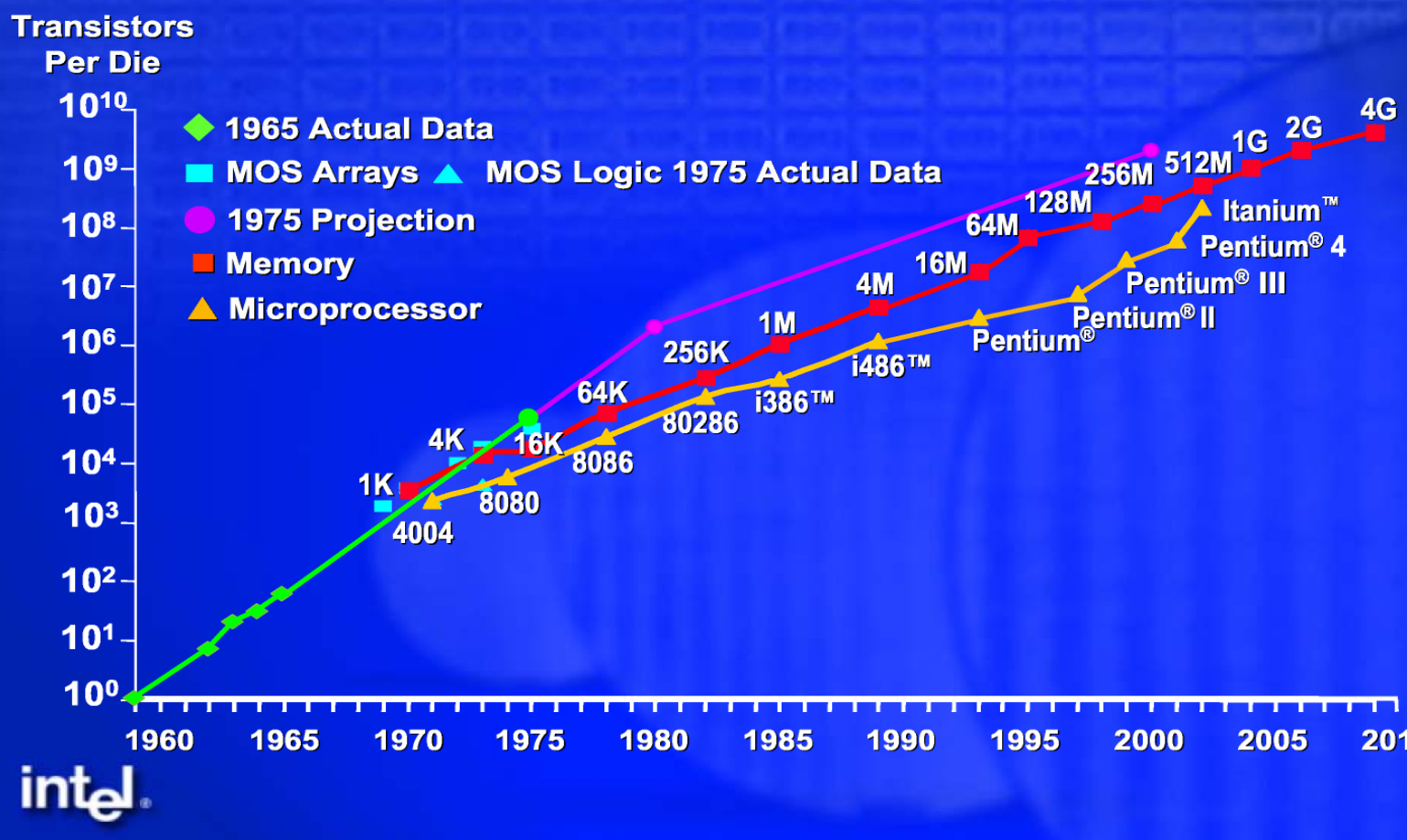
Moore's Law continues to be the benchmark



Source: Intel

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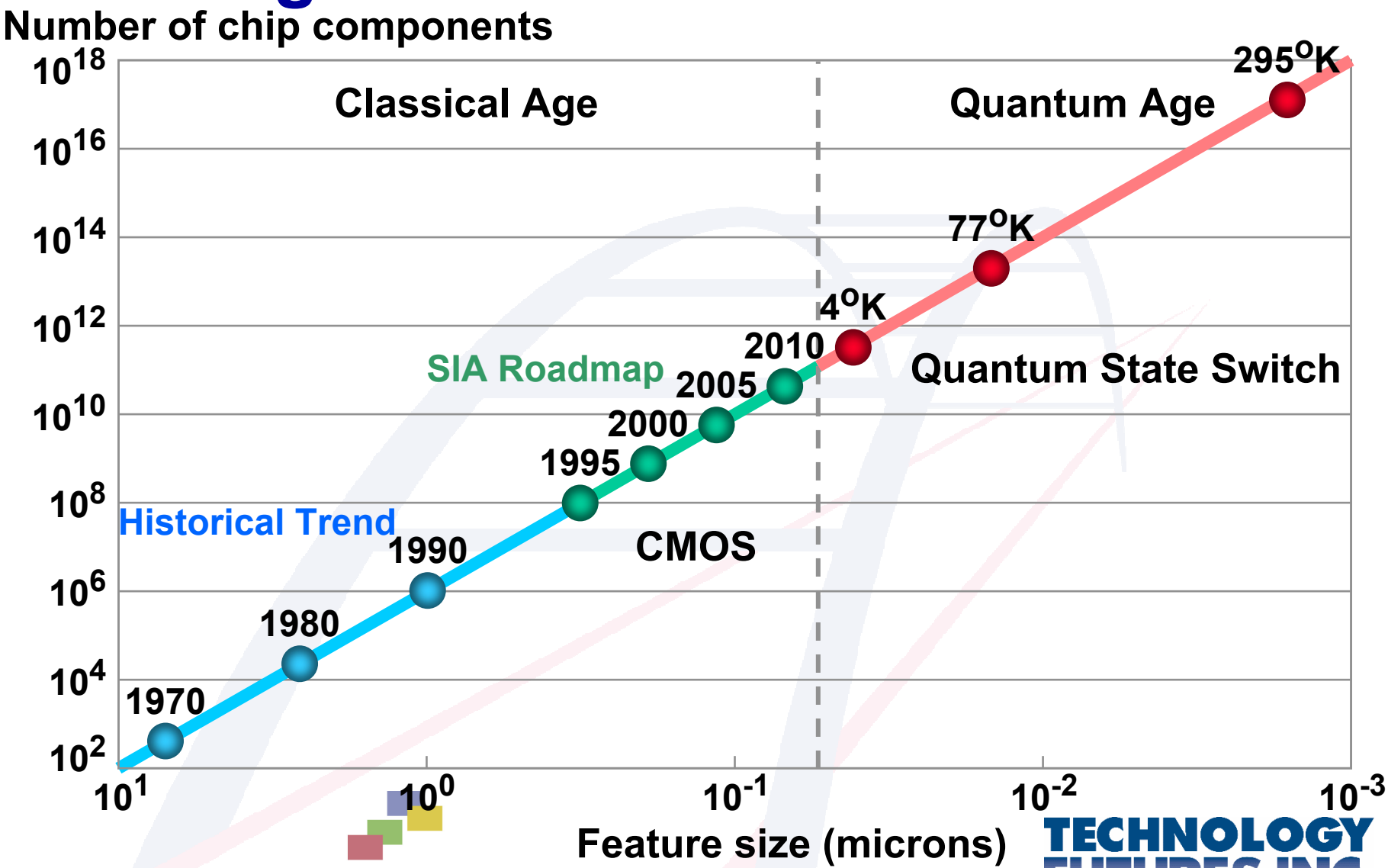
Scaling of Electronic Devices



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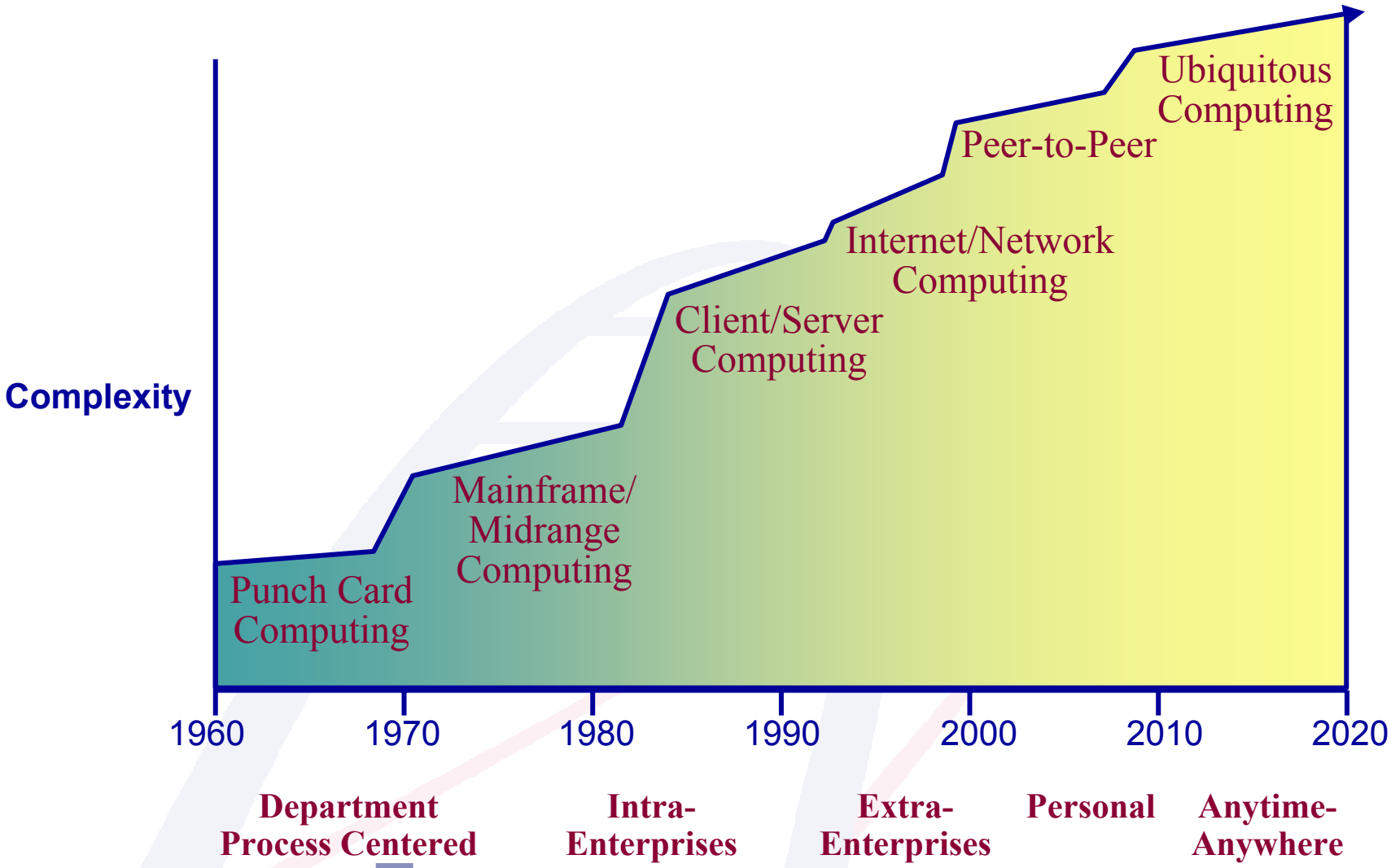

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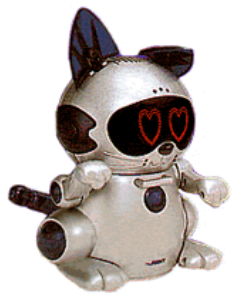
Ubiquitous Computing

- Laptops outsell desktops already
- Handheld PCs are gaining market share
- Appliances become smart
  - Microprocessors in TVs, VCRs, refrigerators, stoves, etc.
    - As the profit margin on basic hardware gets squeezed out, smarts are the next competitive area
- Even your pet…



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Embeddedness
The Invisible Computer

- Embeddedness – digital convergence technologies will “form the invisible technical infrastructure for human action – analogous to the visible infrastructure provided by buildings and cities” (Nordman 2004).
- Embeddedness is driven by cost-effective computing, Moore’s Law, miniaturization, ubiquitous communication, and advanced materials and sensing devices.
- In 2000, 98% of computing devices sold are embedded in products and are not apparent to the product’s user (Borrielllo and Want 2000).

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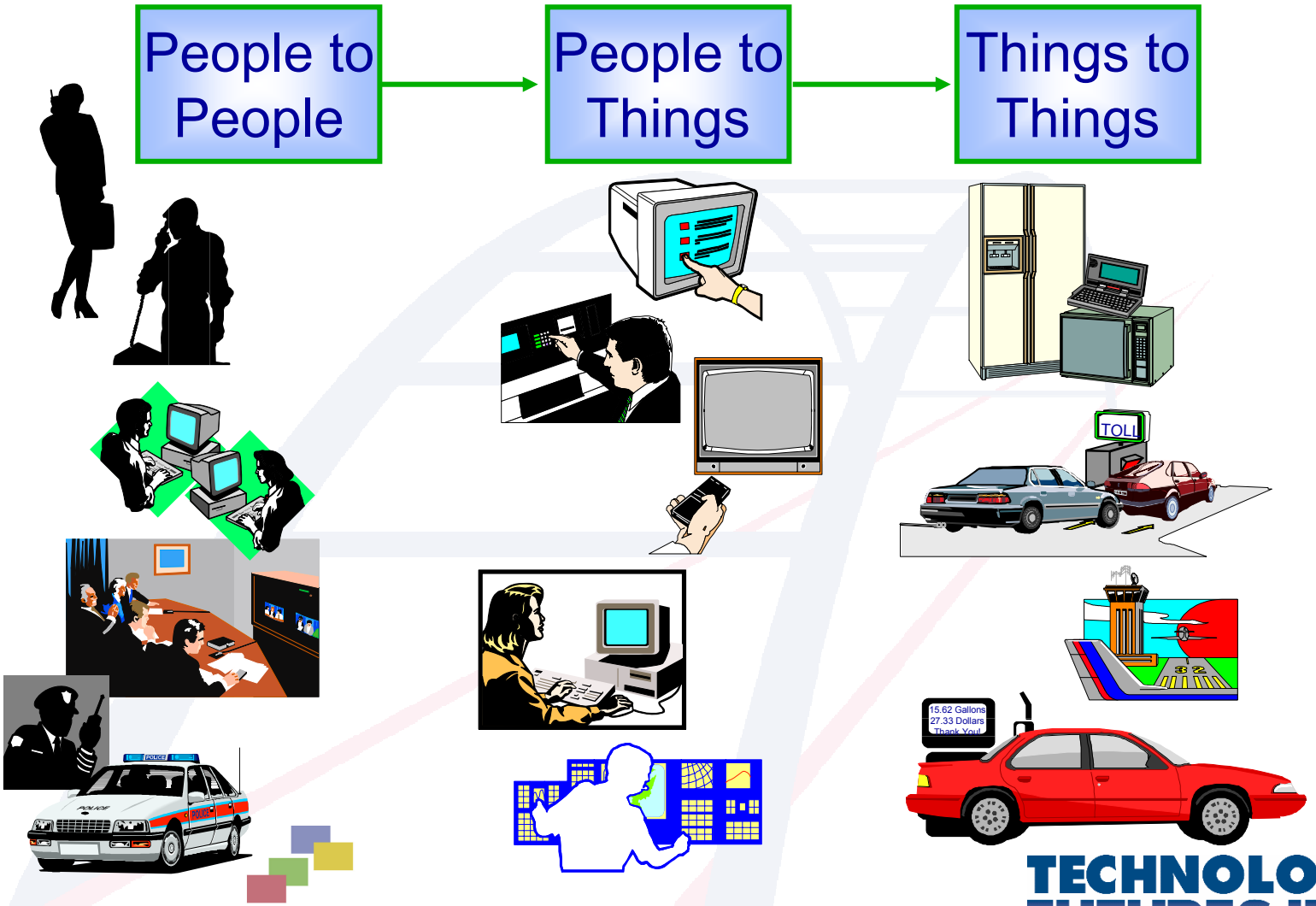
The Nature of Communications Has Been Changing...



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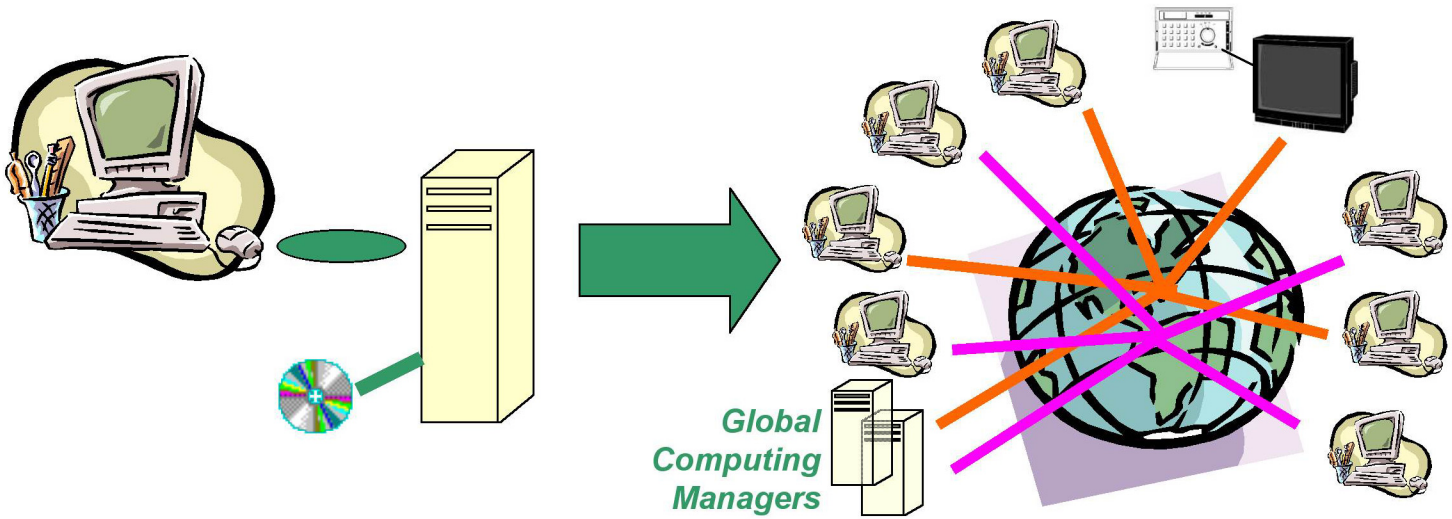
The Global Grid

From Client/Server… **…to every computer's a server**



Client systems are dedicated to needs of a user	Clients systems do work and store data for other users
Single application running in client or server	Application "chunks" run concurrently in multiple systems
A data object resides on a single server	Data object is segmented and stored redundantly

Source: Technology Futures, Inc.

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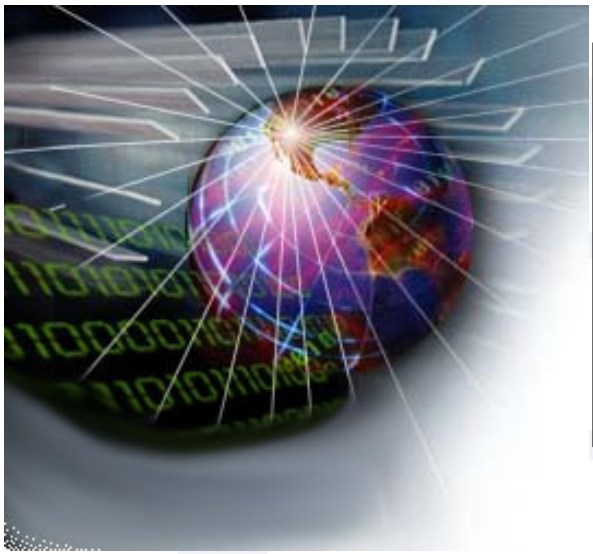
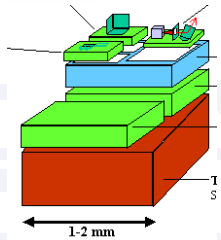
To Every Sensor is a Server

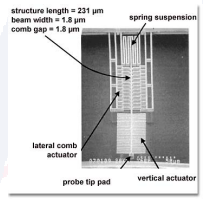


- Processor
- Data Storage
- Communications
- Rich variety of sensors

Phone -PDA

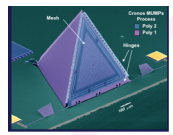


Smart Dust

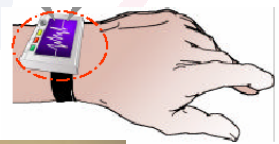


Microstorage

(Areal density 100x's CD)



Microphone



Embedded Biofluidics Chip

Robot

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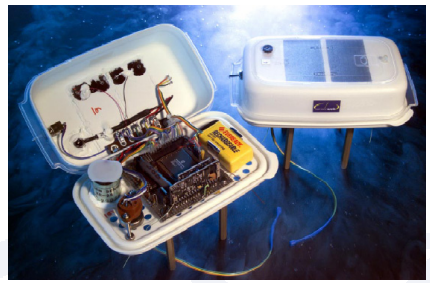
Micro Servers

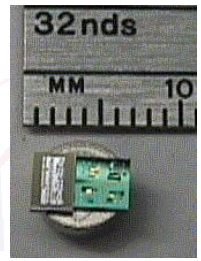
NASA/JPL Sensor Web 1 Pod

Rockwell Scientific Remote Sensor

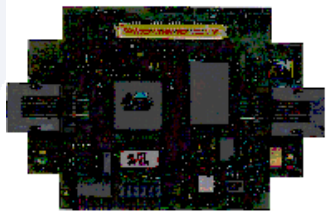


NASA/JPL Sensor Web 2 Pod

XPort Embedded Device Server



Berkeley Mote (1999)



UCLA Medusa MK-2

Crossbow MIICA Mote

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Convergence

- Cable companies are providing phone and ISP service
- Telephone companies in entertainment programming business
- Newspapers online
- Yahoo/eBay magazines

Final View on Convergence

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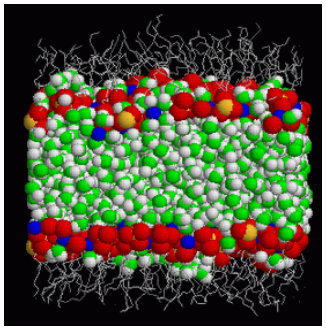
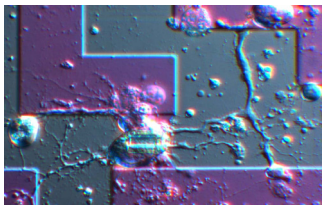
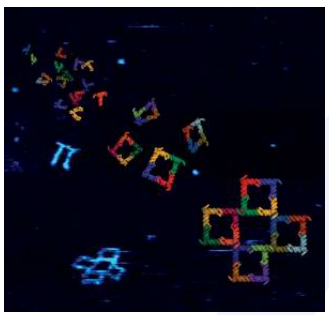
General Drivers





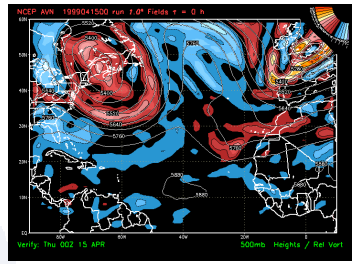


- We are leaving the age of physics and entering the age of bio.
- Mobility will expand even more as a driver.
- Computing and broadband communications will become ubiquitous.
- New forms of computing will emerge (e.g., quantum, DNA, optical).
- There will be a proliferation of location-based services.
- Material science, in conjunction with biotechnology, will create fundamentally new capabilities .

(continued)

General Drivers *(continued)*

- Machines will probably surpass overall human intellectual capability by 2020.
- There will be a proliferation of intelligent devices that communicate to provide telemetry, tracking, metering, monitoring, surveillance, control, response, etc.
- Increased appreciation of the impacts of global warming will motivate major changes in energy production and utilization. There will be a major increase in the use of nuclear power, and there will be a migration to non-fossil fuel and an intelligent energy economy.
- Nanotechnology will not only change medicine, but revolutionize many aspects of our society.



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Drivers for Digital Home Convergence

- Broadband Internet Now Mass Market
- VoIP Telephony Subscription Providers for the Home
- The Growth in the Use of Digital Video, T.V & Music
- Digital Cameras Have Replaced Film-based Cameras
- Online Gaming Increases In Popularity

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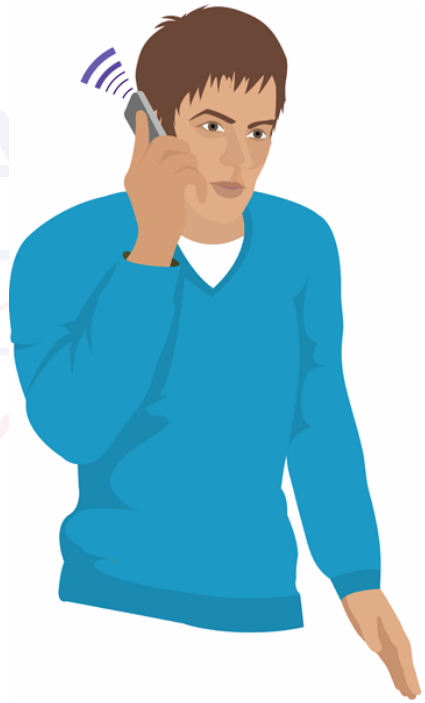
Applications Driving Convergence: VoIP

- Telephony Services via a Broadband Internet Connection
- Cell Service by Wi-Fi
- Inexpensive Calls over the IP network
  - Fixed rates for local, long distance & International calls
- Same Features as Existing PSTN Telephony
  - E.g. caller ID, call return, call waiting etc
- Use Existing Analog Phone
  - Connected to a special Wireless VoIP adapter



Applications Driving Convergence – Audio Visual

» **Digital Videos**

Store downloaded movies and digitalized home videos on a PC. Play videos from the PC on a Television using a wireless connection

» **Digital Videos**

Play digital music from a PC through a stereo or hi-fi system – wirelessly connected to the home network

Applications Driving Convergence – Digital Imagery

- **Digital Photos**

Store digital photos on a PC to share wirelessly across the Internet or print on a wirelessly connected photo-quality printer

Applications Driving Convergence – Media Storage

- Digital photos, video & music files eat up PC hard-drive space
- Provision of home Network Attached Storage (NAS) will be needed
- Solution:
  - Link a hard drive device to the home wireless network

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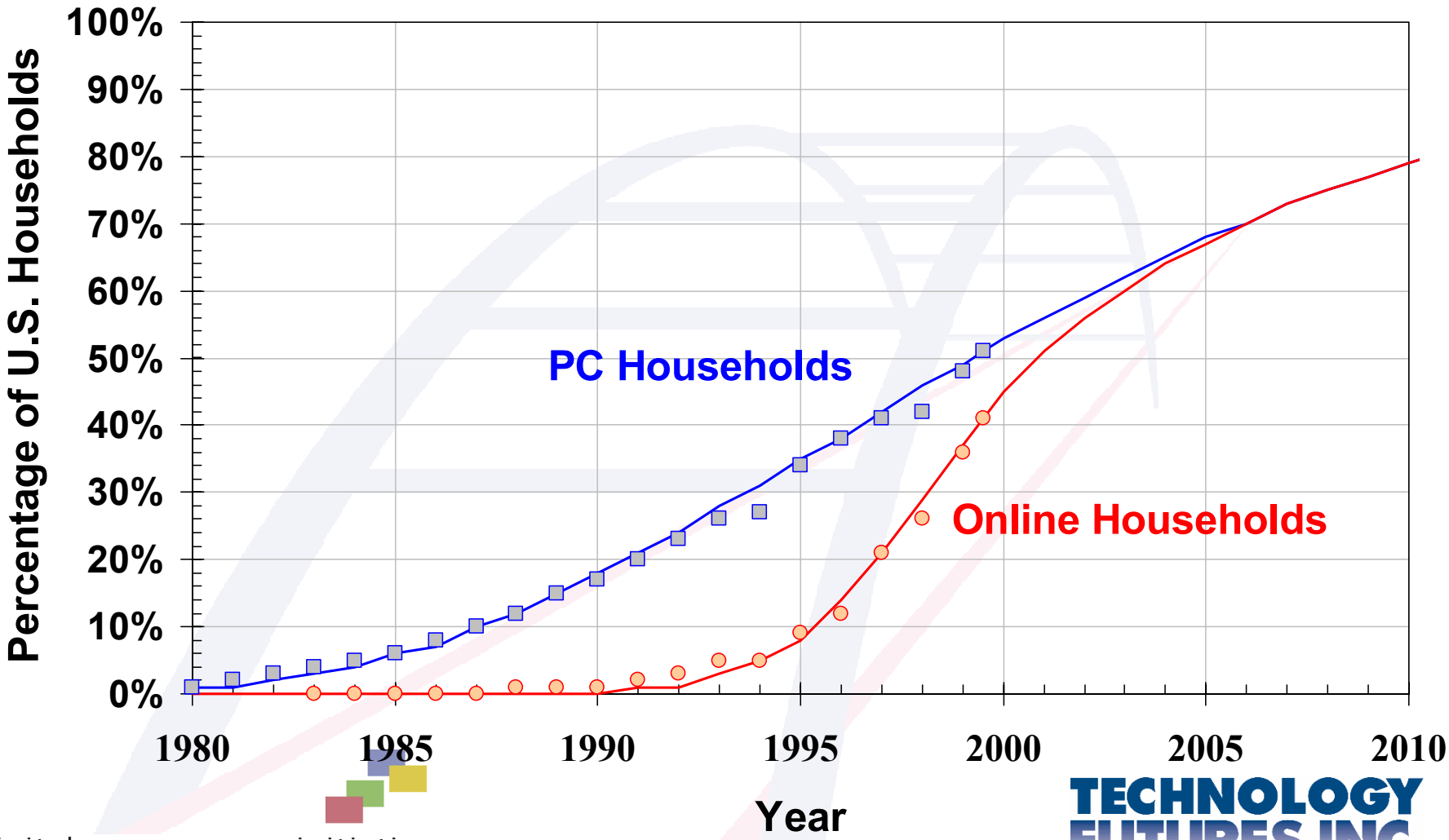
U.S. Adoption of Home PCs and Online Services—TFI Base Forecasts



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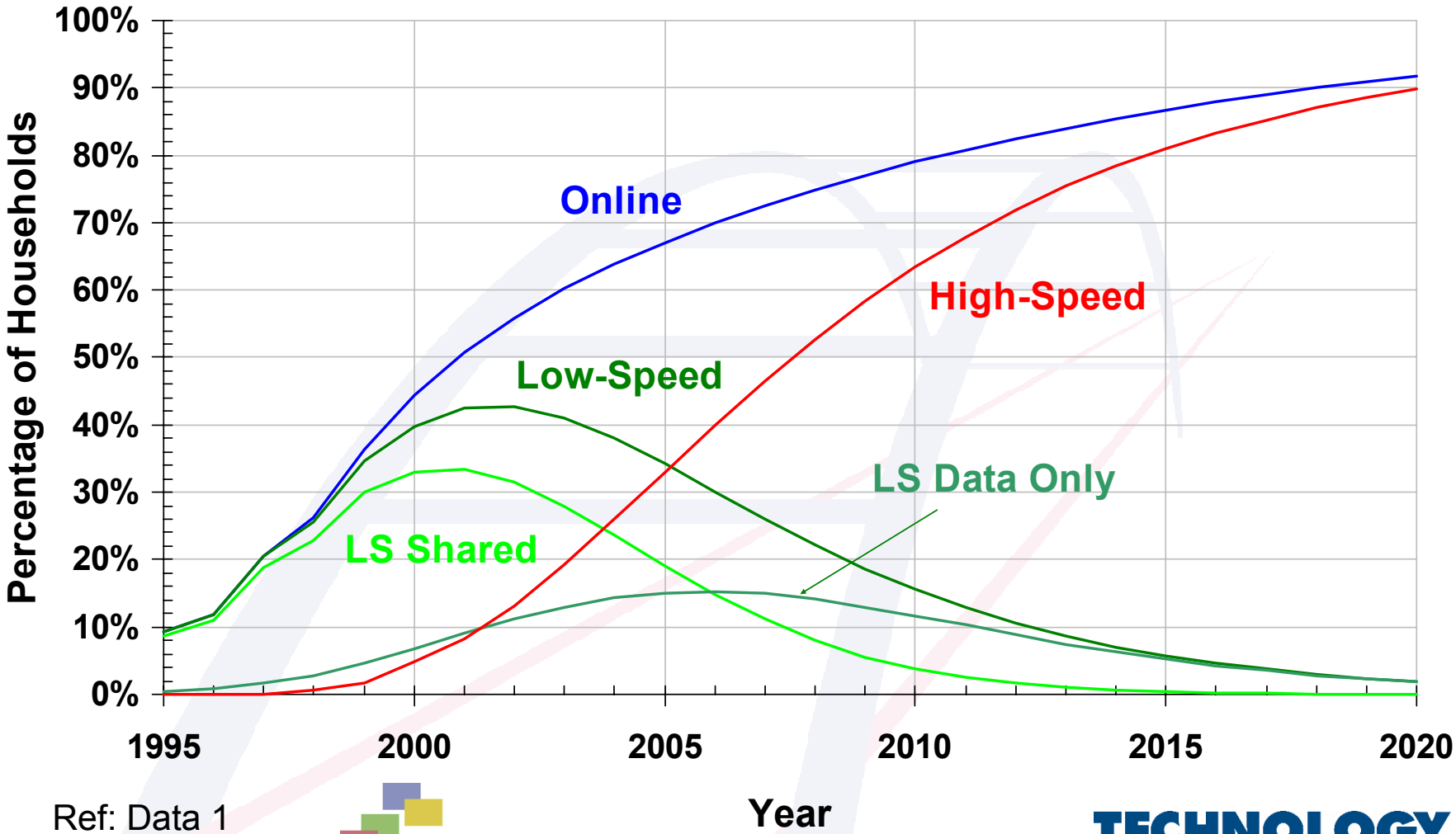
Online Households by Primary Data Access Type



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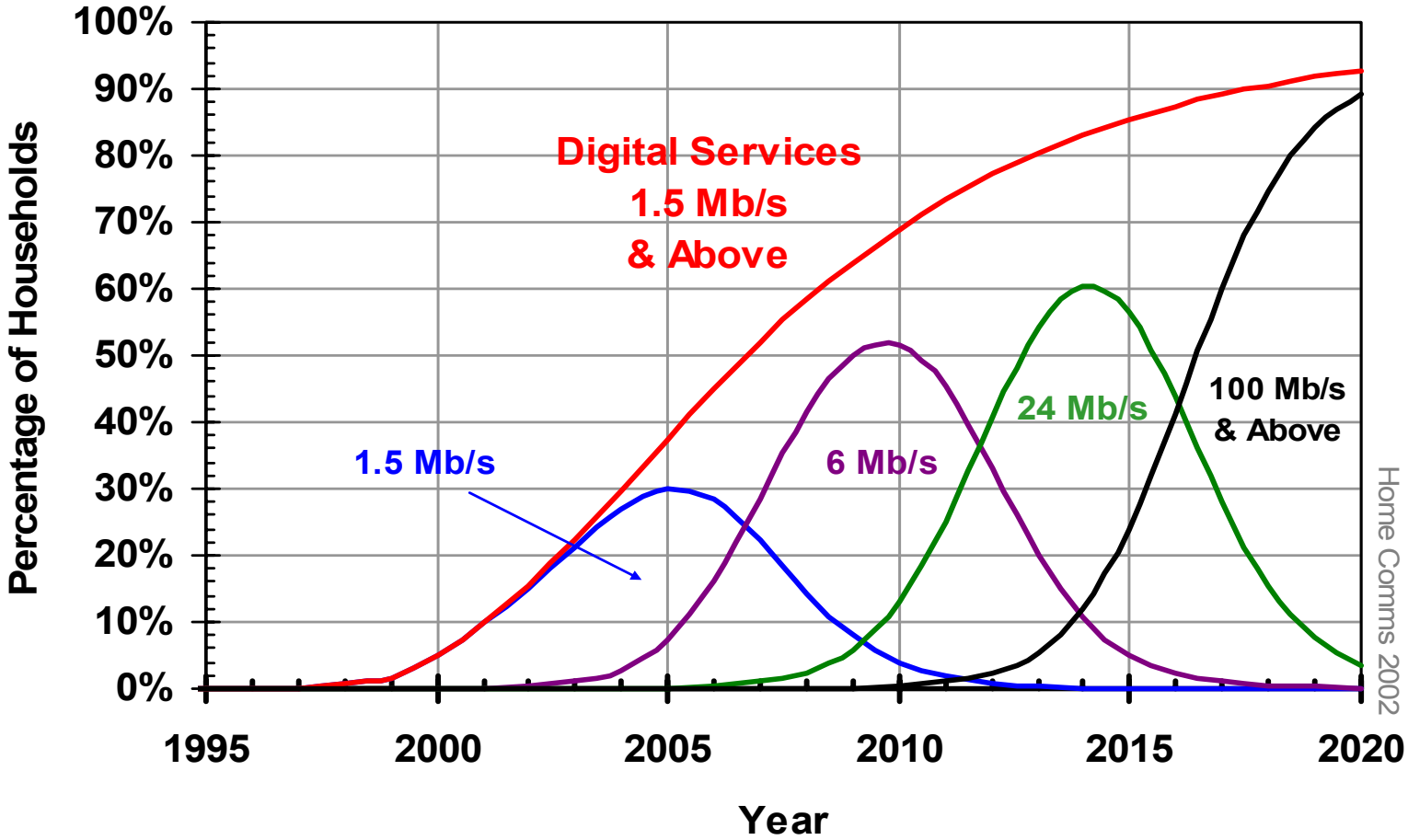
Households Using Digital Services—Minimum Competitive Data Rates



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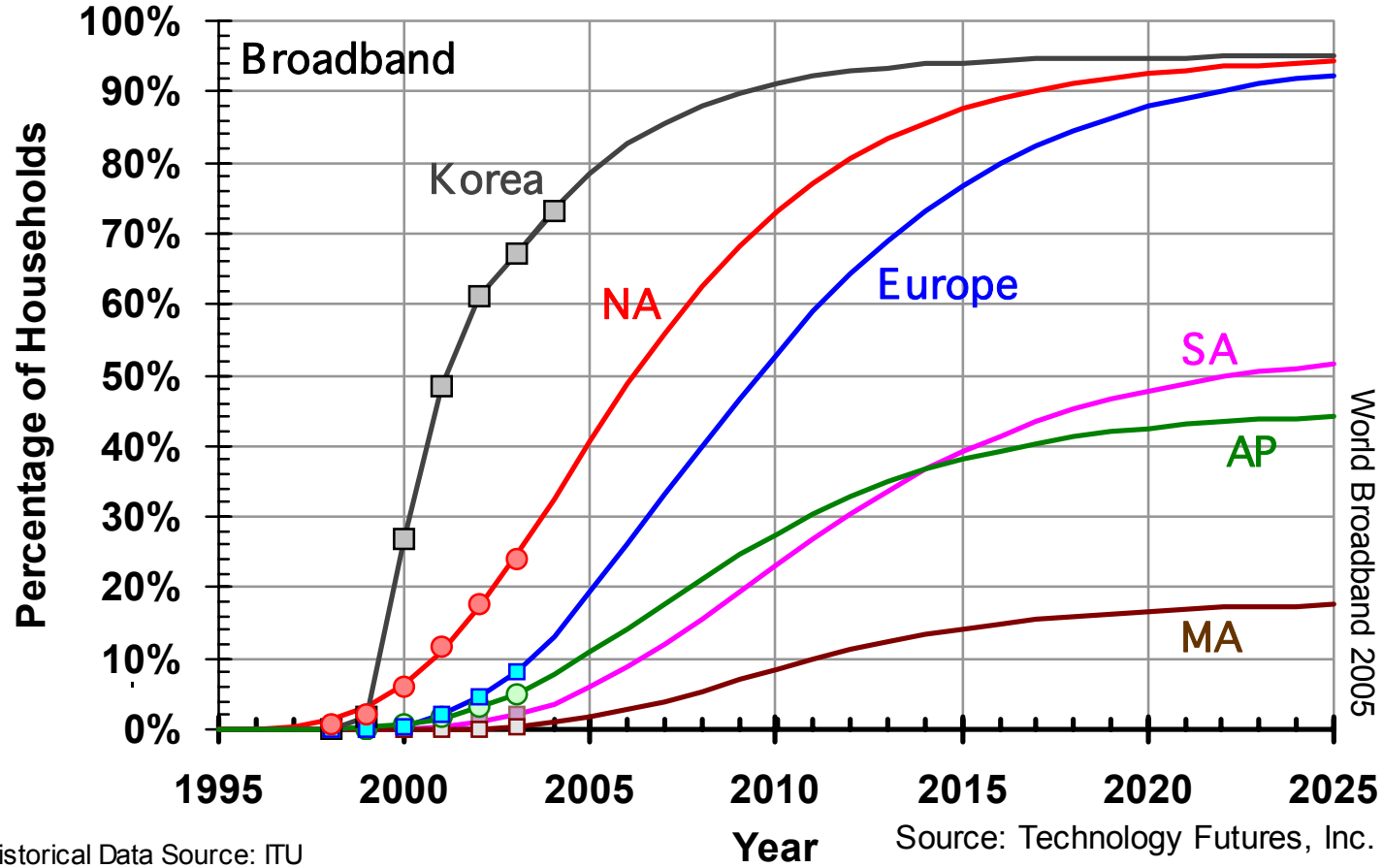
Broadband Penetration – Percentage of Households



Historical Data Source: ITU

Source: Technology Futures, Inc.

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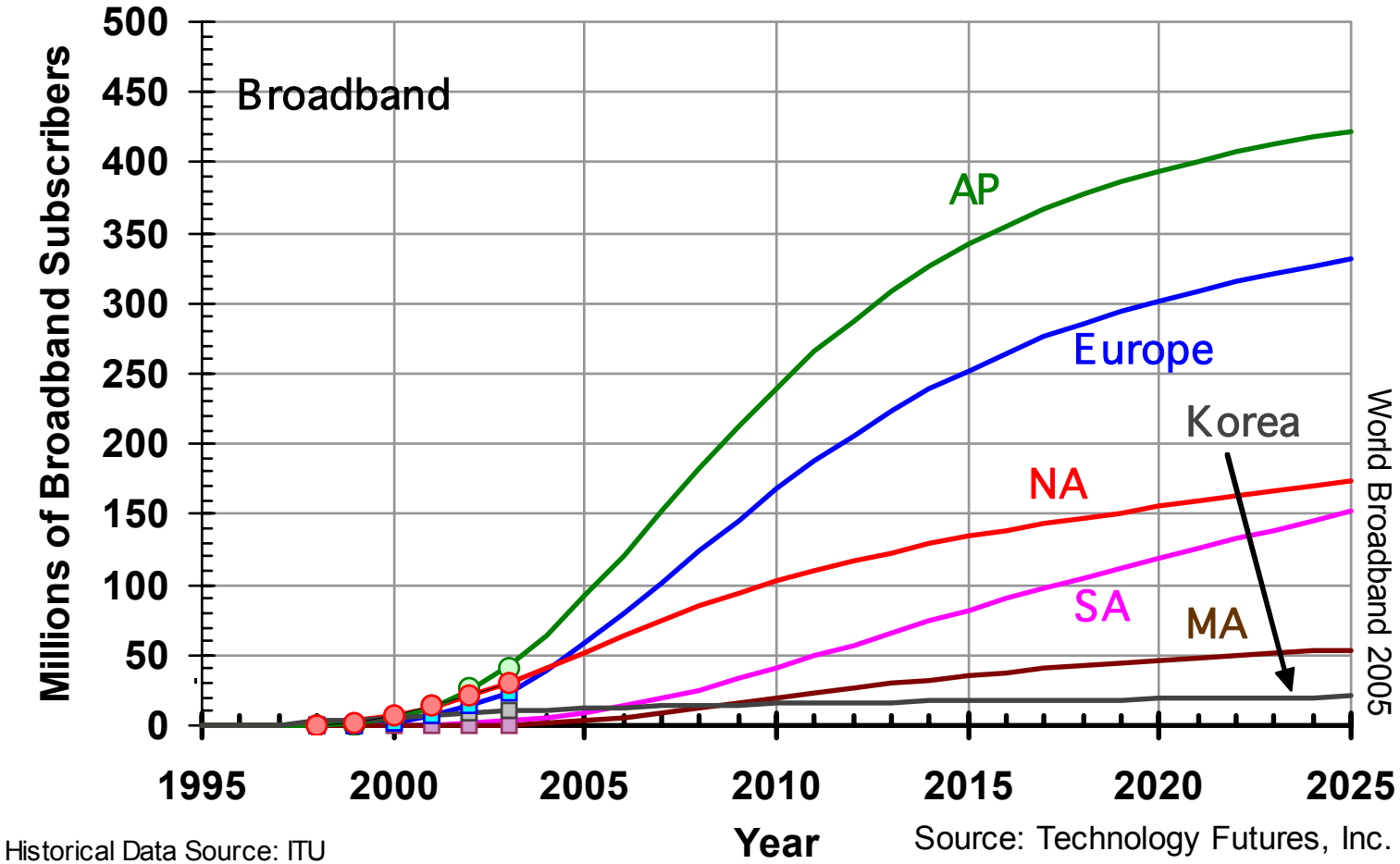
Broadband Households - Millions



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Source: Technology Futures, Inc.

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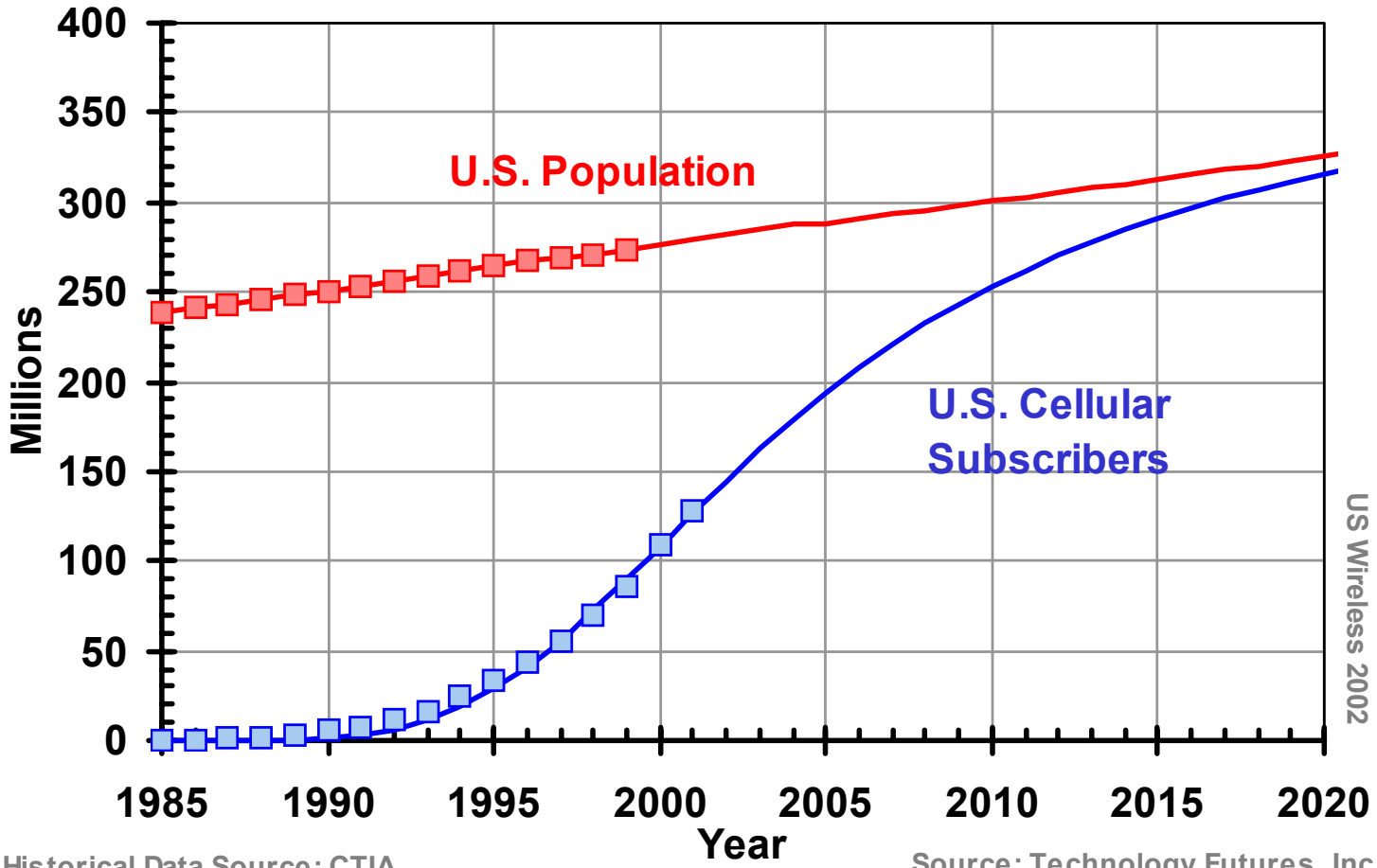
U.S. Cellular/PCS Subscribers



Historical Data Source: CTIA

Source: Technology Futures, Inc.

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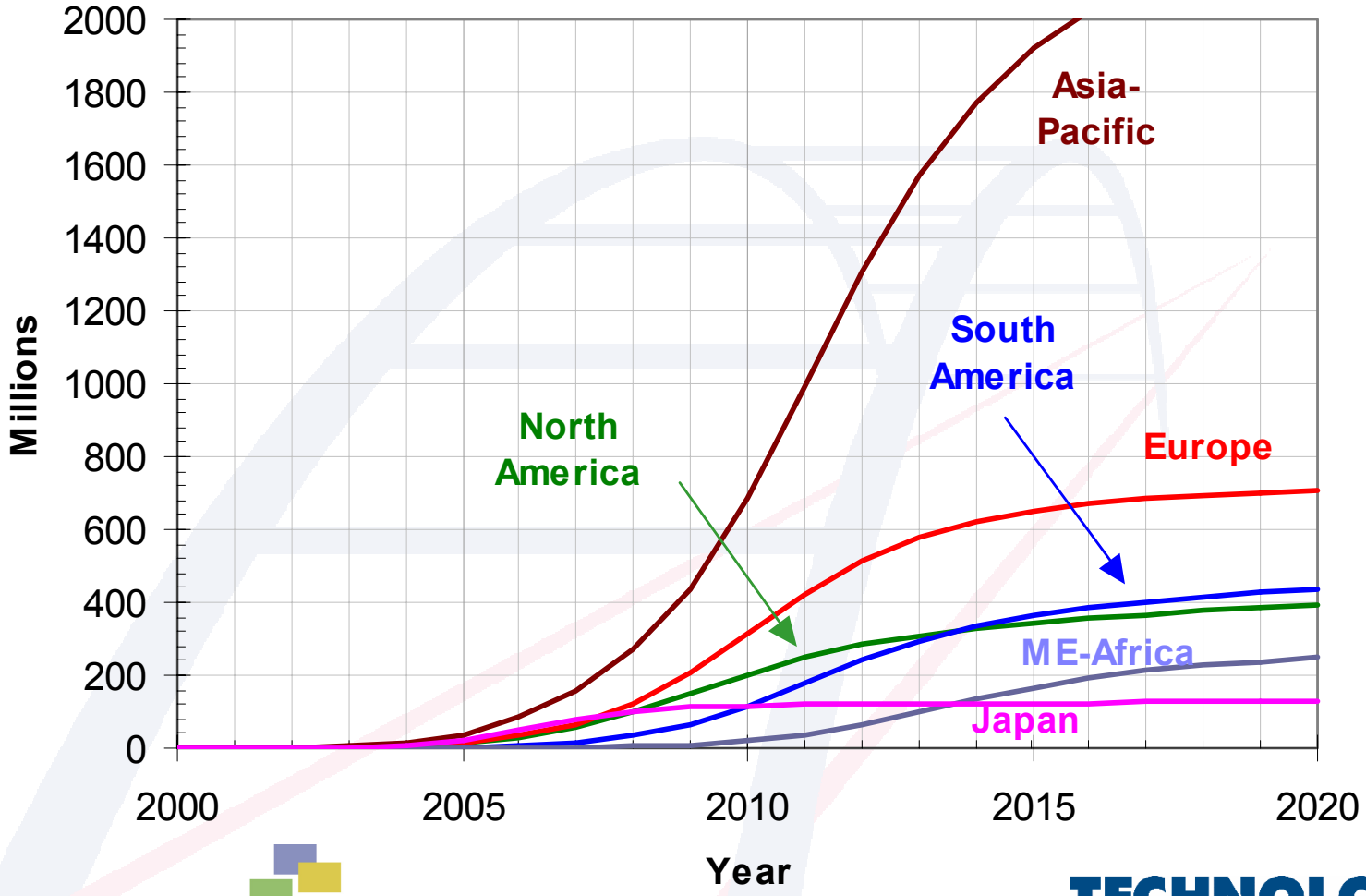
Forecast of 2.5G and Above Subscribers by Region—Millions



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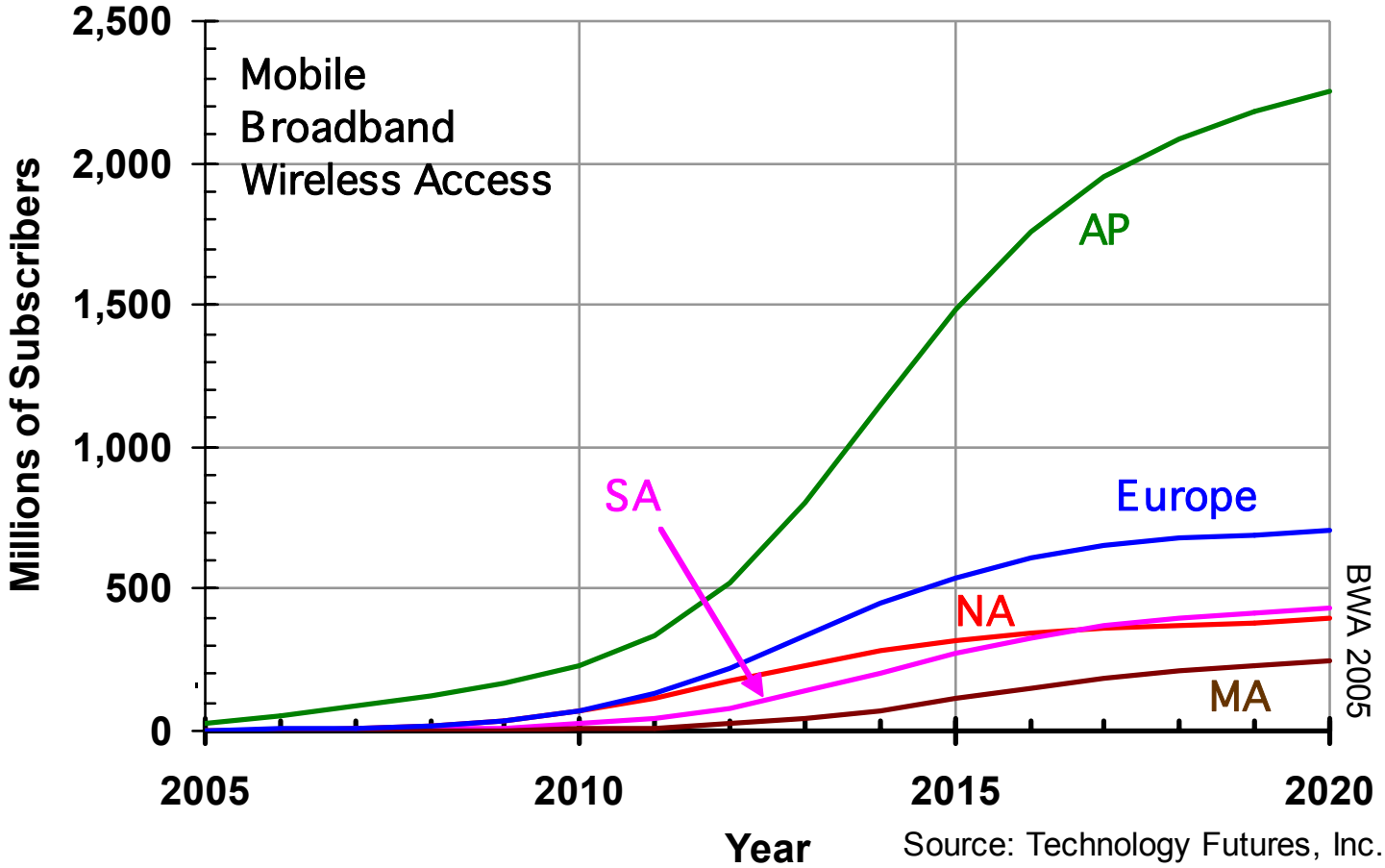
Mobile Wireless Broadband Subscribers - Millions



Source: Technology Futures, Inc.

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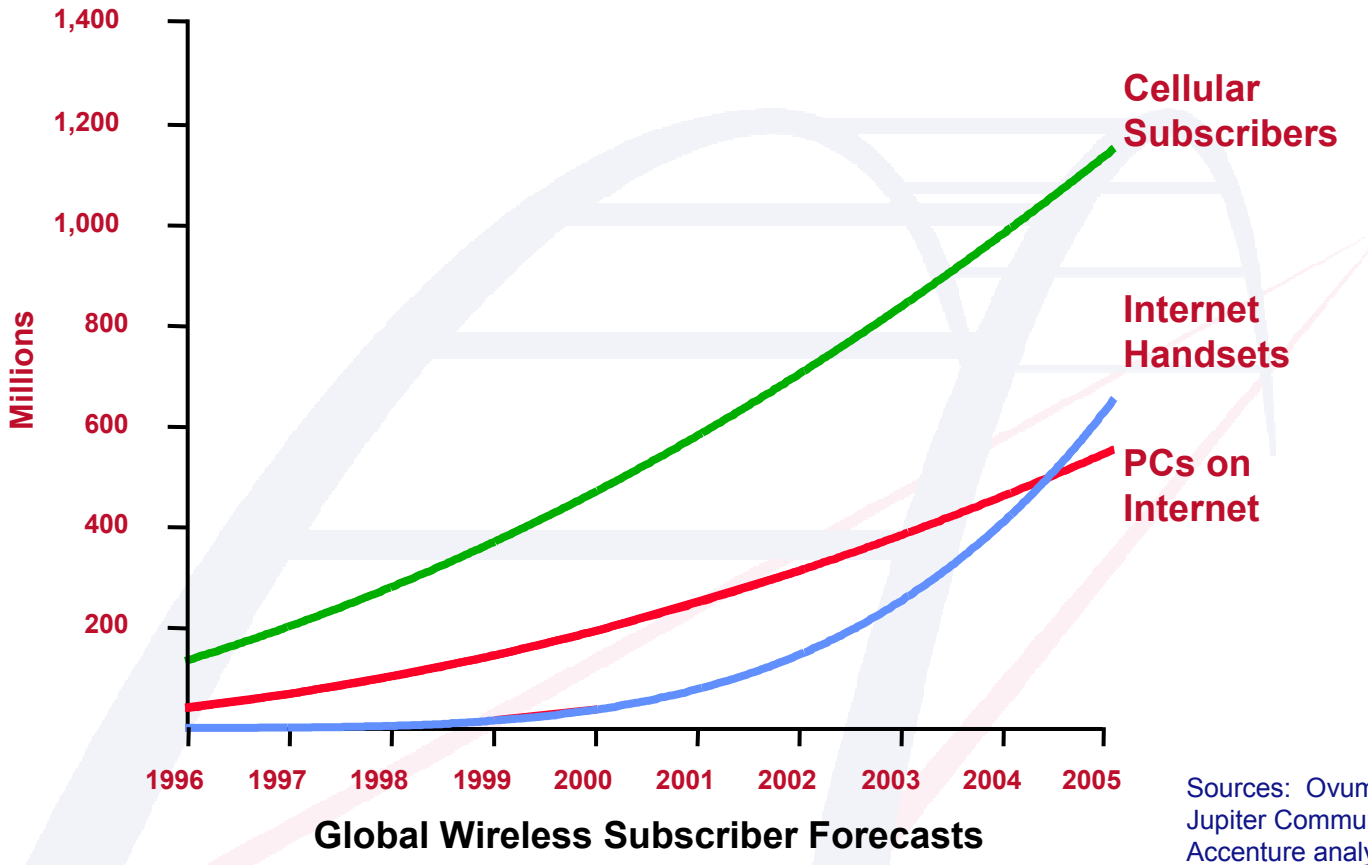
Wireless Mobile Phone vs. PC-Based Internet Penetration



Global Wireless Subscriber Forecasts

Sources: Ovum; Yankee Group; Jupiter Communications; Nokia; Accenture analysis

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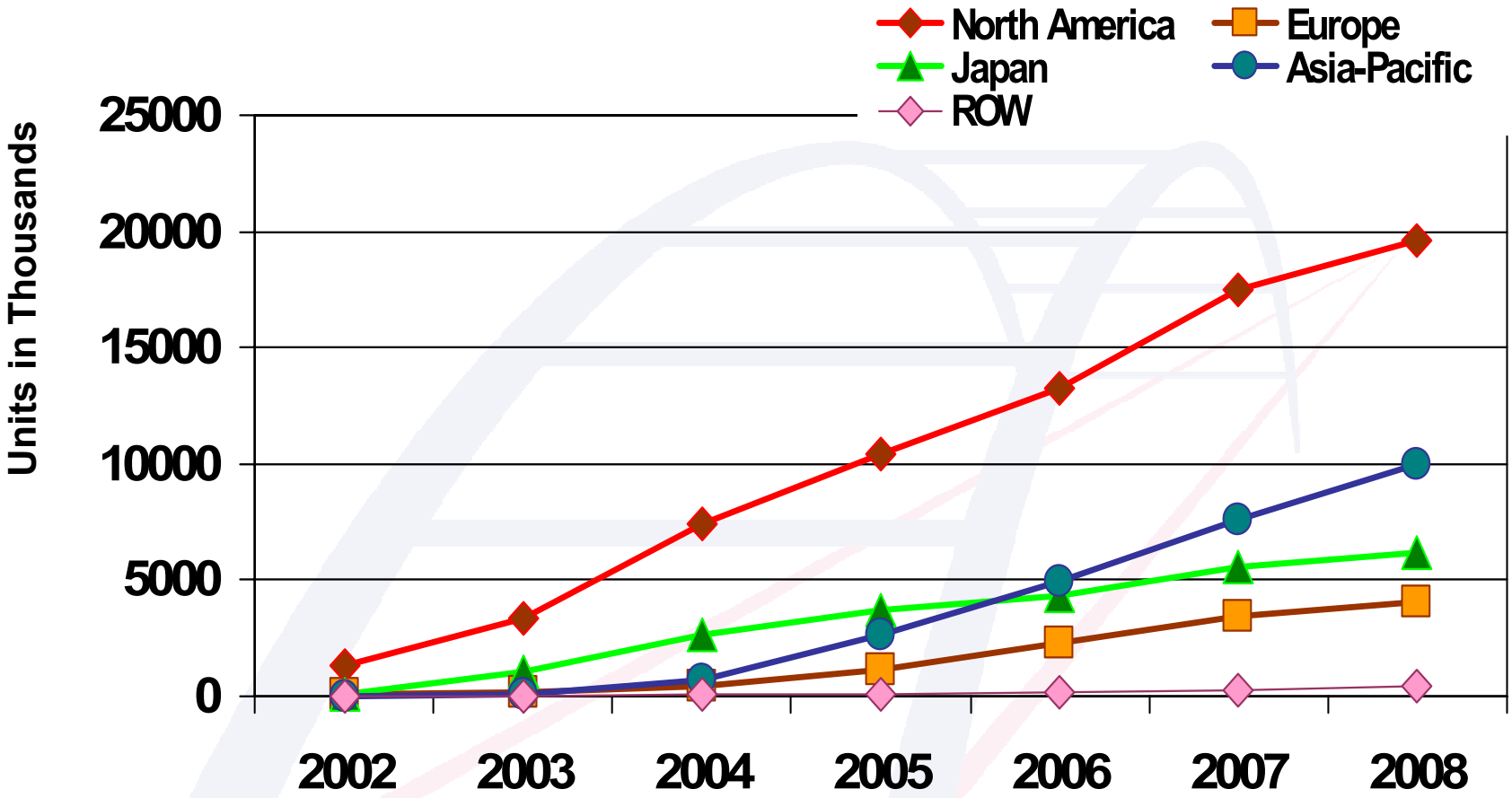
Worldwide PVR Unit Shipment Forecast



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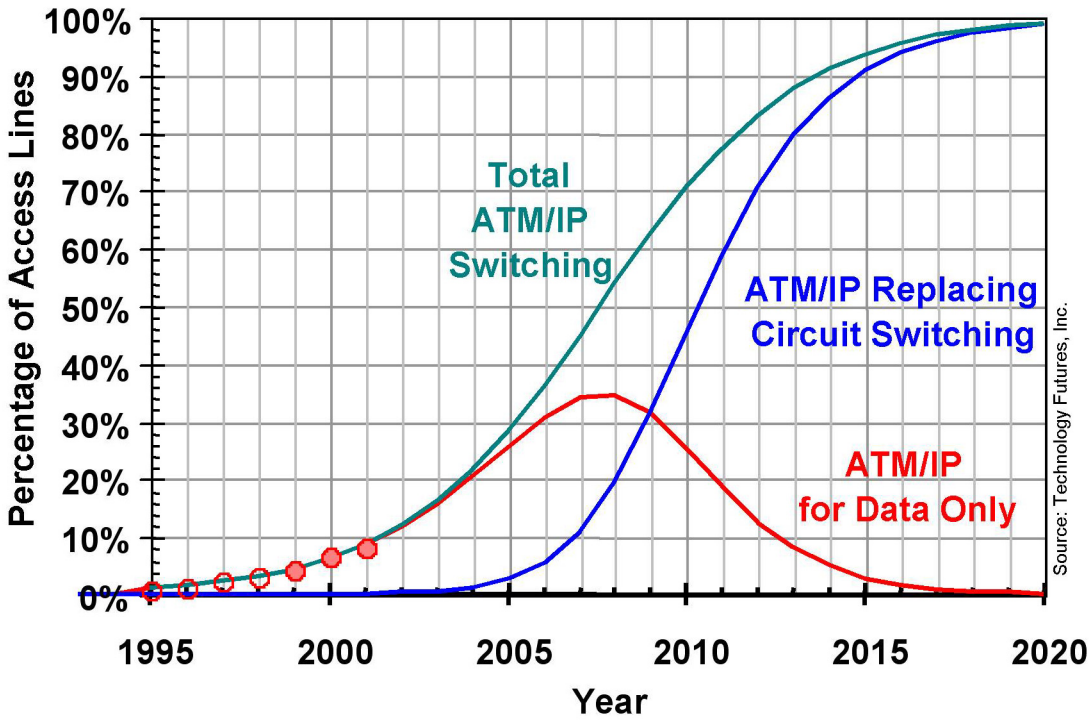
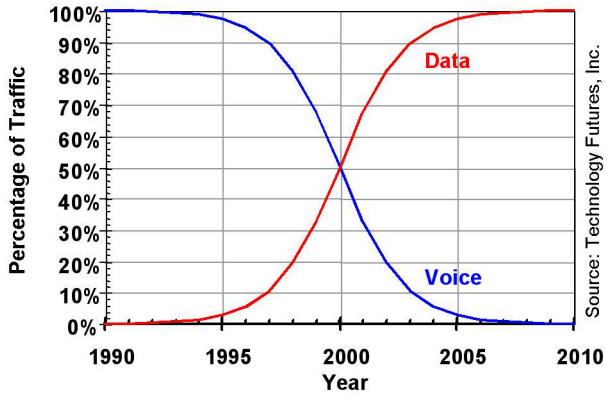
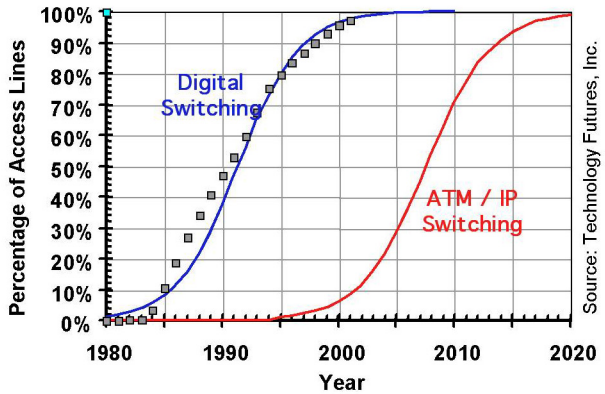
Packet for Circuit Switching







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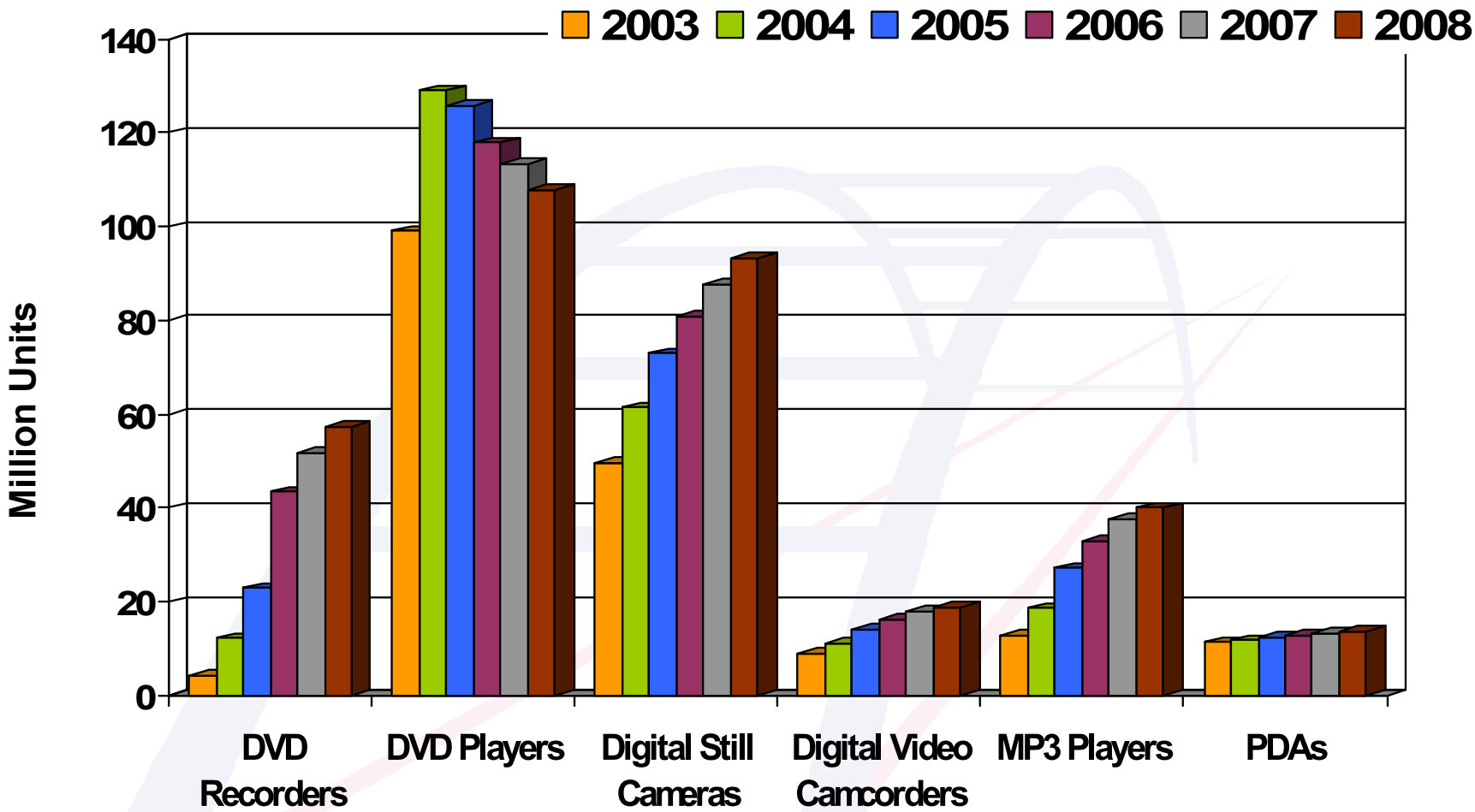
Consumer Electronics: Worldwide Growth



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Constraints

- Digital Rights
- Capitalization for Digital Cinema, the driver for rich image-based media
- Network reliability
- Security
- Complexity

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The Converged, Collaborative, Managed Network of 2010

Always on

Worldwide coverage

Rapid growth in number & types of end points

Packet based

Continuous user contact across network boundaries with different devices

Mixed rich media to text to sensor data

Extremely secure and reliable

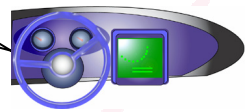
Optical core

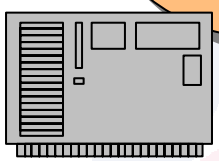
Wireless edge

Autonomous agents







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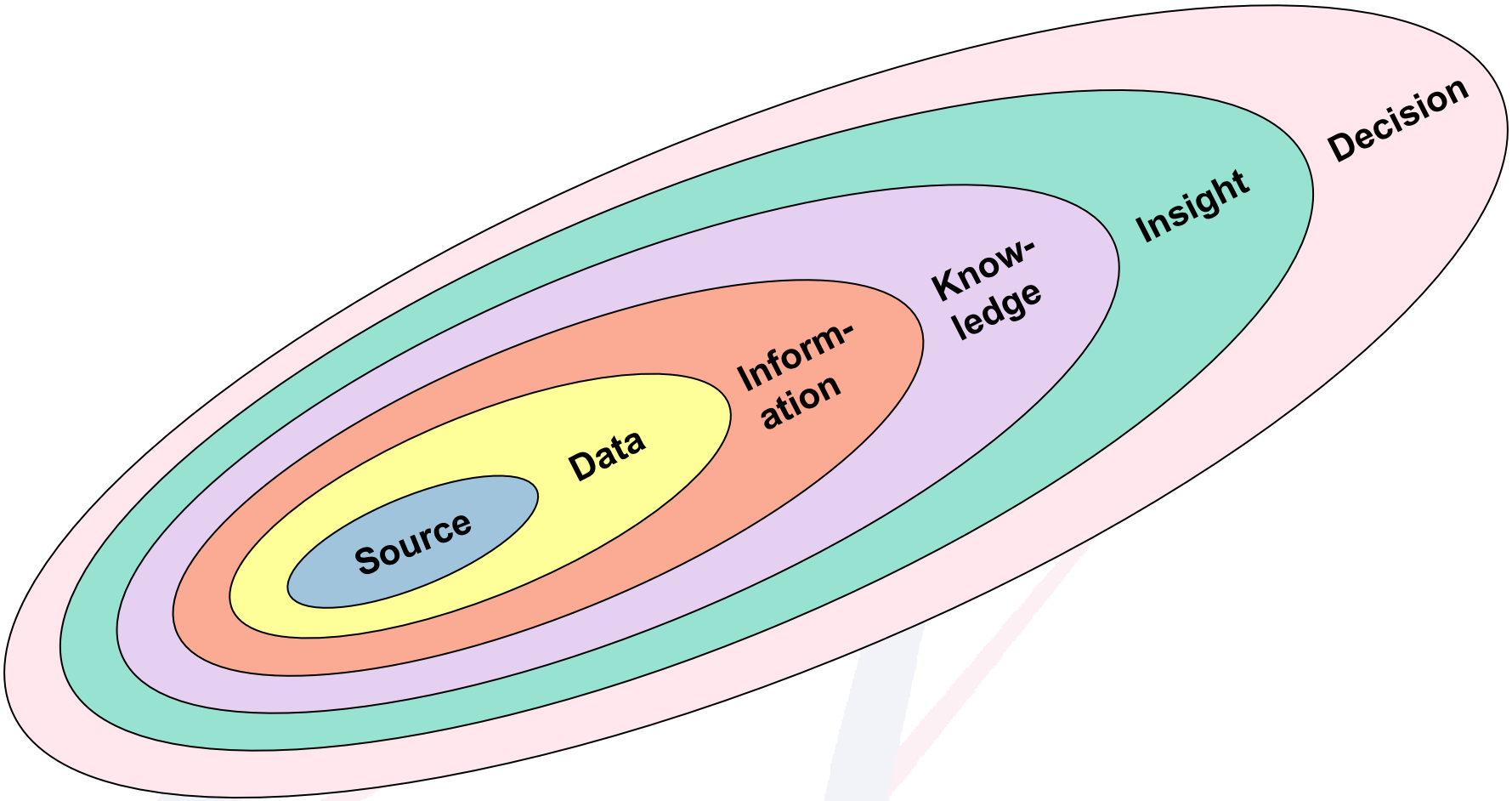
The Evolution of Content



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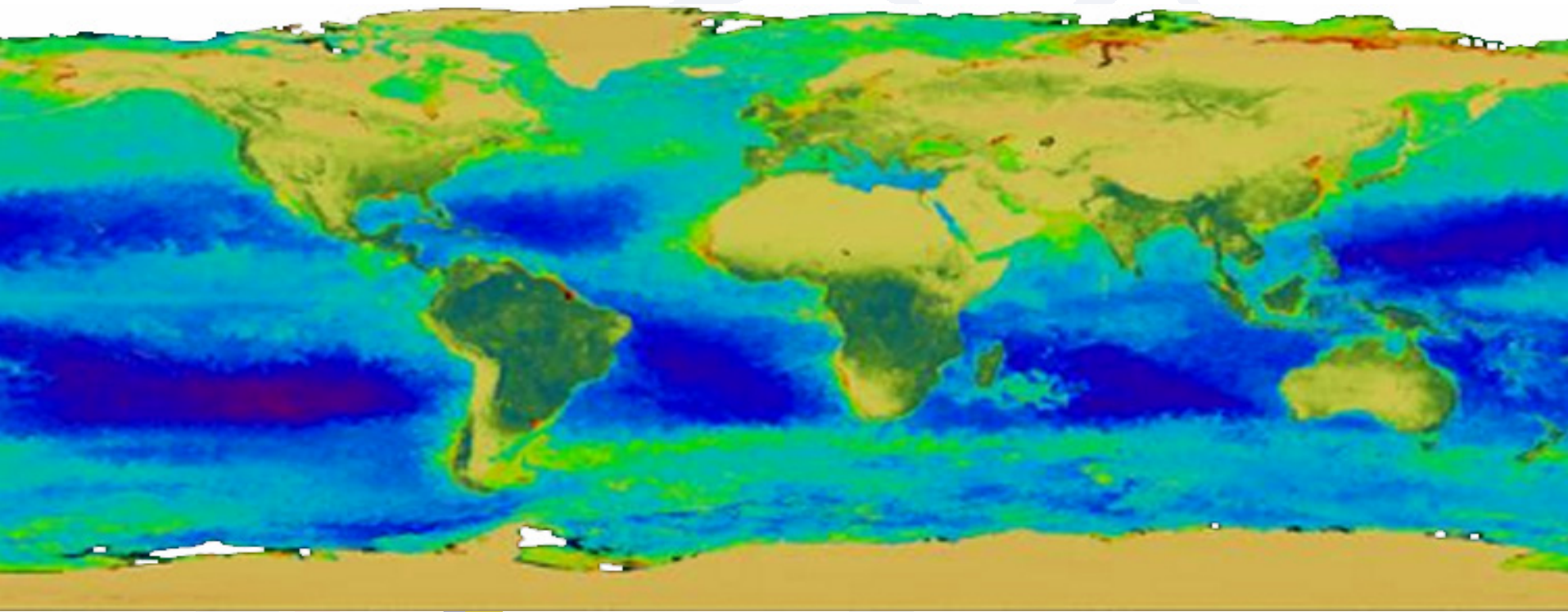
The United States now has to compete for every job going forward. That has not been on the table before. It has been assumed we had a lock on white-collar jobs and high-tech jobs. That is no longer the case."

—Craig Barrett
CEO, Intel



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“The corporation as we know it, which is now 120 years old, is unlikely to survive the next 25 years. Legally and financially, yes, but not structurally and economically.”

—Peter Drucker, quoted in
Business 2.0, August 22, 2000

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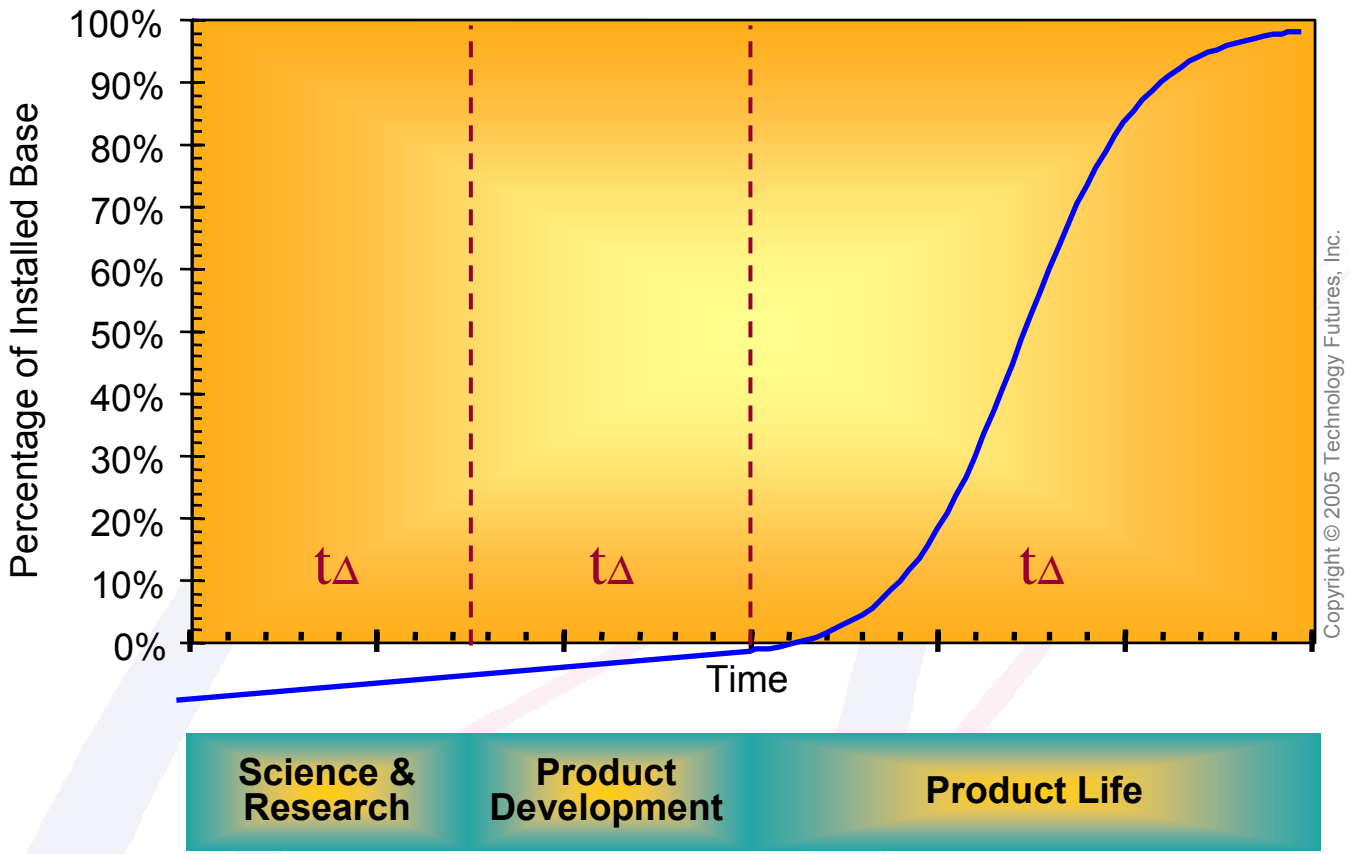
S-Curve for Innovation, Development, and Product Life



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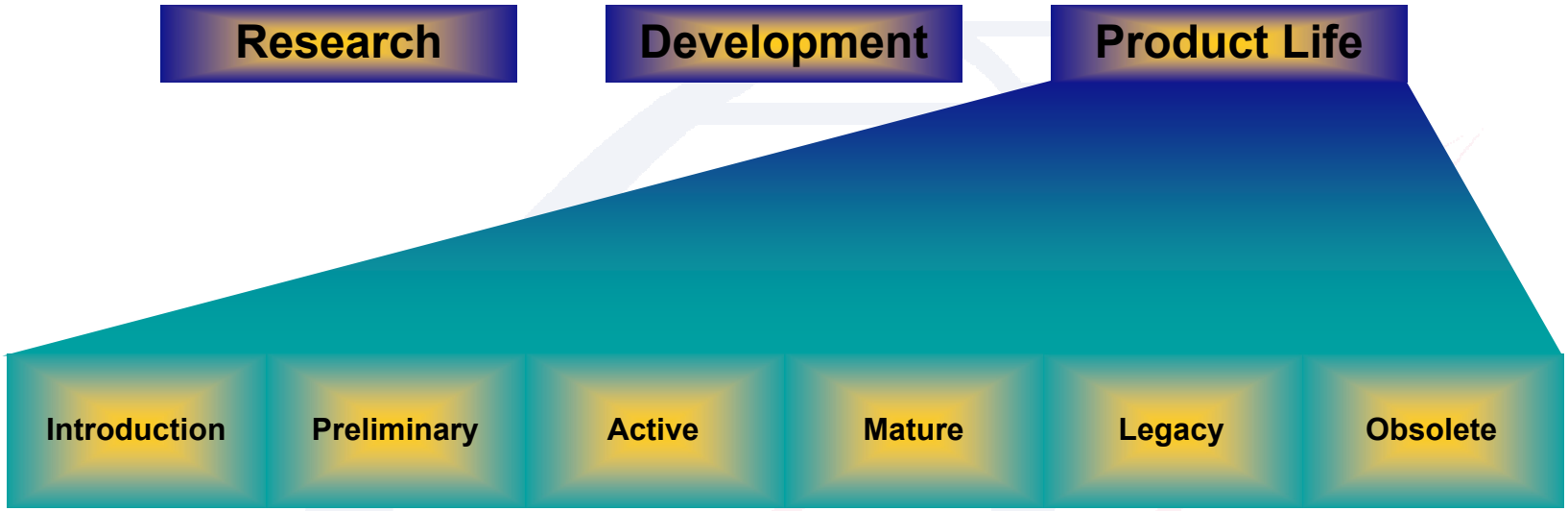
Research/Product Life Cycle



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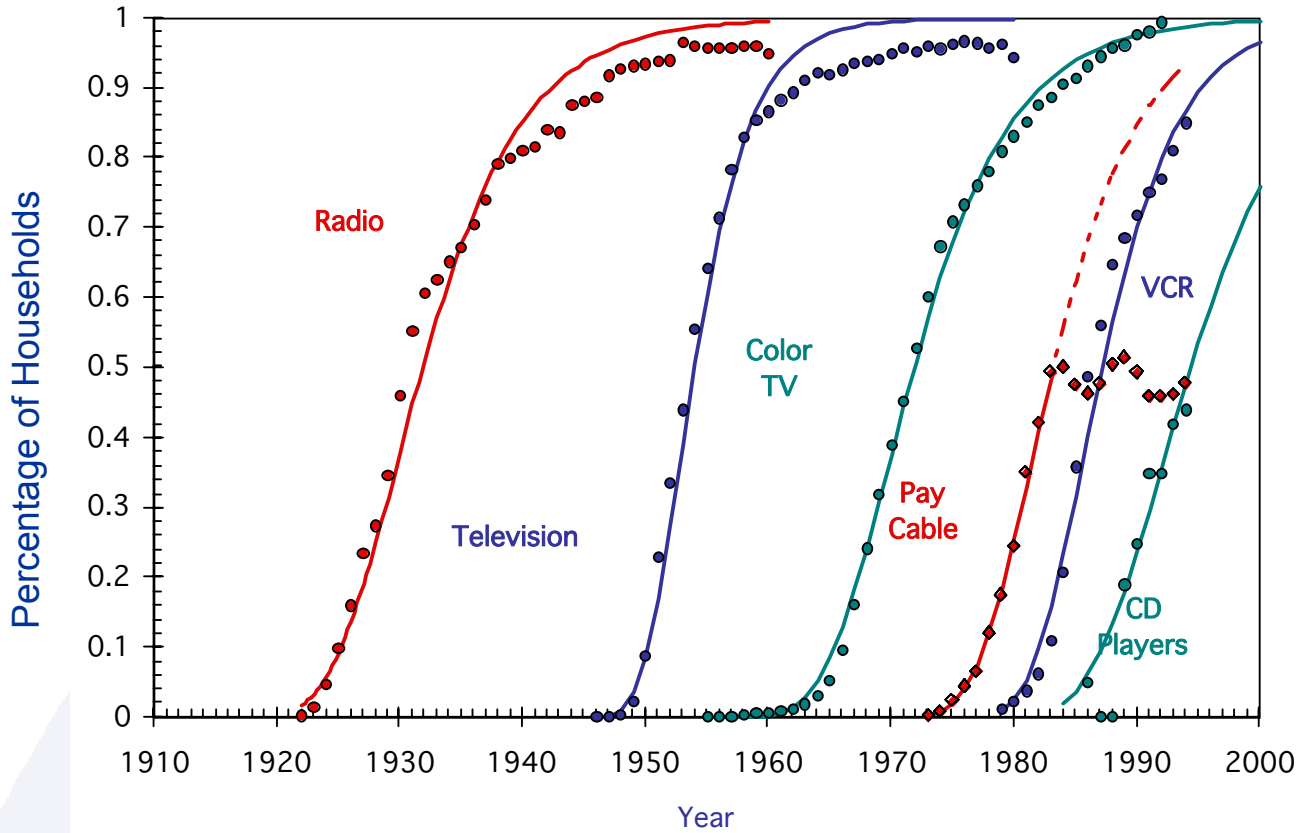
Examples of Consumer Adoptions



Gomp exs

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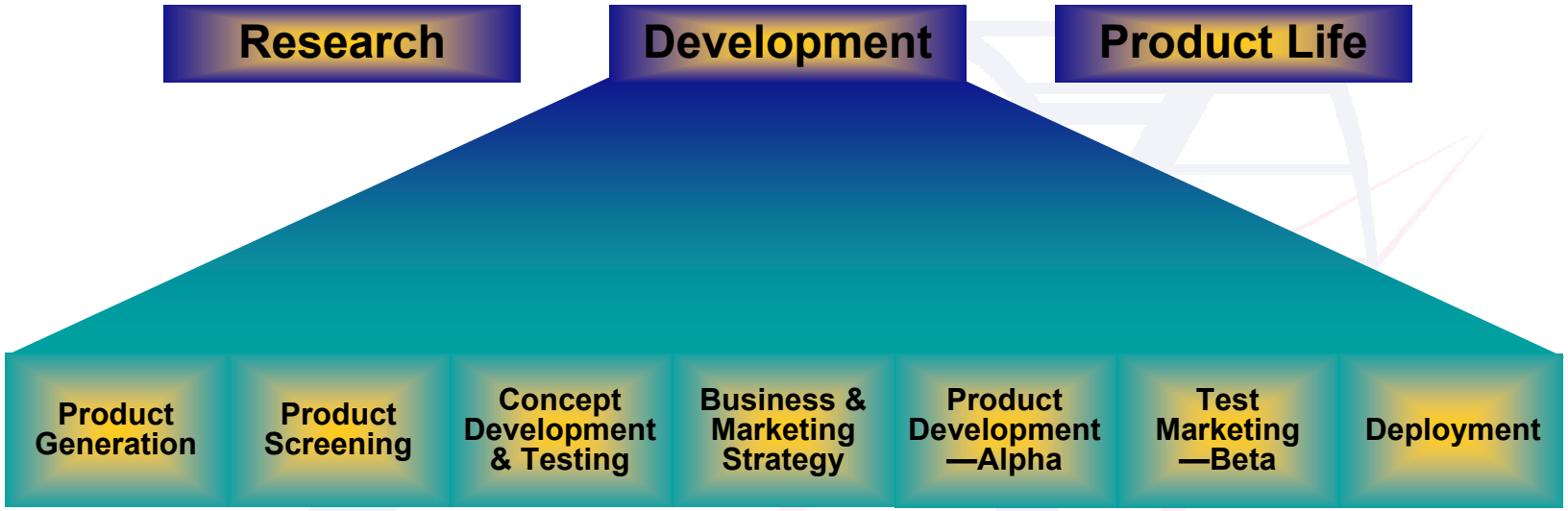
Research/Product Life Cycle



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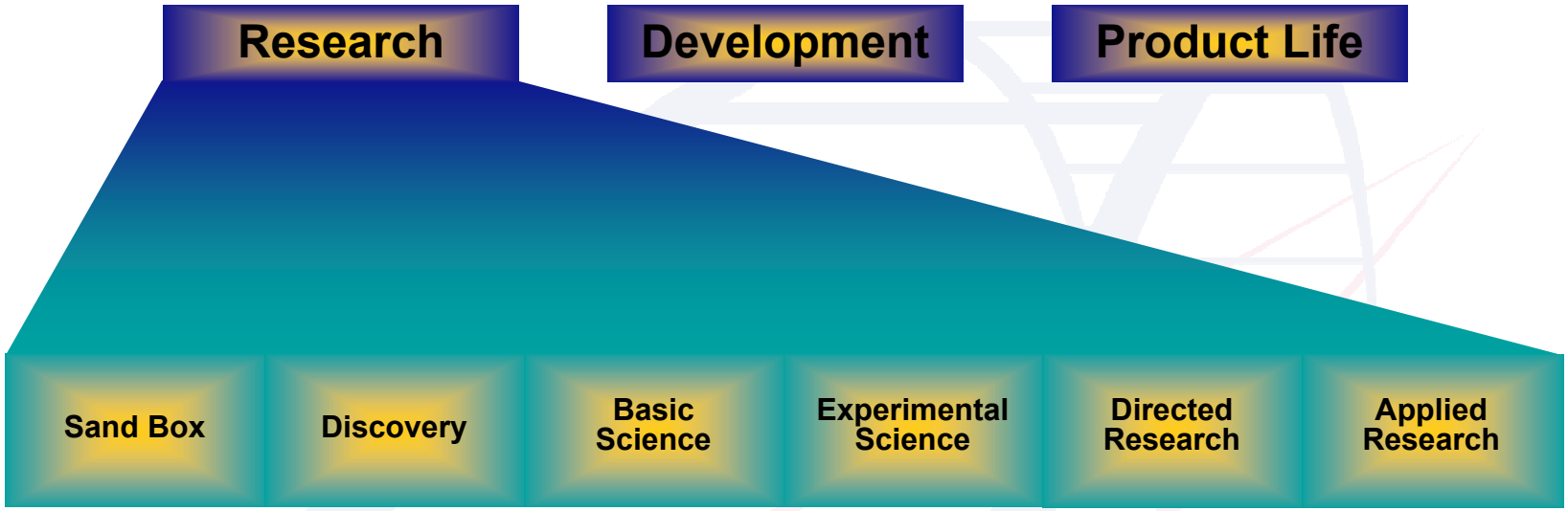
Research/Product Life Cycle



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Why DCI?

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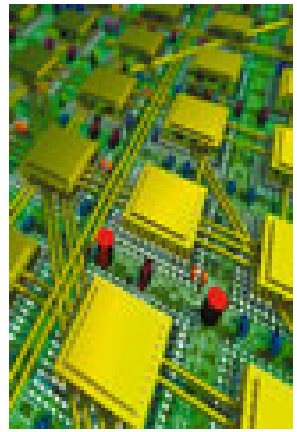
Semiconductor Industry

(NAICS 3344)



- Texas Industry Facts
  - Firms 374
  - Employment 51,459
  - Value of Shipments $13.3 billion
  - Total Capital Investments $1.13 billion
- How Texas Ranks
  - All Employees 2
  - Value of Shipments 2
  - Total Capital Investments 1

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Sources: Texas Workforce Commission and Annual Survey of Manufacturers

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Electrical Equipment, Appliance & Component Manufacturing Industry

(NAICS 335)

- Texas Industry Facts
  - Firms 425
  - Employment 17,667
  - Value of Shipments $4.5 billion
  - Total Capital Investments $73.2 million
- How Texas Ranks
  - All Employees 8
  - Value of Shipments 9
  - Total Capital Investments 10

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Sources: Texas Workforce Commission and Annual Survey of Manufacturers

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Computer Industry
(NAICS 334)

- Texas Industry Facts
  - Firms 1,176
  - Employment 112,876
  - Value of Shipments $41.3 billion
  - Total Capital Investments $2.1 billion
- How Texas Ranks
  - All Employees 2
  - Value of Shipments 2
  - Total Capital Investments 2

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Sources: Texas Workforce Commission and Annual Survey of Manufacturers

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Communications Equipment Industry (NAICS 3342)

- Texas Industry Facts
  - Firms 156
  - Employment 17,606
  - Value of Shipments $8.3 billion
  - Total Capital Investments (data incomplete)
- How Texas Ranks
  - All Employees 2
  - Value of Shipments 2
  - Total Capital Investments (data incomplete)

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Sources: Texas Workforce Commission and Annual Survey of Manufacturers

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Music Industry

- Texas Industry Facts
  - Firms 7,248
  - Employment 58,052
  - Economic Impact $71. million

Source: Texas Music Office

Film Production Industry

- Texas Industry Facts
  - Total Films 55
  - Total Budget $214. million
  - Estimated Corporate Budget $76. million
  - Estimated Sports Budget $28.5 million
  - Total $319. million

Source: Texas Film Commission

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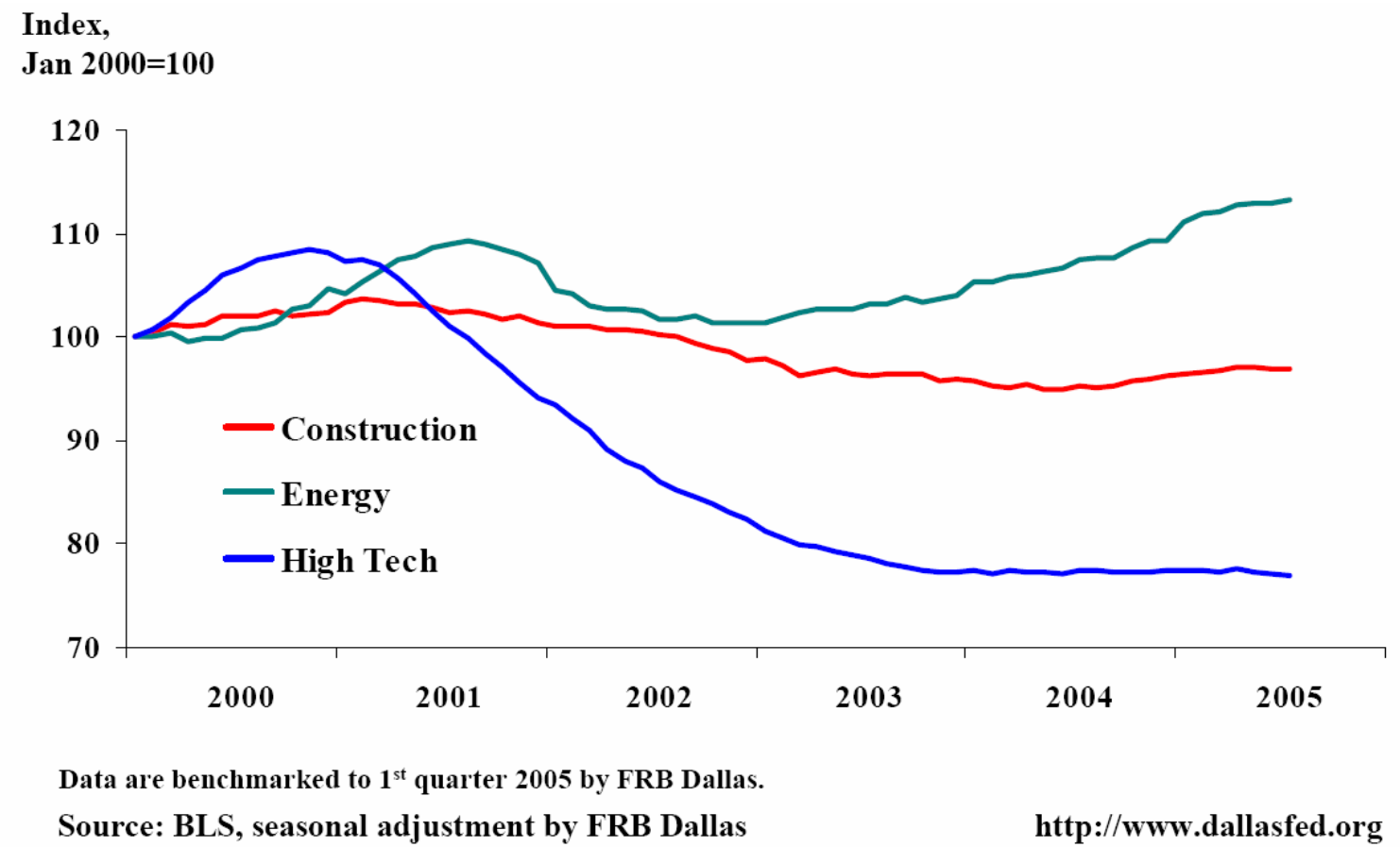
Texas Payroll Employment



Data are benchmarked to 1st quarter 2005 by FRB Dallas.

Source: BLS, seasonal adjustment by FRB Dallas

http://www.dallasfed.org

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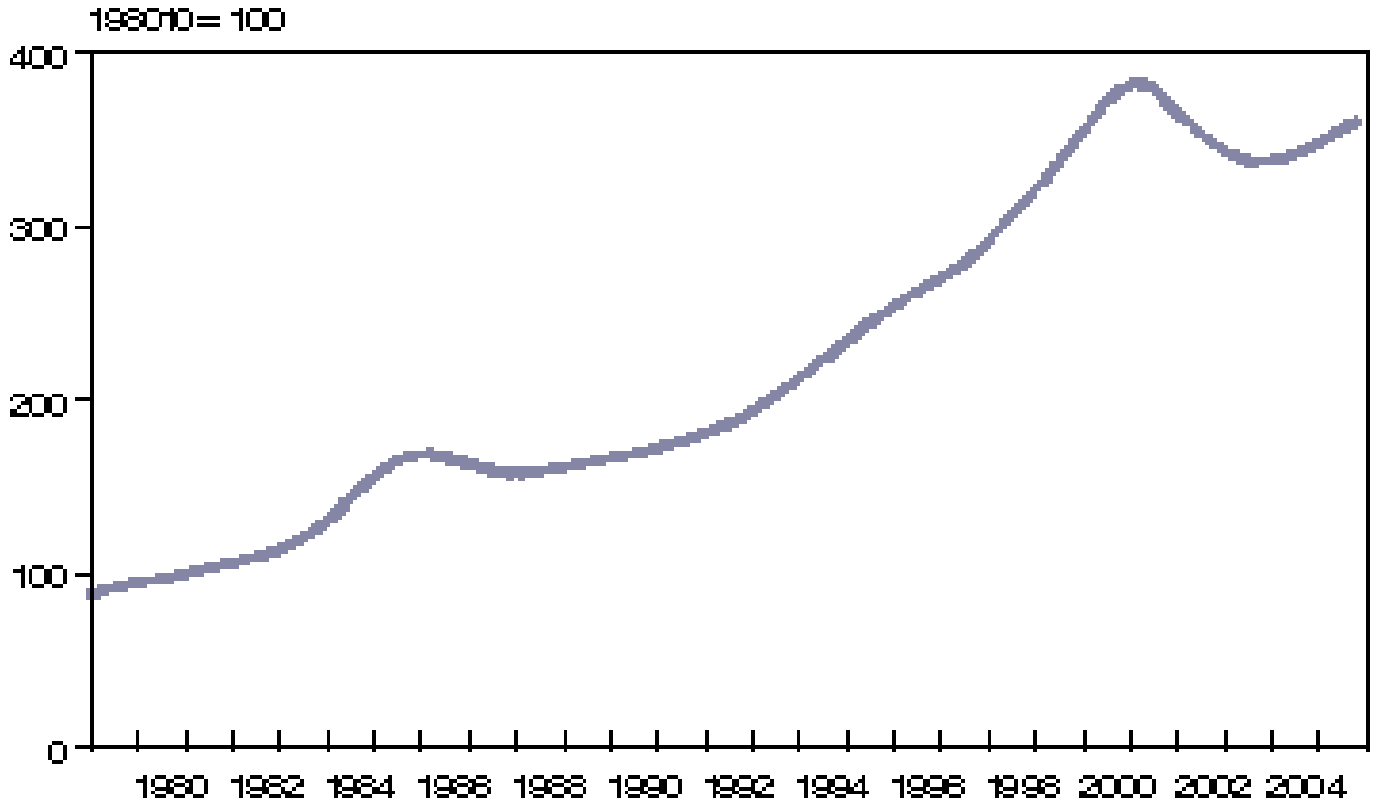
Metro Business—
Cycle Index: Austin-Round Rock

Monthly, Seasonally Adjusted, 198010=100



LAST DATA ENTRY JULY 2005

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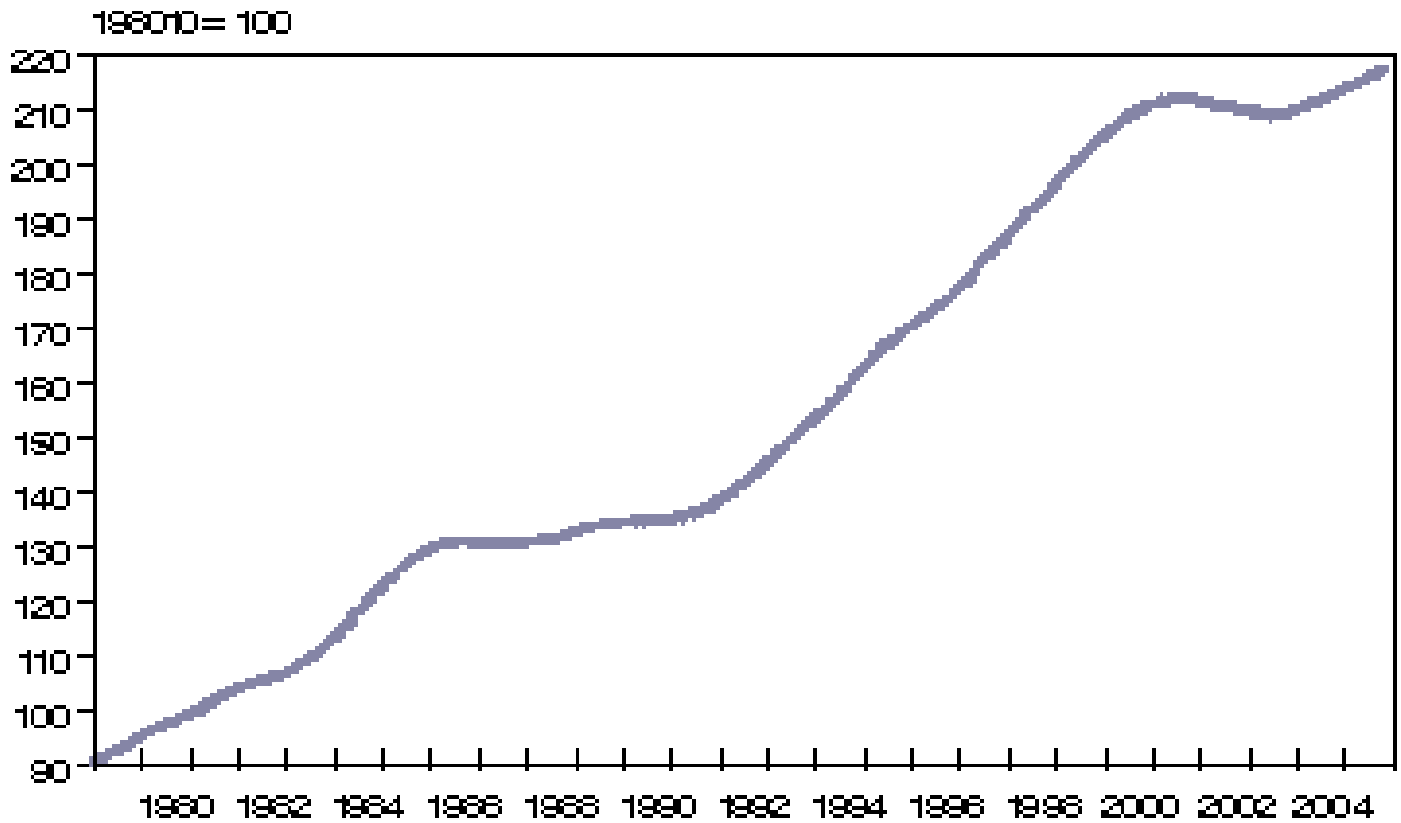
Metro Business—
Cycle Index: San Antonio

Monthly, Seasonally Adjusted, 198010=100



LAST DATA ENTRY JULY 2005

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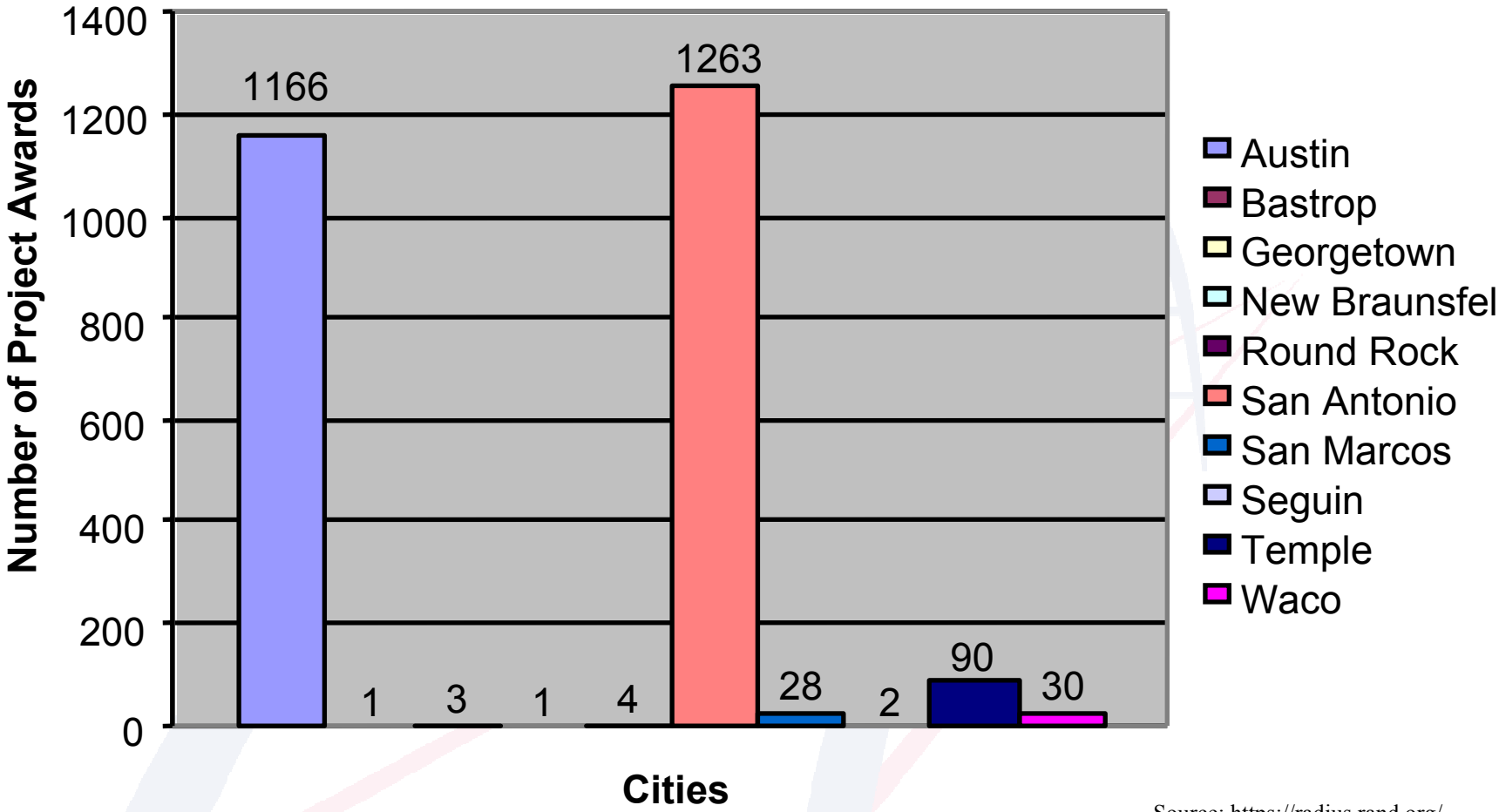
Federal Research Dollars in FY 2003



Source: https://radius.rand.org/

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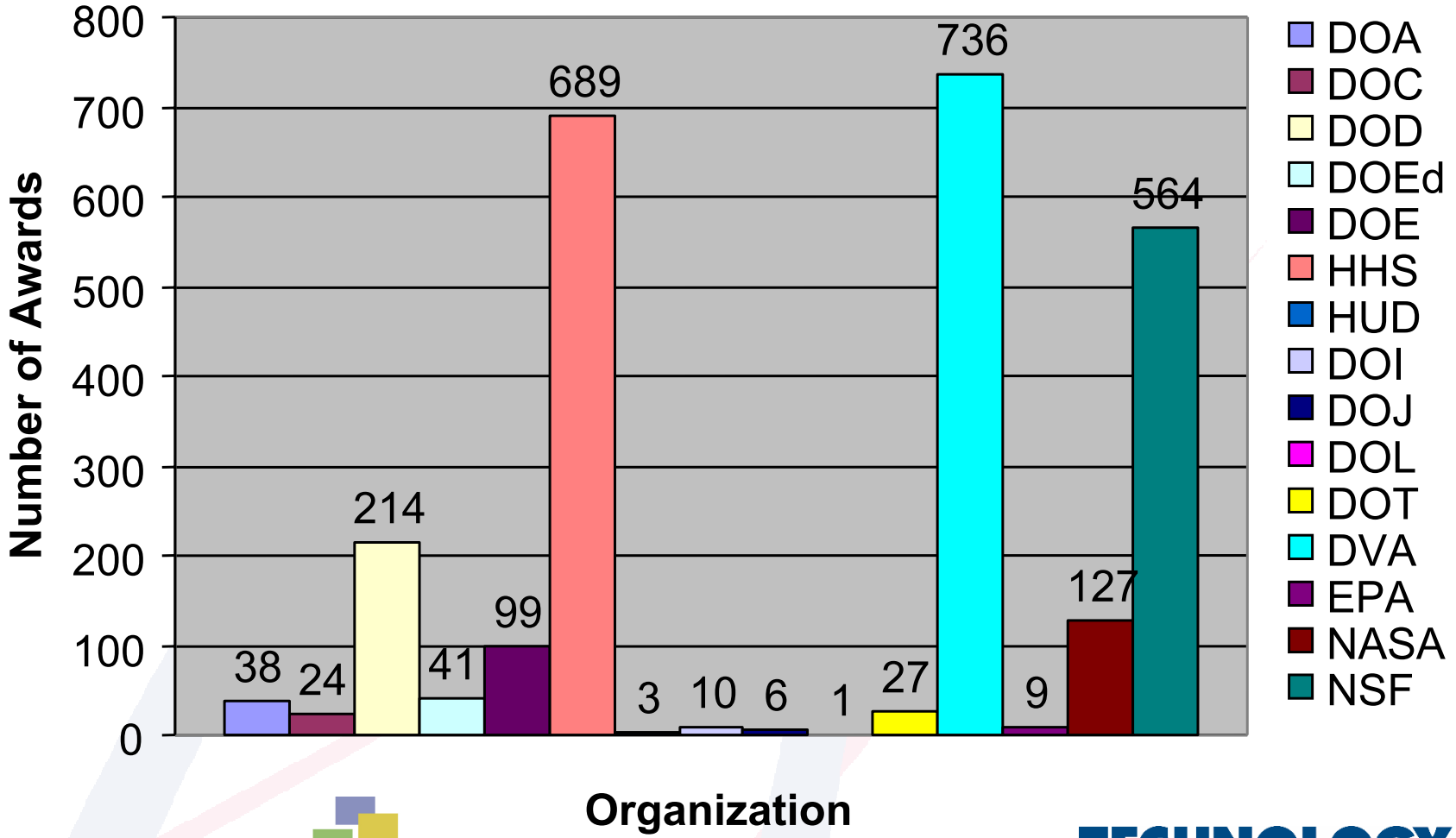
FY 2003 Federal Research Dollars—
Waco to San Antonio by Organization



Source: https://radius.rand.org/

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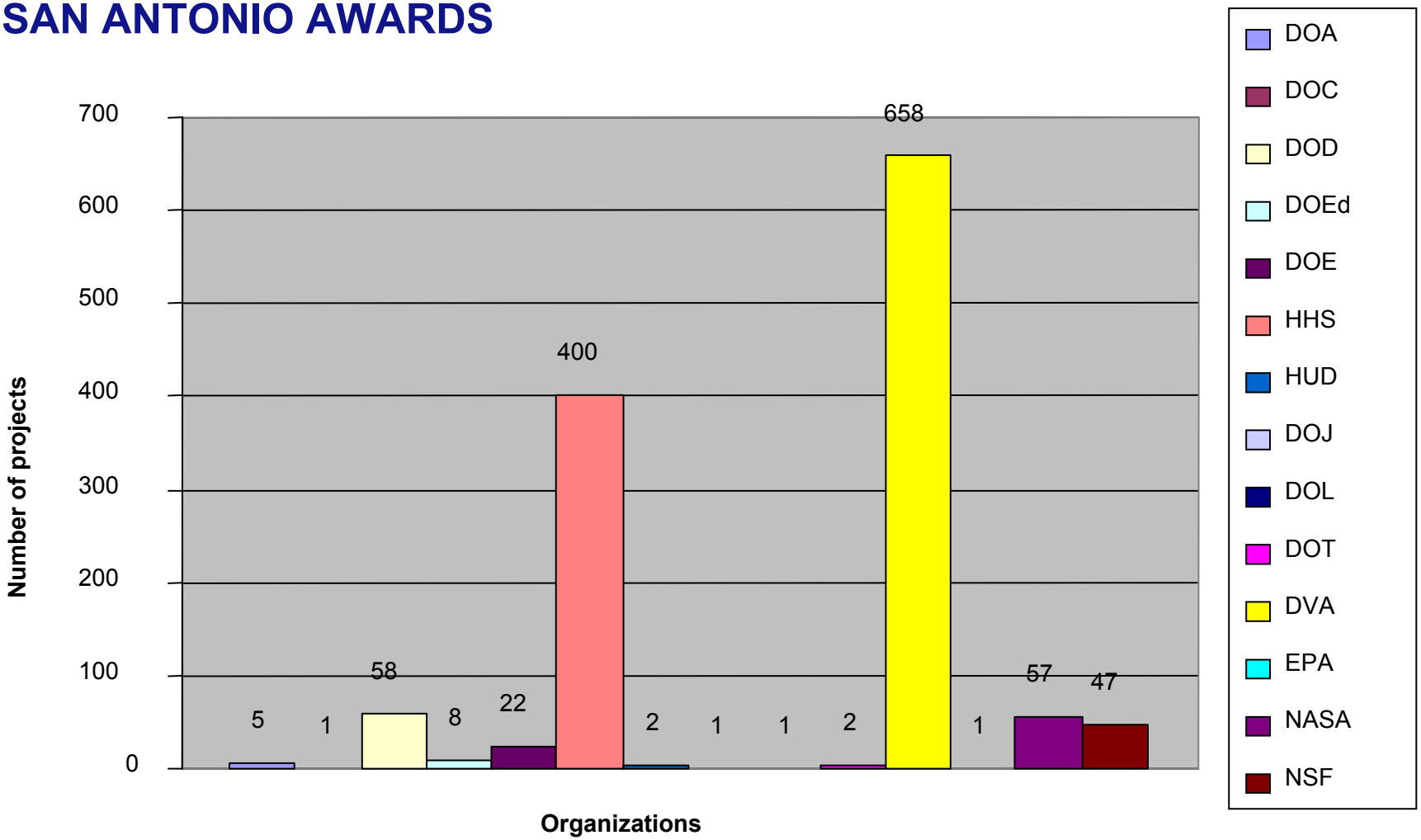
SAN ANTONIO AWARDS



Source: https://radius.rand.org/

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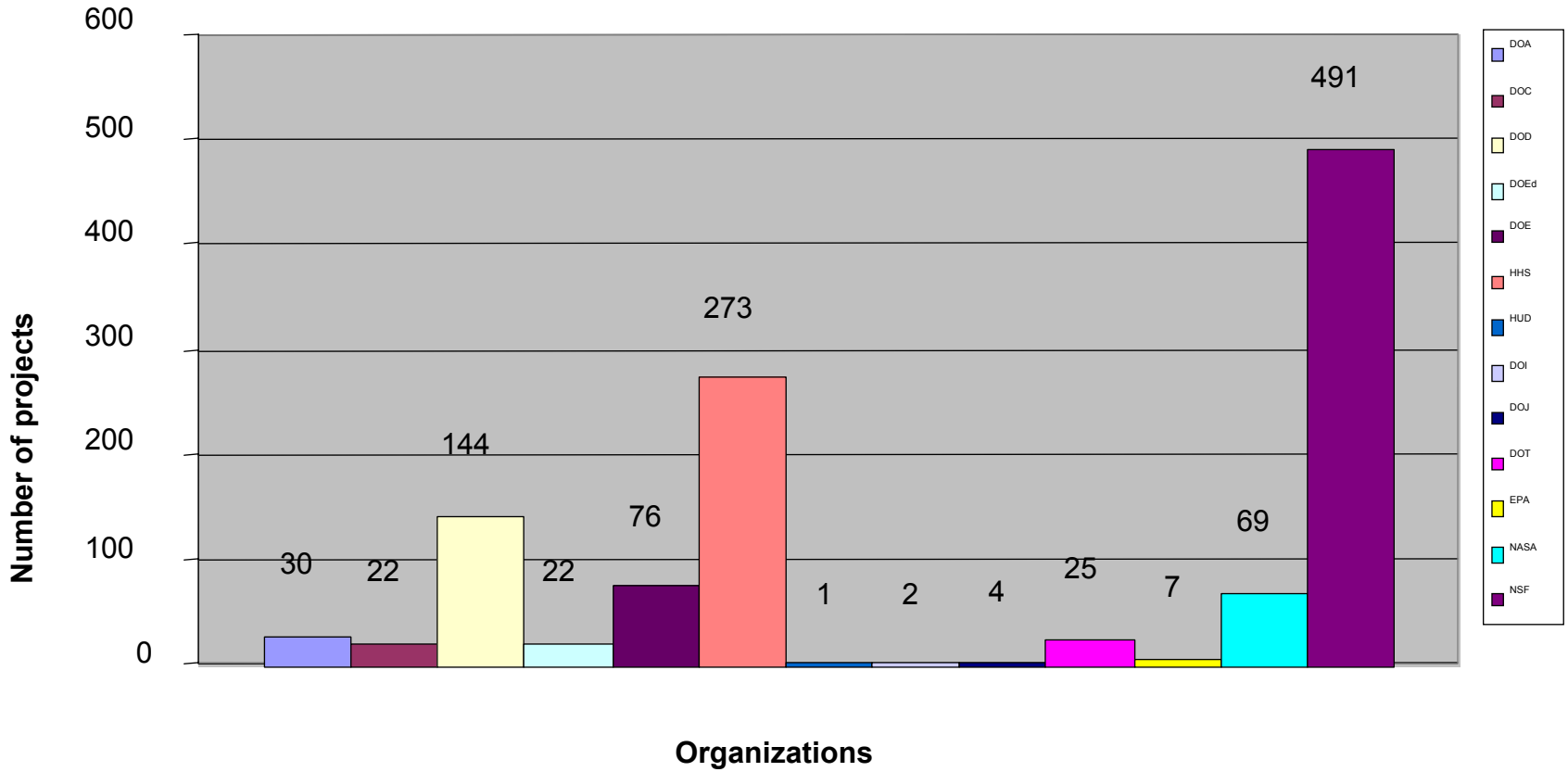
AUSTIN AWARDS



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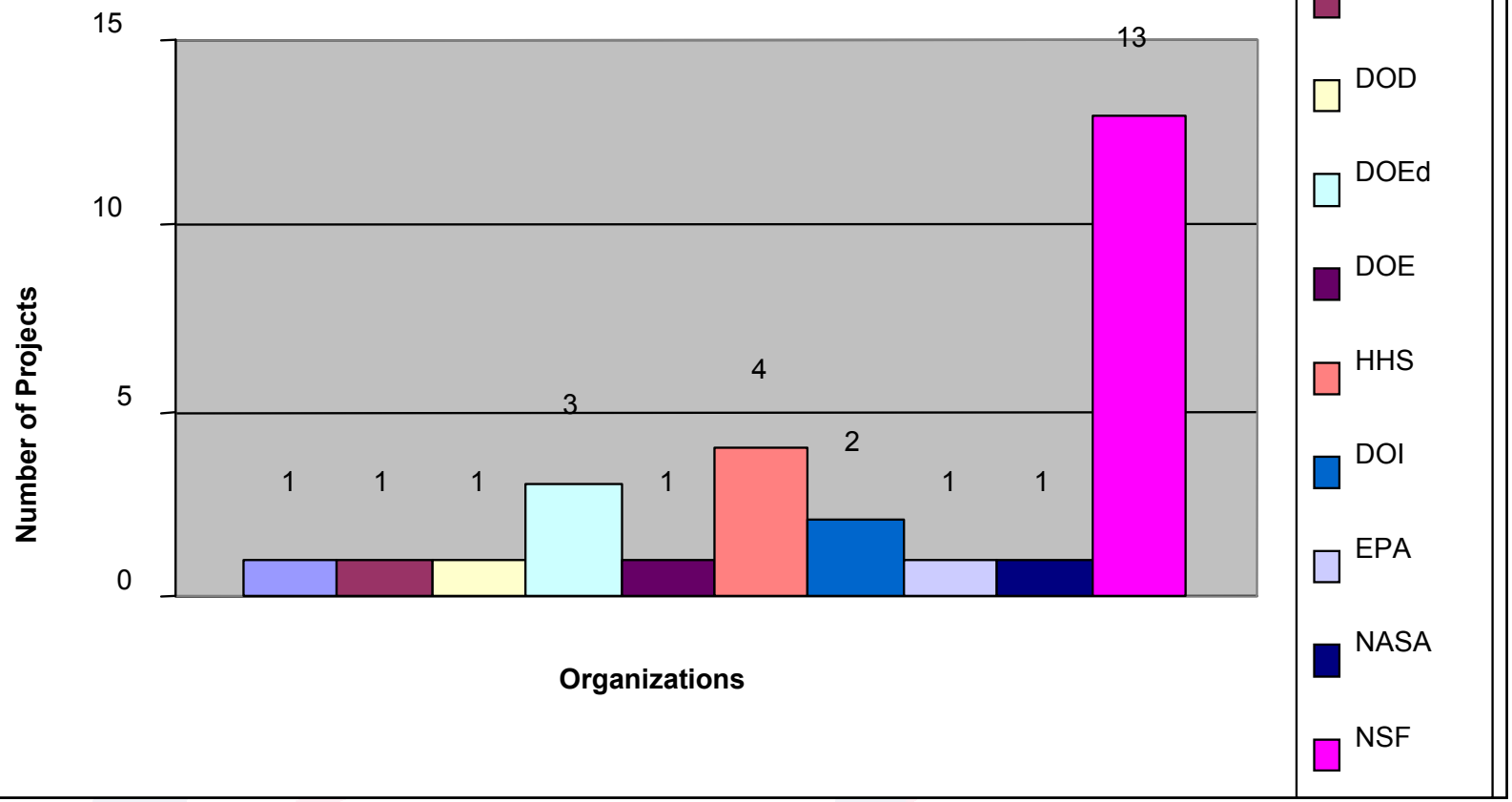
SAN MARCOS AWARDS



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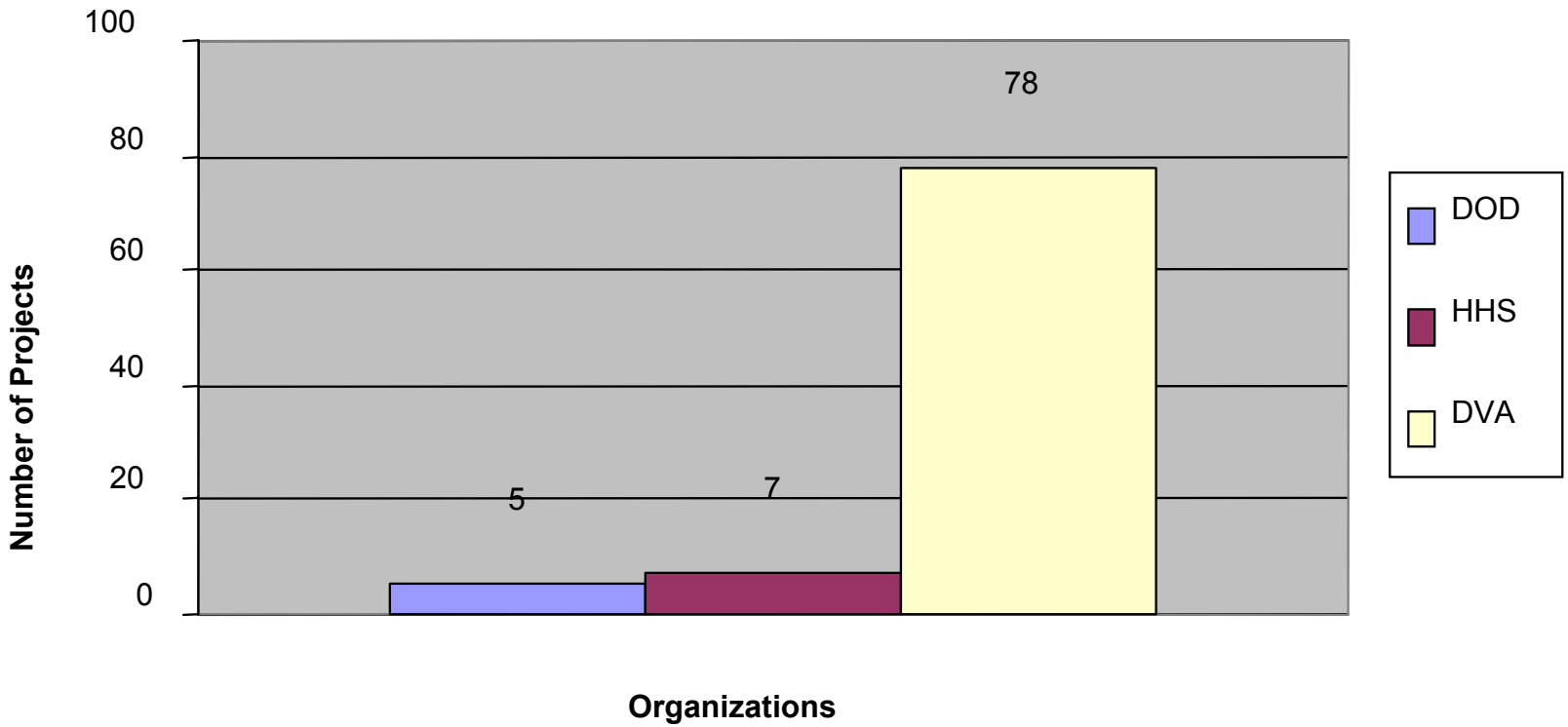
TEMPLE AWARDS



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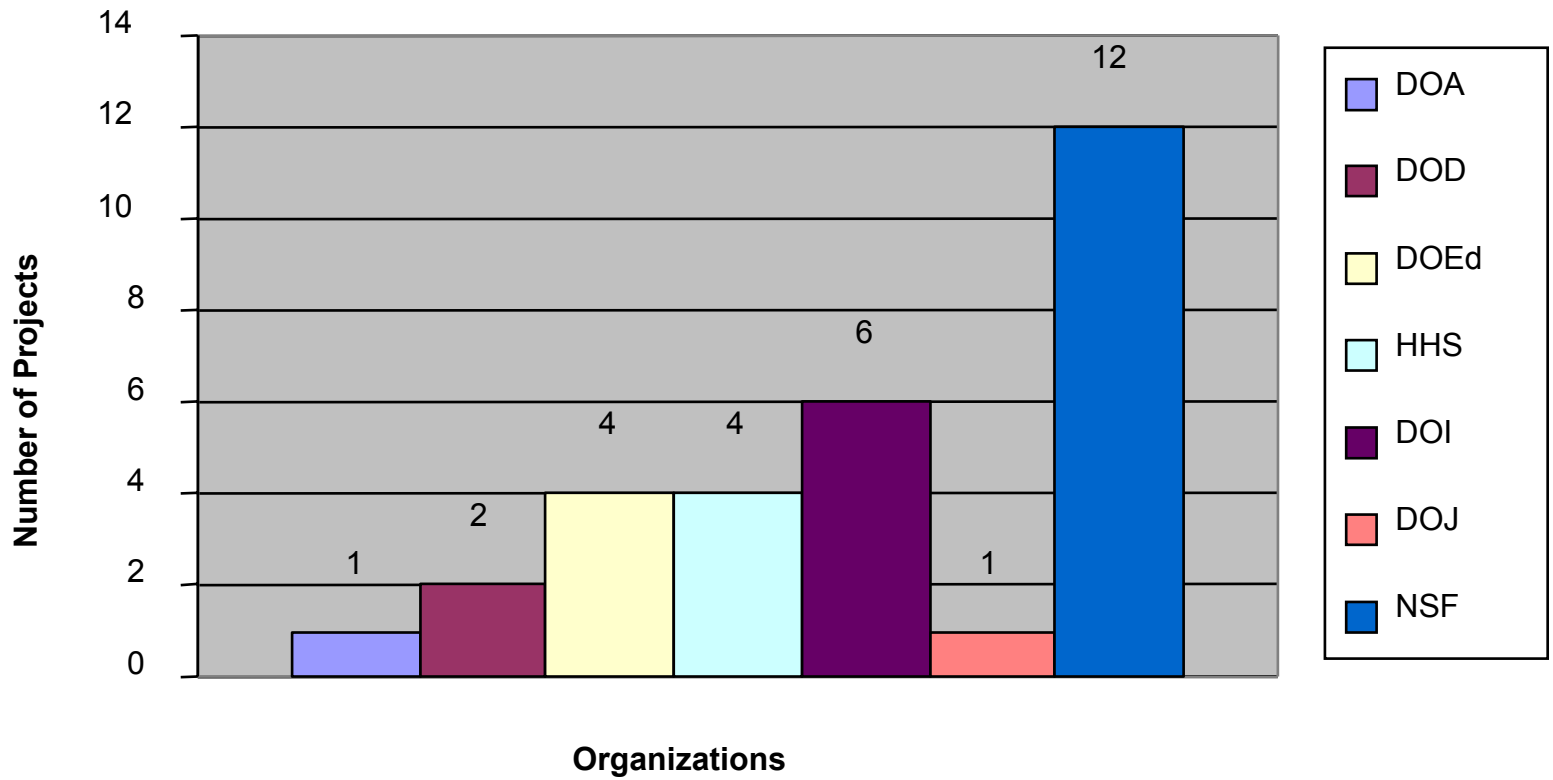
WACO AWARDS



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Executive Survey
Business Climate Rankings

Top Ten States

1. Texas
2. Georgia
3. Alabama
4. Florida
5. South Carolina
6. Tennessee
7. Nevada
8. Arizona
9. North Carolina
10. Colorado

Source: *Site Selection* survey of corporate real estate executives, August 2004.

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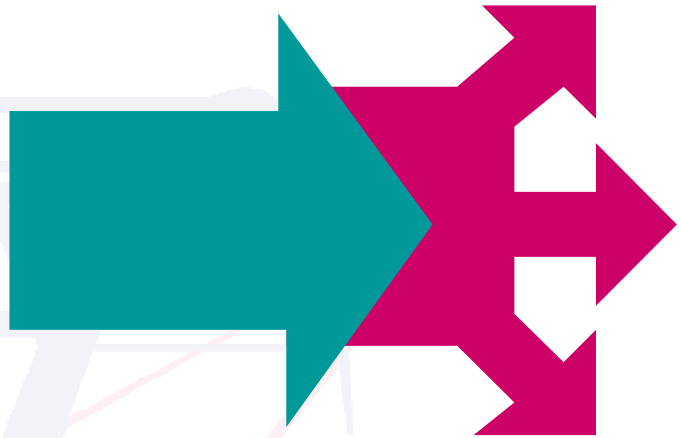
If we don't change our direction, we'll end up exactly where we are headed.

—Ancient Chinese Proverb



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Your Bridge to the Future