

# Cloud Computing, Grids, and the coming IT Cambrian Explosion

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# The Internet: Industri Knowledge Economy



# Internet Evolution - 1996

Networking

Communications

Information

***World Wide Web  
e-business***



e-business = Web + IT

## Industrial Strength

Database  
Scalability  
Security

Transactions  
Systems Mgmt  
Availability

IT →

Web →



**e-business**

## Universal Connectivity

TCP/IP      Standards  
HTML      SSL      GUIs  
HTTP      Browsers      Java  
Web Servers

# Internet Evolution – 2002

Networking

Communications

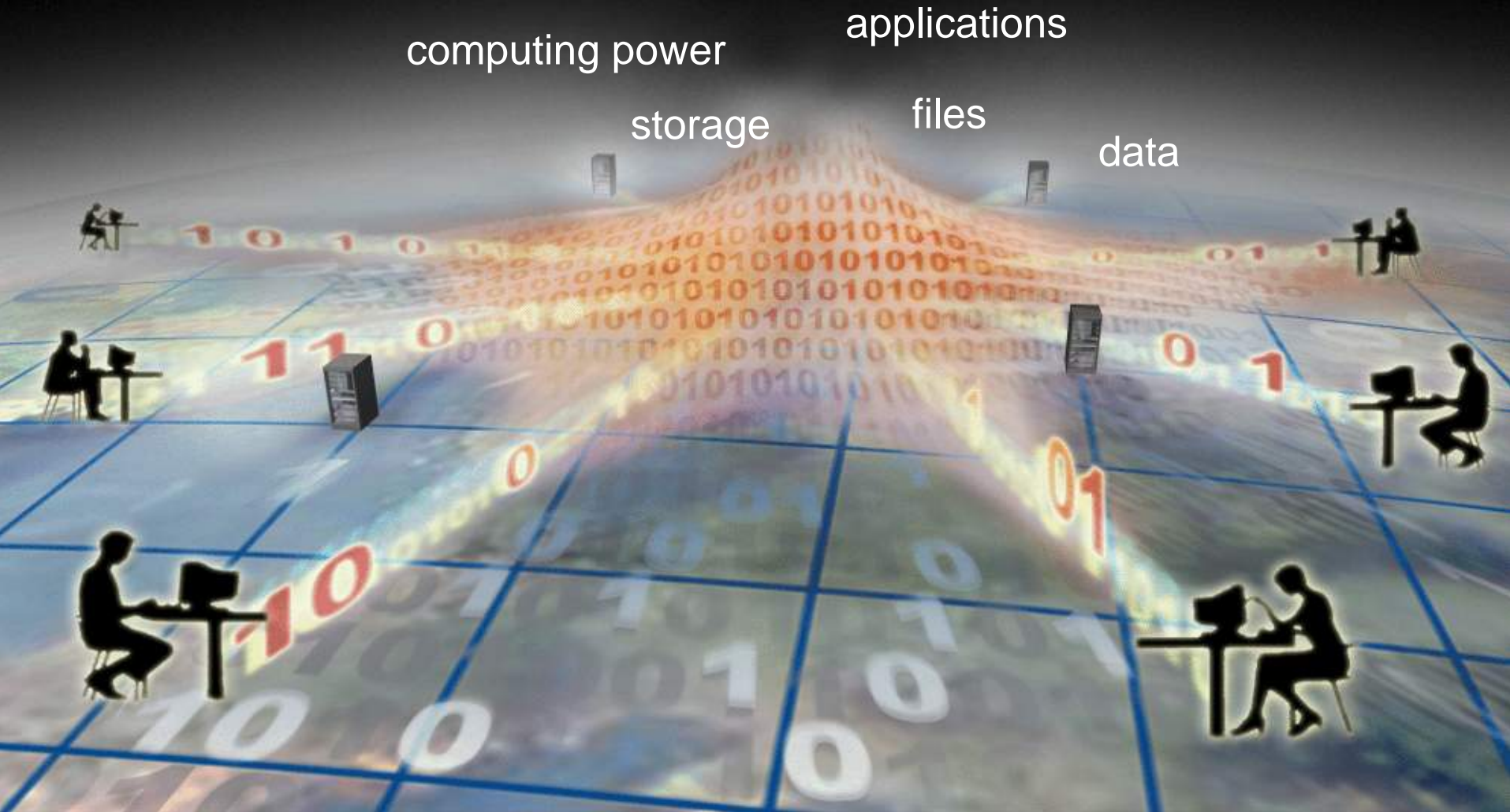
Information

Distributed  
Virtual Systems

***Grid Computing  
On Demand***

# Virtualization

## *Physical Internet*





# Virtualization: Grid Computing

*Accessing and Sharing Resources over the Internet, or Private Intranets, based on Open Protocols*



# Pervasive Computing





# Virtual Access to Computing



# Internet Evolution – 2008

Massive Scalability  
Services, Information, Devices

Distributed  
Virtual Systems

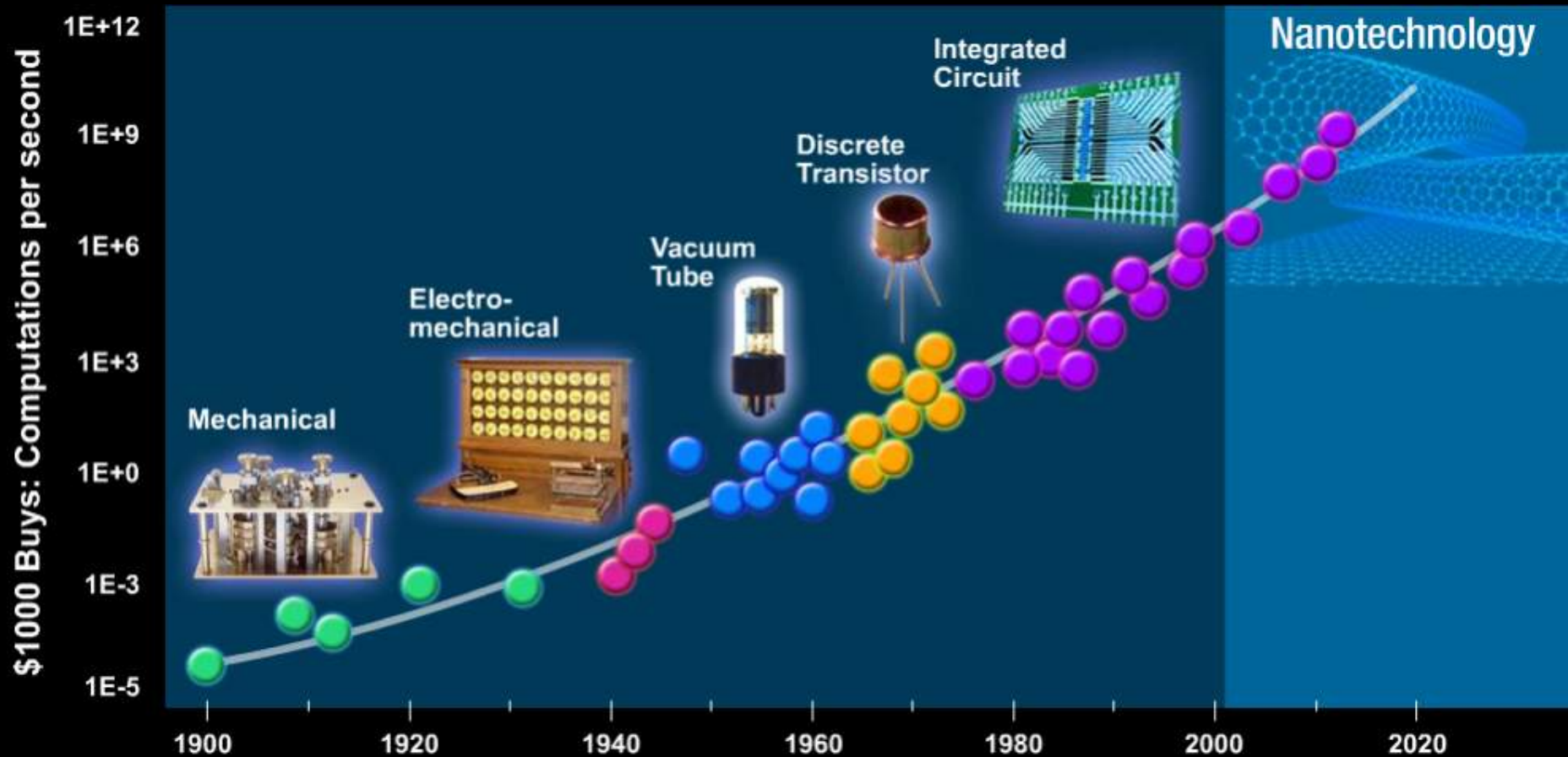
Information

Communications

Networking

***Cloud Computing***  
***New Enterprise Data Center***

# Accelerating Advances in Information Technologies

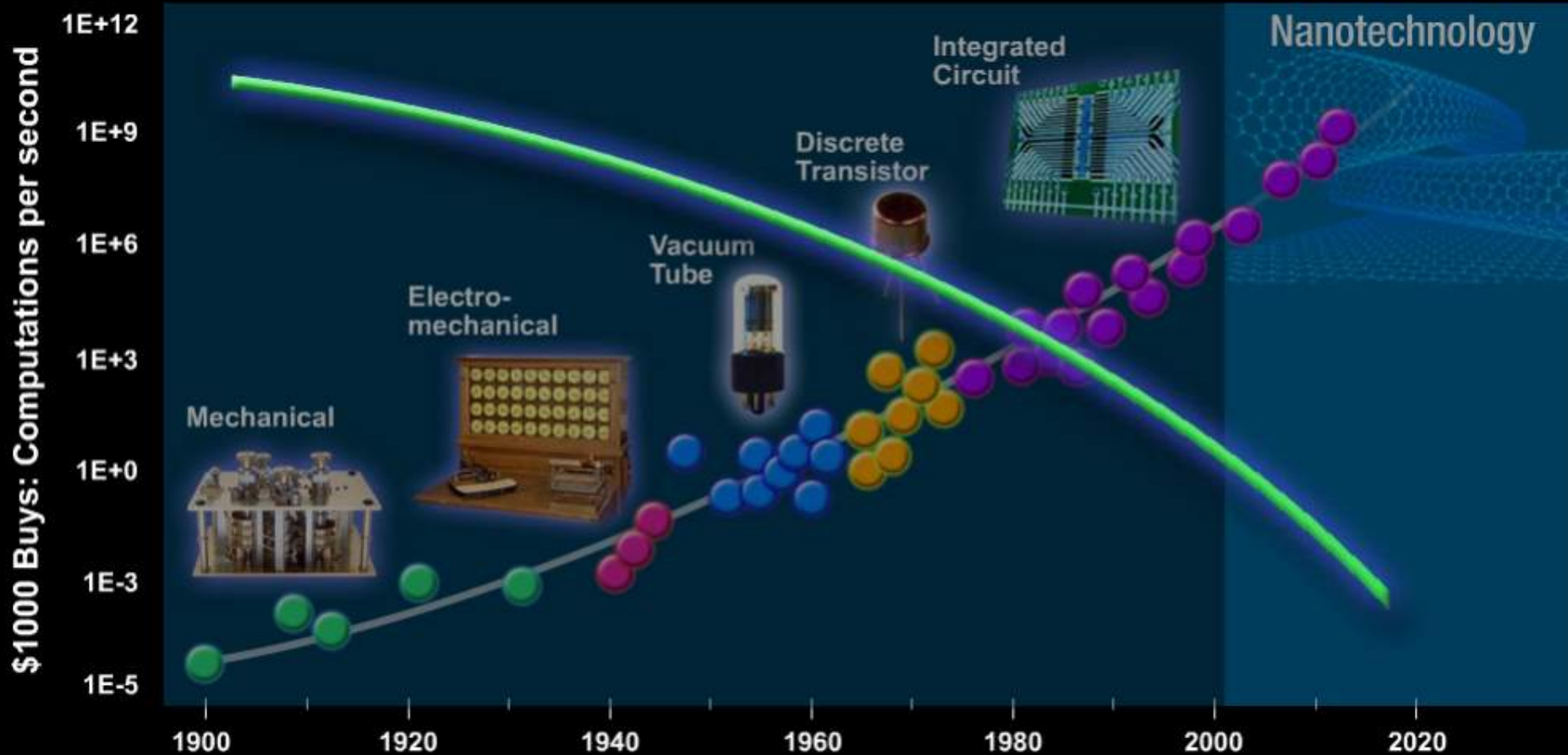


Source: Kurzweil 1999 – Moravec 1998



# Accelerating Advances in Information Technologies

## *Driving Costs Steadily Downward*



Source: Kurzweil 1999 – Moravec 1998

# A Stream of Disruptive Innovations



The background of the slide features a dramatic image of the Earth from space, showing a bright blue horizon and white clouds. A series of bright, fiery streaks, representing disruptive innovations, are shown striking the Earth's surface from the upper right towards the lower left. The streaks are composed of multiple parallel lines of varying lengths and colors, including yellow, orange, and red, creating a sense of rapid movement and impact.

**Globalization**      **Services Sciences**      **Web 2.0**

**Mobile Devices**      **Offshoring**

**Flat World**      **Ubiquitous Sensors**

**Petaflop supercomputers**      **Virtual Worlds**

**Commoditization**      **Real-time Information**

**Emerging Economies**

**Energy & Environment**

# Cambrian Explosions

*Massive Scalability, Rich Diversity*

**Business and  
Consumer Services**

**Real-time Information**

**New Enterprise Data Centers**  
*Systems, servers and storage*

**People, Devices, Sensors**





# Cambrian Explosions Business and Consumer Services



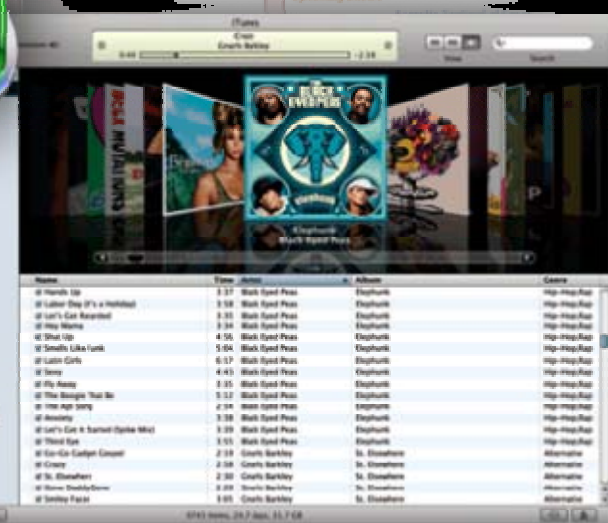
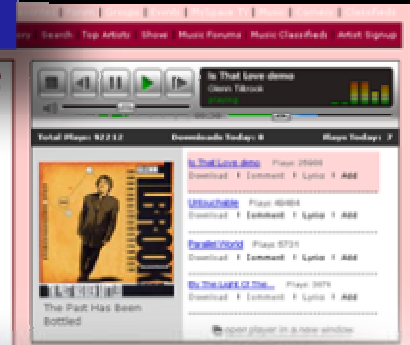
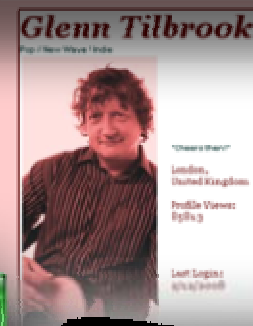
facebook



Google  
Finance BETA



myspace.com



# Cambrian Explosions Real-time Information





# Cambrian Explosions Devices, Sensors, etc





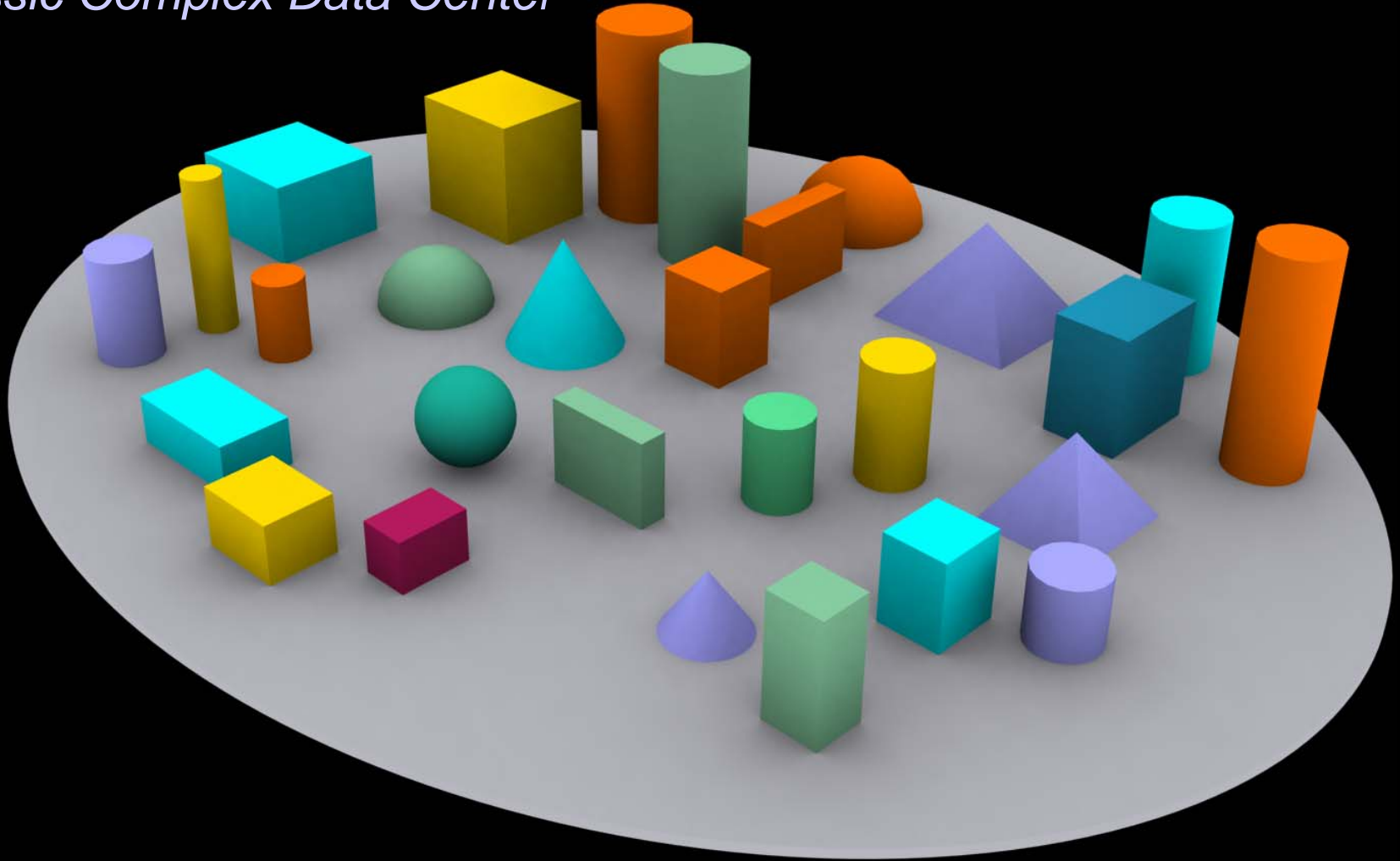
Cambrian Explosions

# New Enterprise Data Centers

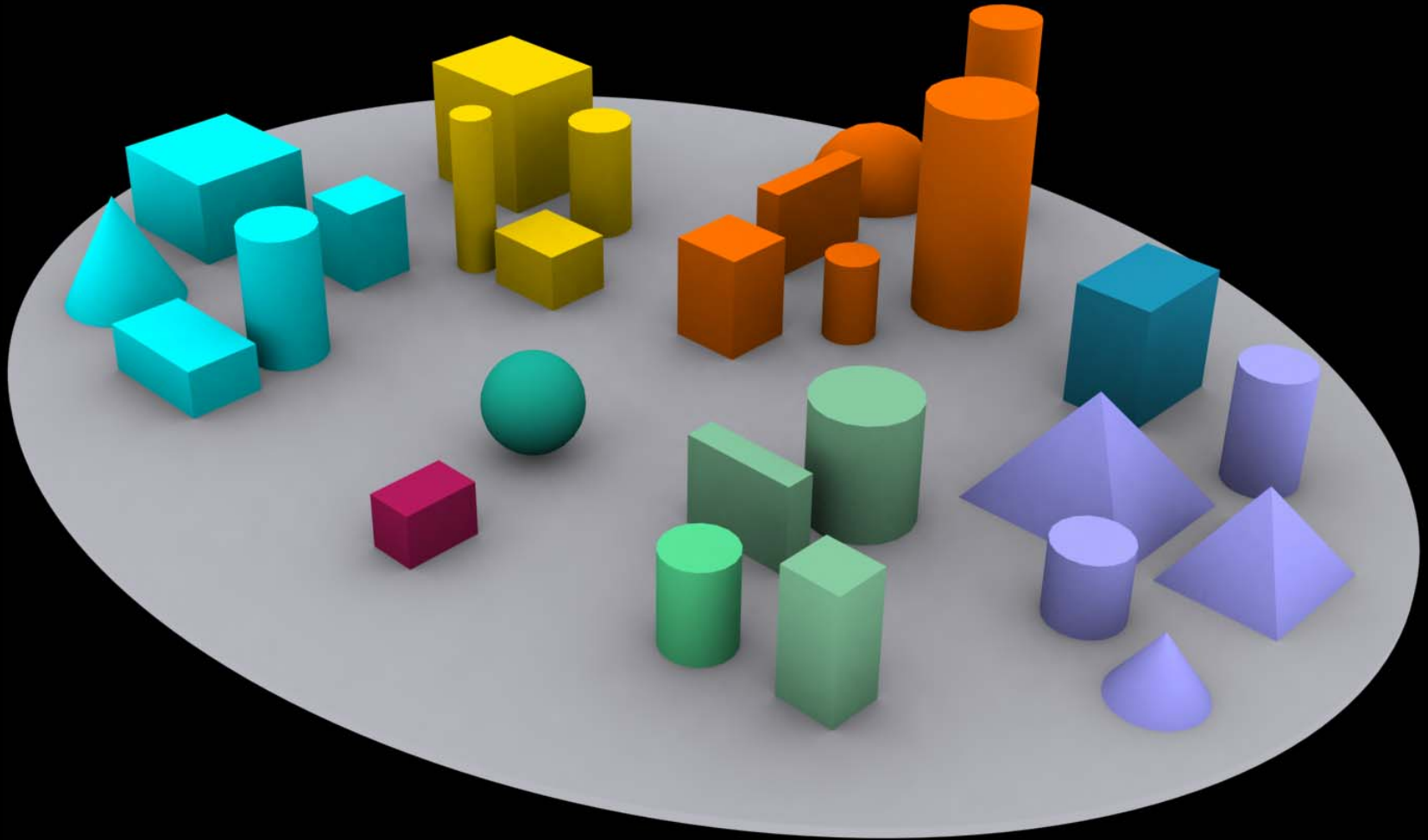


# The IT Complexity Crisis

## *Classic Complex Data Center*

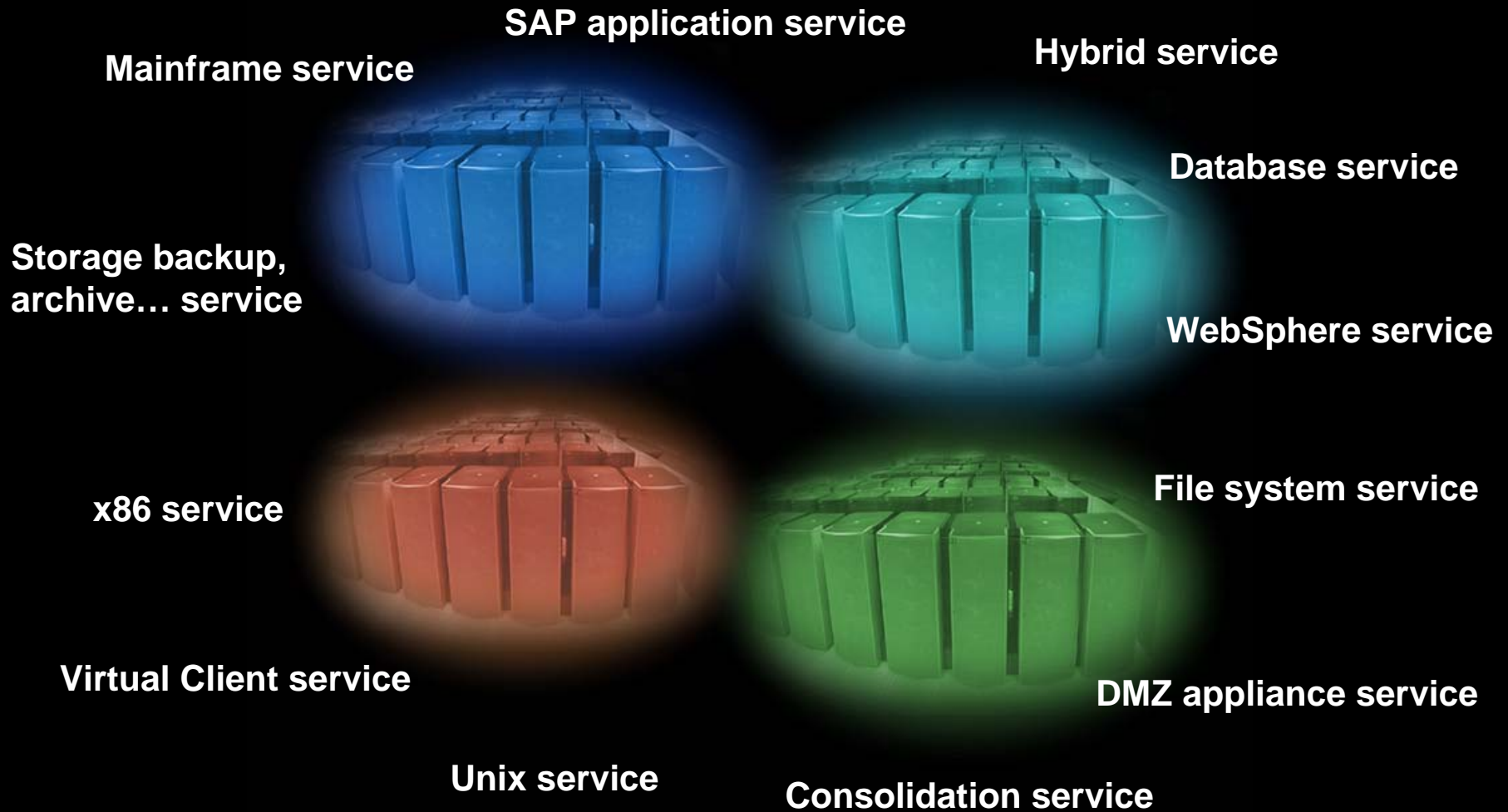


# Data Center “Ensemble” Approach To IT Simplification

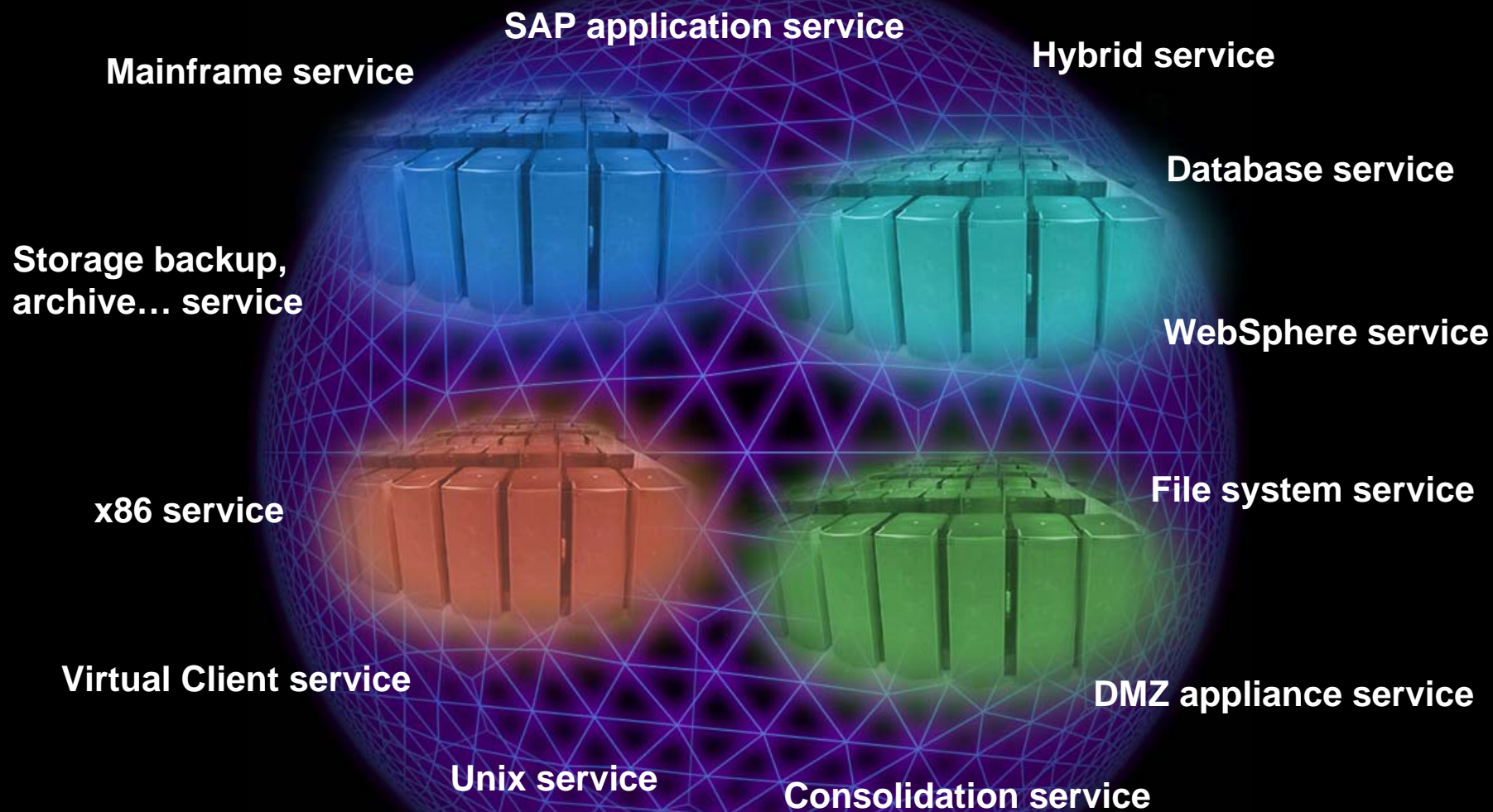




# Ensembles



# Virtualized, Federated Ensembles – SOA/Grid Protocols



# New Enterprise Data Center - Blue Cloud





# Critical Requirements

*Flexible, Adaptable Architectural Frameworks*



# Autonomic Computing

Self-protecting

Self-healing



Self-optimizing

Self-configuring

# New Enterprise Data Centers = Clouds + IT

## Industrial Strength, Universal Connectivity

Content      Browsers      Java      Standards  
Transactions      Systems Mgmt  
Web Servers      Availability  
Security

IT →

Cloud →

## Massive Scalability, Rich Diversity

Business Services      Devices  
Real-time Information  
Sensors      Autonomic Mgmt      Computing Capacity  
Consumer Services      Storage & Content





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