Linux: a Disruptive Force — Then and Now

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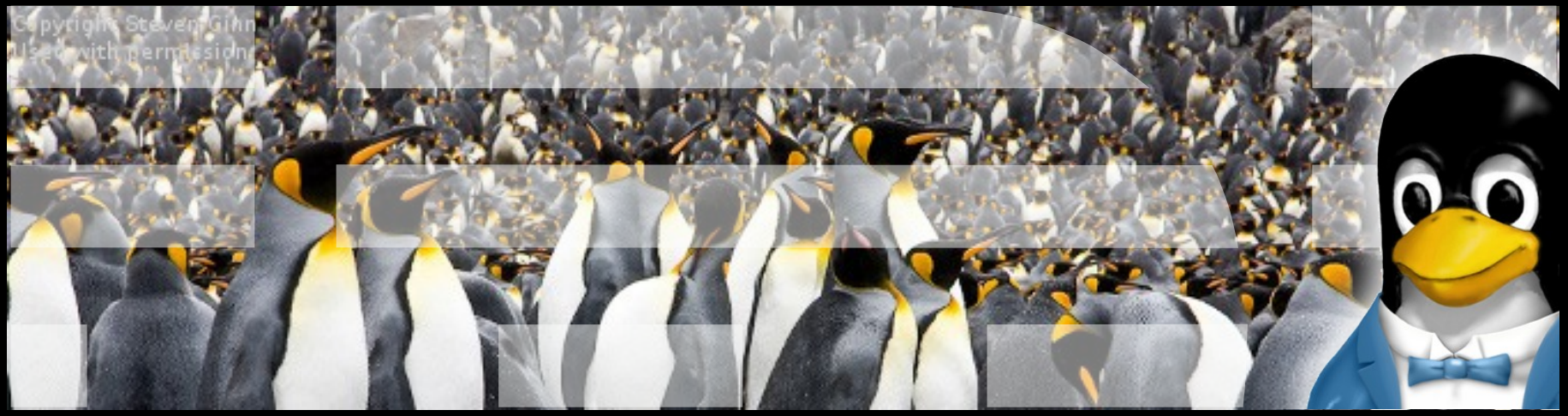
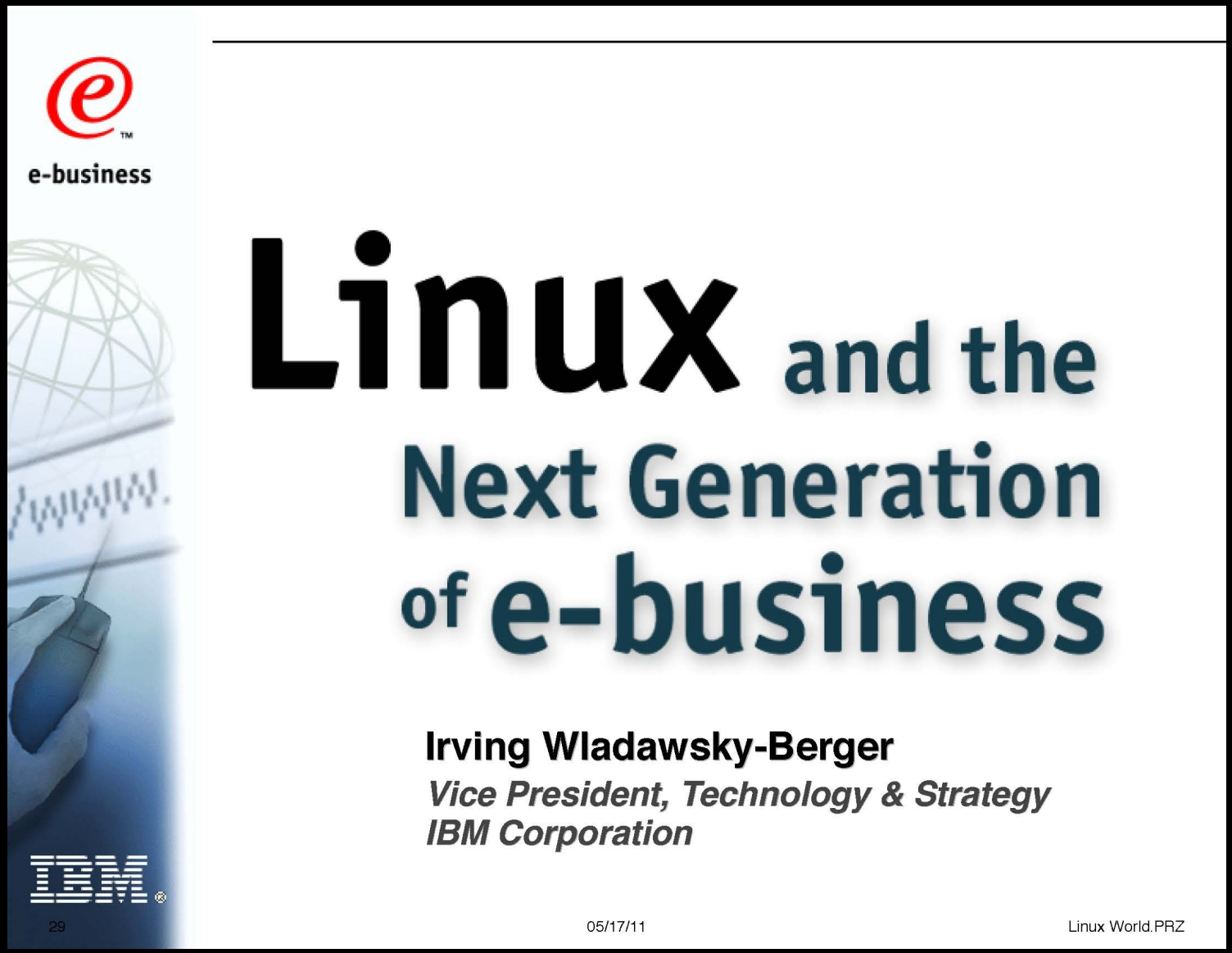


LinuxCon - Vancouver; August 18, 2011

Agenda

- Linux then
- Linux now
- Linux in the future
- Call to action

LinuxWorld 2000

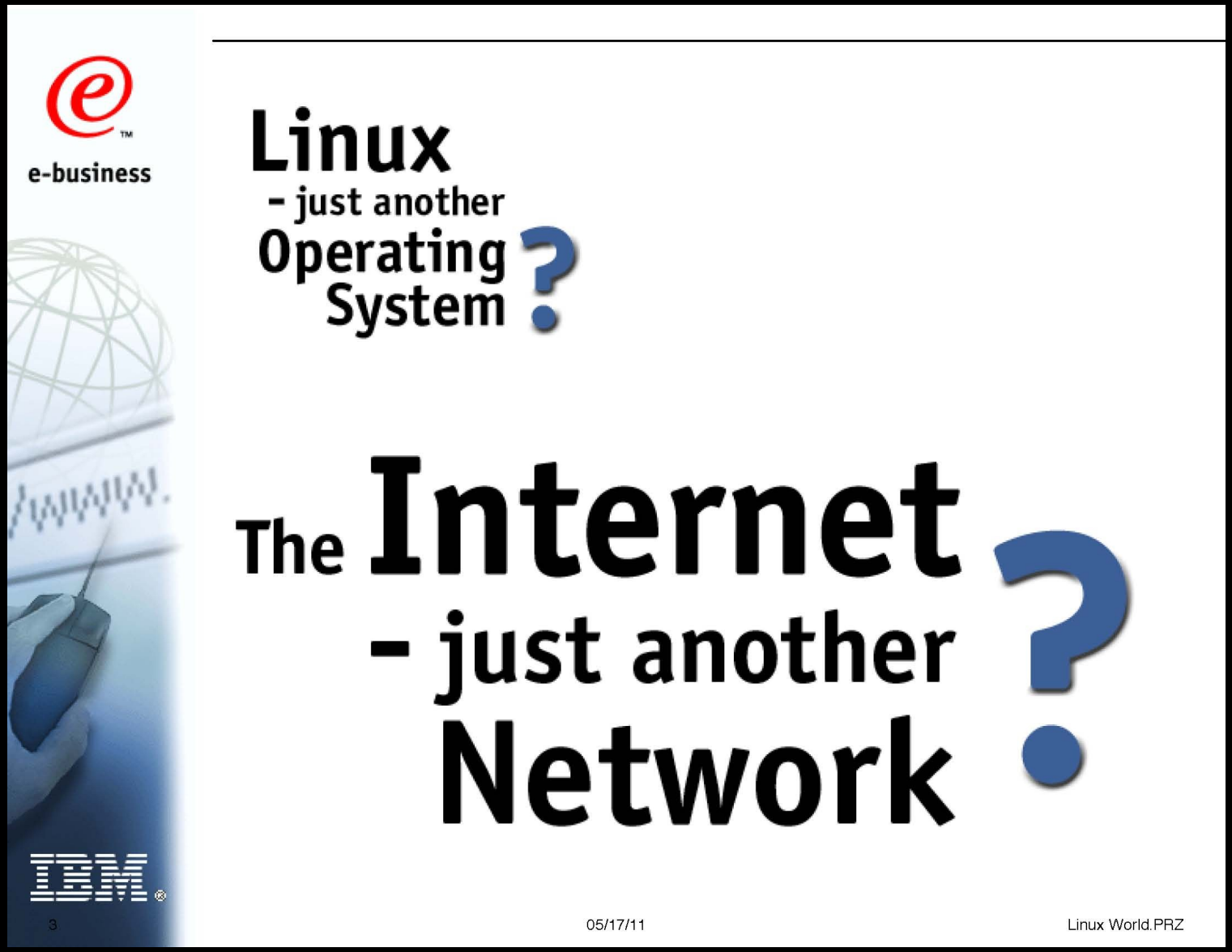


e-business

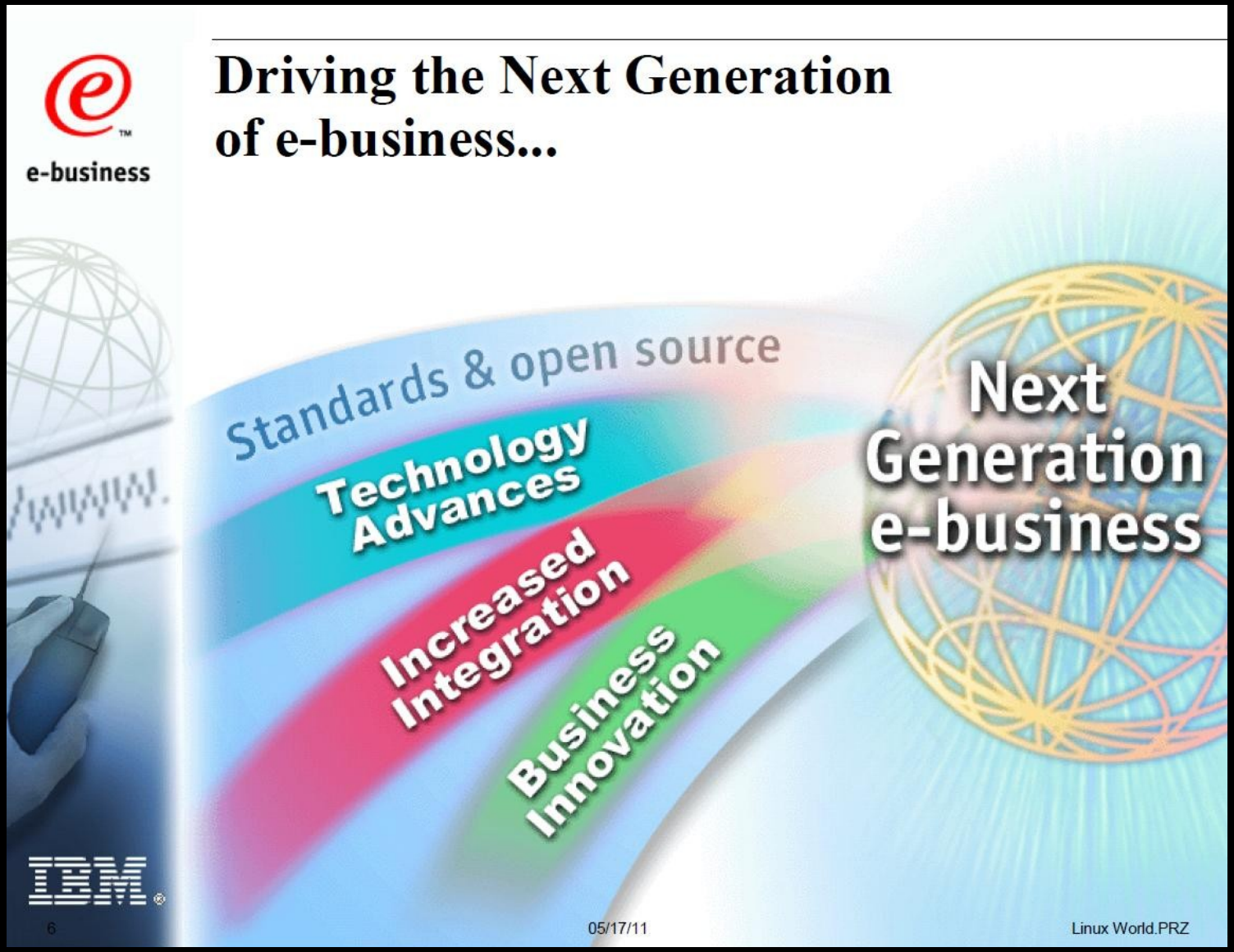
Linux
- just another Operating System ?

IBM

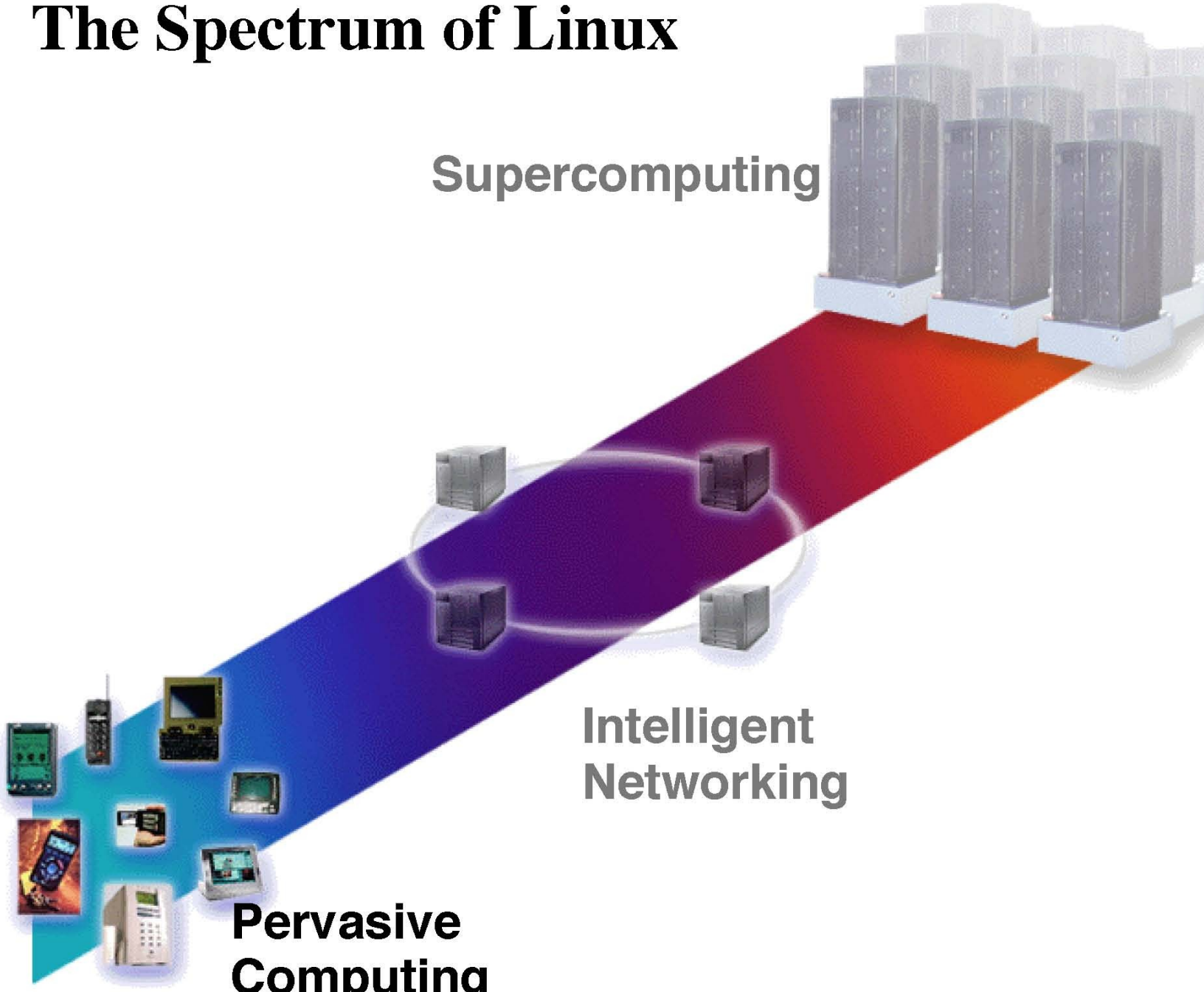
In 2000, Linux already a disruptive force



IBM embraced Linux as a driver of “e-business” innovation



The Spectrum of Linux



Toward an Open e-business World

e-business

Integration

Innovation

Infrastructure

Linux

IBM

The journey hasn't always been easy, but Linux has prevailed

THE LINUX FOUNDATION

IBM intel FUJITSU hp NEC ORACLE

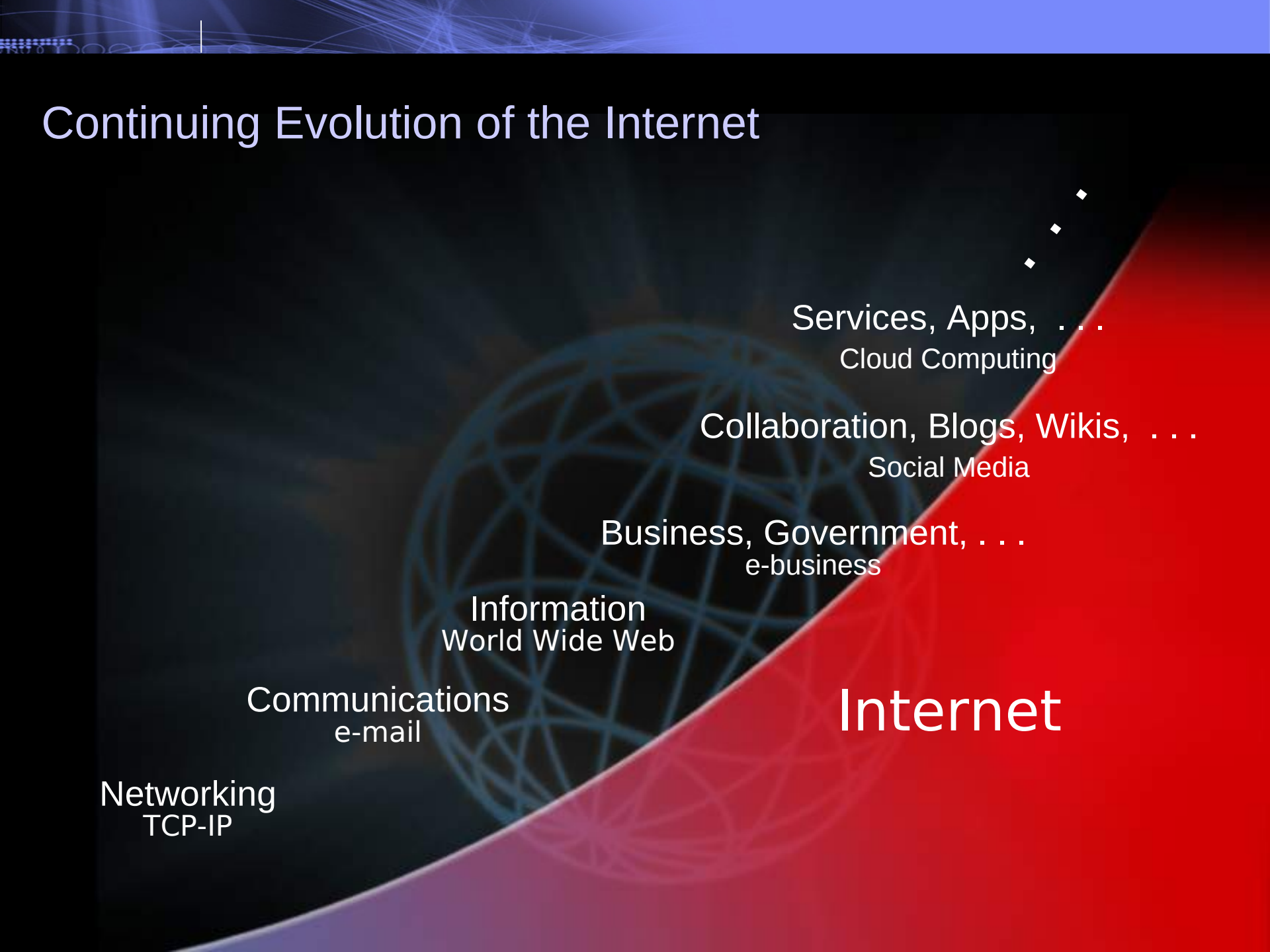
Almost 100 members, and growing...

Agenda

- Linux then
- Linux now
  - Cloud Computing
  - Smarter Planet, Smarter Cities
- Linux in the future
- Call to action

Continuing Technology Advances

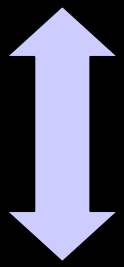
Continuing Evolution of the Internet



Cloud Computing: a consumption and delivery model for services, apps, information, . . .

Consumption Model:

The Mass Customization of Services



Delivery Model:

The Industrialization of Services

Towards Ubiquitous Connectivity

The last three decades have witnessed tremendous progress in global digital connectivity and ubiquity

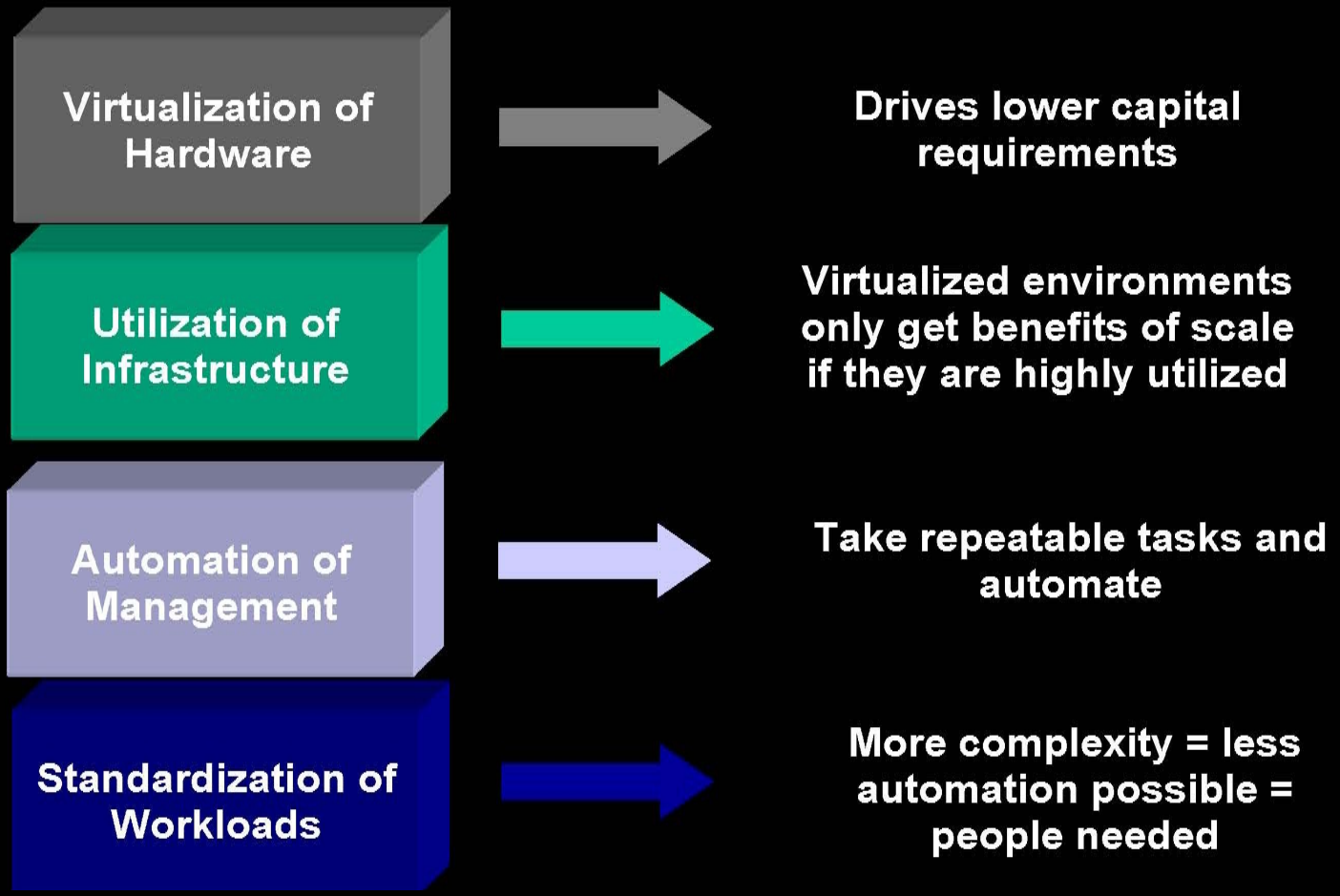
	1981	1994	2011+
			
Media / device	PC	Laptop / internet	Phone
Cost	~$6,000	~$2,000	$25-250
Penetration	1%	10%	75%
e-services potential	Non existent	Medium	High

The decreasing cost of technology is reducing the “digital divide” and democratizing access to consumer, business and government e-services of all sorts

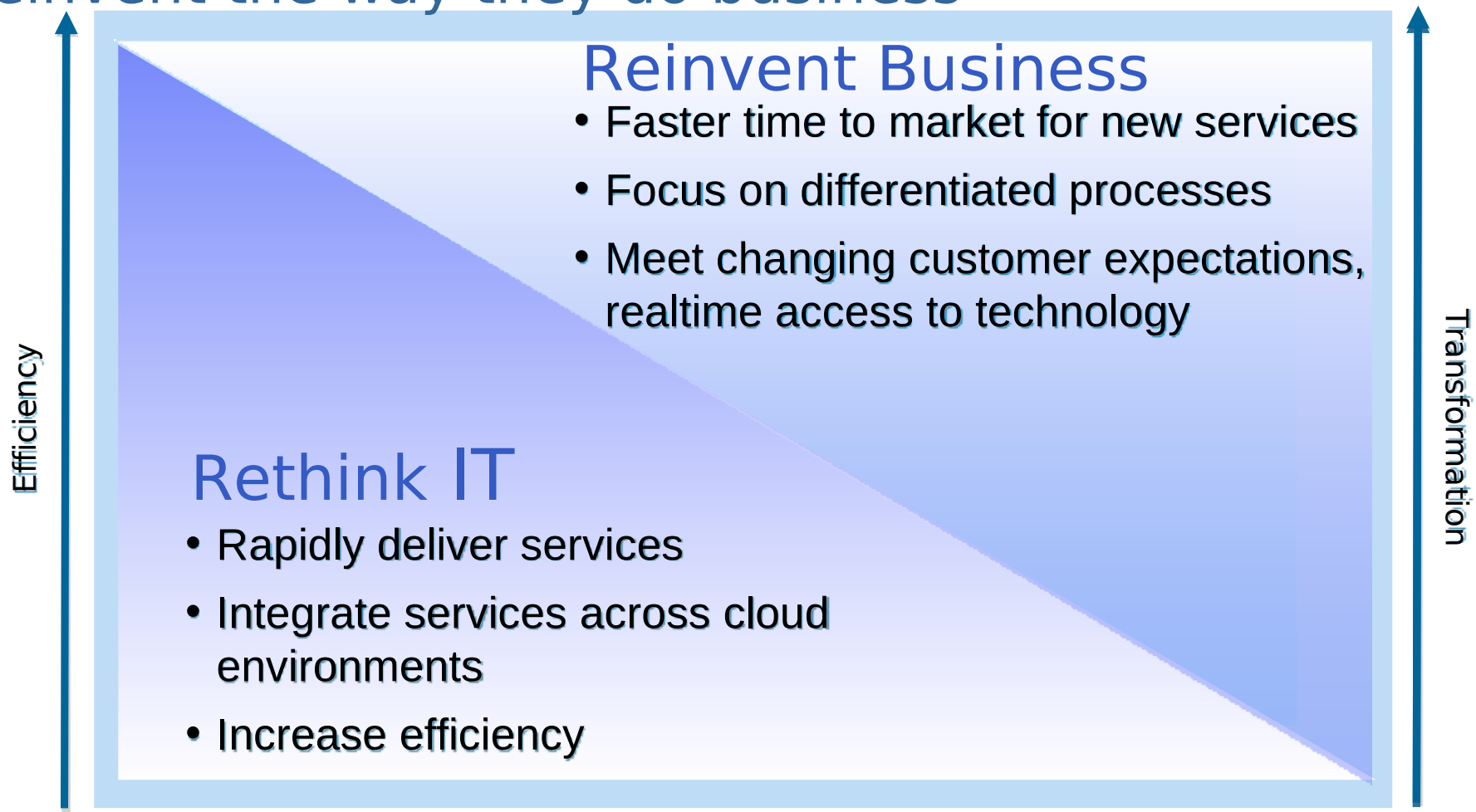
Clouds enable ubiquitous access to applications from an increasingly diverse set of devices

- On demand self service
- Anytime from any device
- Decoupling data from device
- Unified communications
- Delivery of real time data and analysis

Major factors driving cloud economics

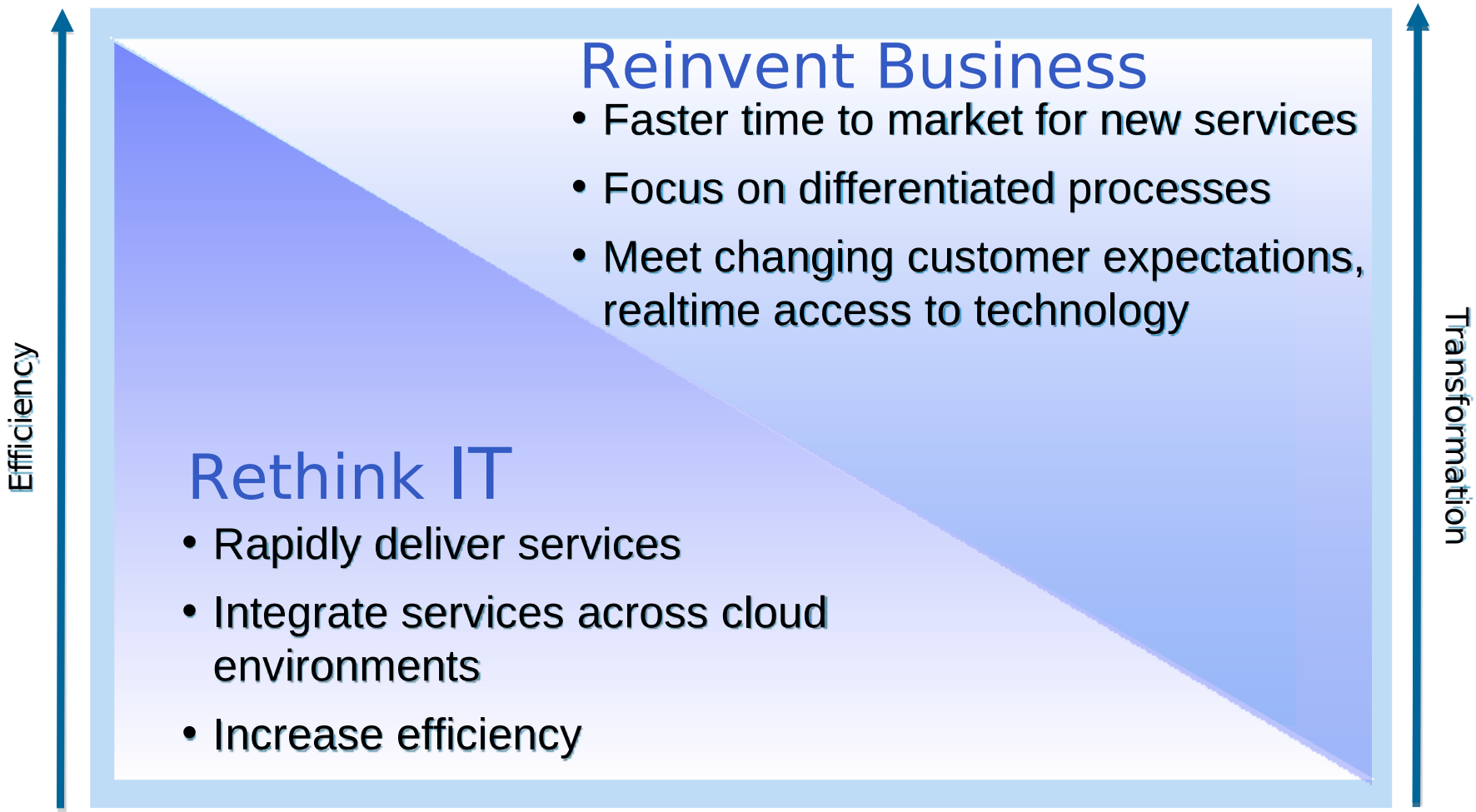


Cloud computing allows companies to rethink IT and reinvent the way they do business



Economics of Computing are Changing

Linux is Playing a Major Role in all Aspects of Cloud



Economics of Computing are Changing

Smart Planet

Leverage all these advances in IT to infuse intelligence into the way everything works

The world is becoming

INSTRUMENTED.

The world is becoming

INTERCONNECTED.

All things are becoming

INTELLIGENT.

The world is getting smarter

Smart traffic systems

Intelligent oil field technologies

Smart food systems

Smart healthcare

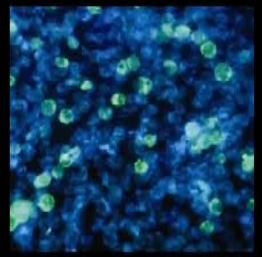
Smart energy grids

Smart retail

Smart water management

Smart supply chains

Smart countries



Smart weather

Smart regions

Smart cities

Linux is helping the world address them…

Smarter cities like Dubuque, which will be enabled by a Linux-based cloud and analytics solution

Smarter medicine: Astellas Pharma reduces drug discovery with Linux clusters

Smarter oil and gas exploration with Shell, simulating more and speculating less

Smarter traffic systems in Stockholm, driven by Linux

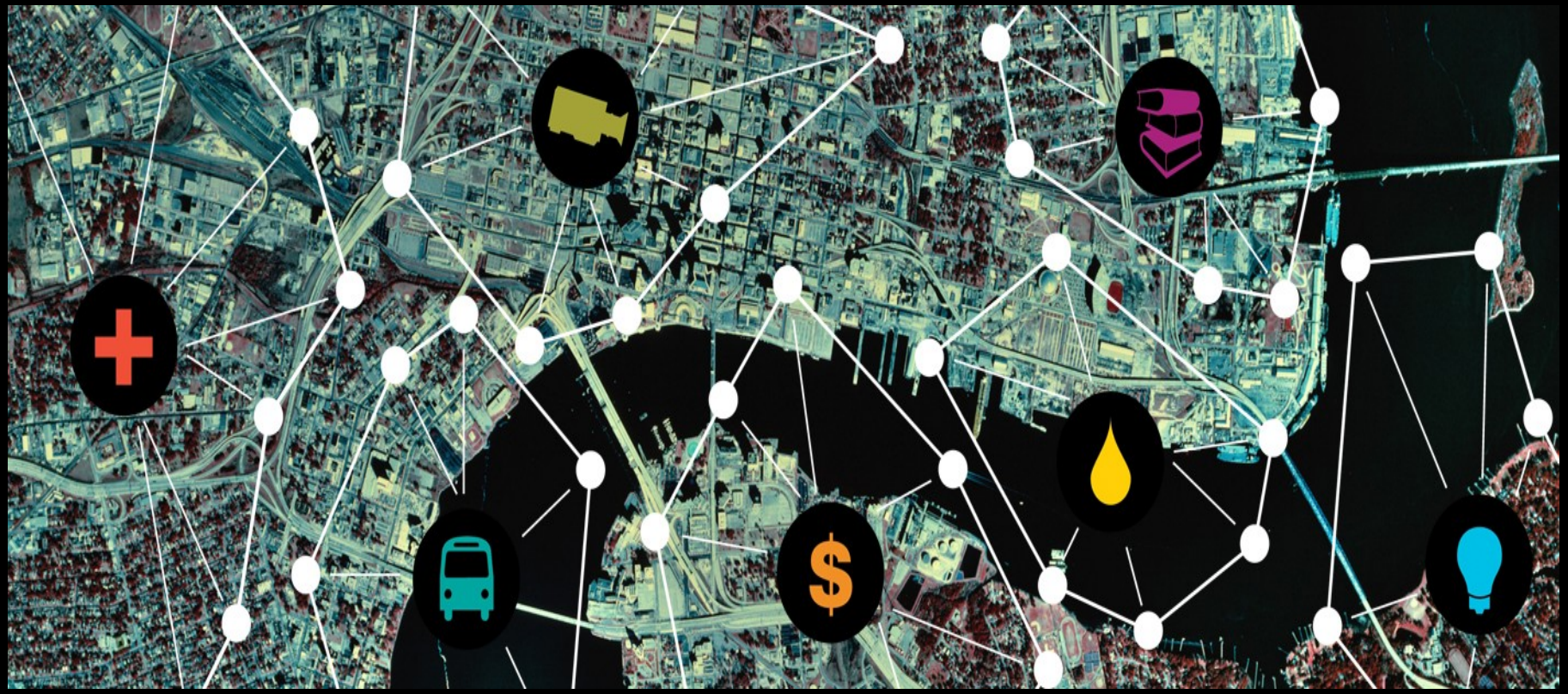
A Planet of Smart Cities

- In 1900 only 13% of the world's population lived in cities
- Now, the majority of the world's populations lives in cities
- By 2050, cities will likely make up over 70% of the world's population
- Urban areas are expected to absorb all the planet's population growth

- 2.5 billion people - over the next four decades

Smart Cities as Systems of Systems

EDUCATION • TRANSPORTATION • SOCIAL SERVICES • UTILITIES • ENERGY • HEALTHCARE • COMMUNICATIONS



RETAIL • AUTOMOTIVE • FINANCE • MANUFACTURING • FOOD • POSTAL SERVICE • MEDIA • DEFENSE • CUSTOMS

The challenges remain daunting…

Many system integrations are required to make “anything” smarter

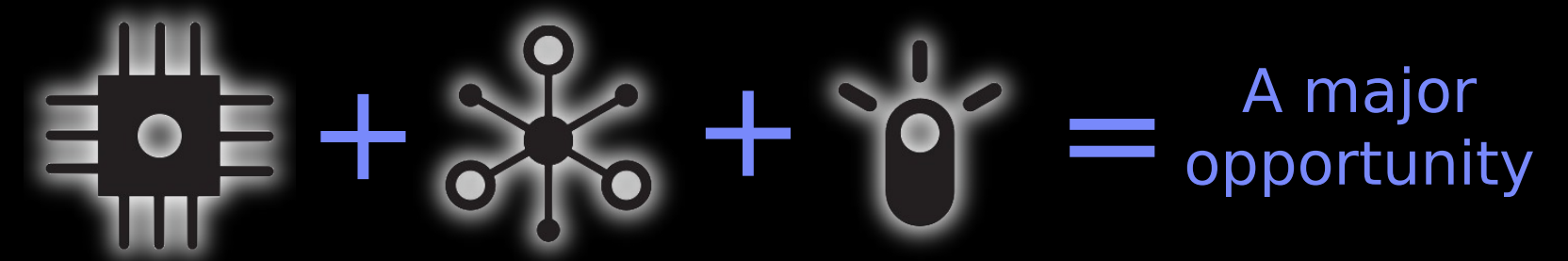
Much computing power is needed to discover “new treatments for cancer”

Massive amounts of data from “smart power meters” must be read per hour

Very large numbers of images must be captured, stored, managed and linked to “billing and collection systems” in real time

Linux is at the forefront of smarter solutions

The world is changing



Enemalta Corporation is transforming utility billing with a nationwide smart grid and Linux servers

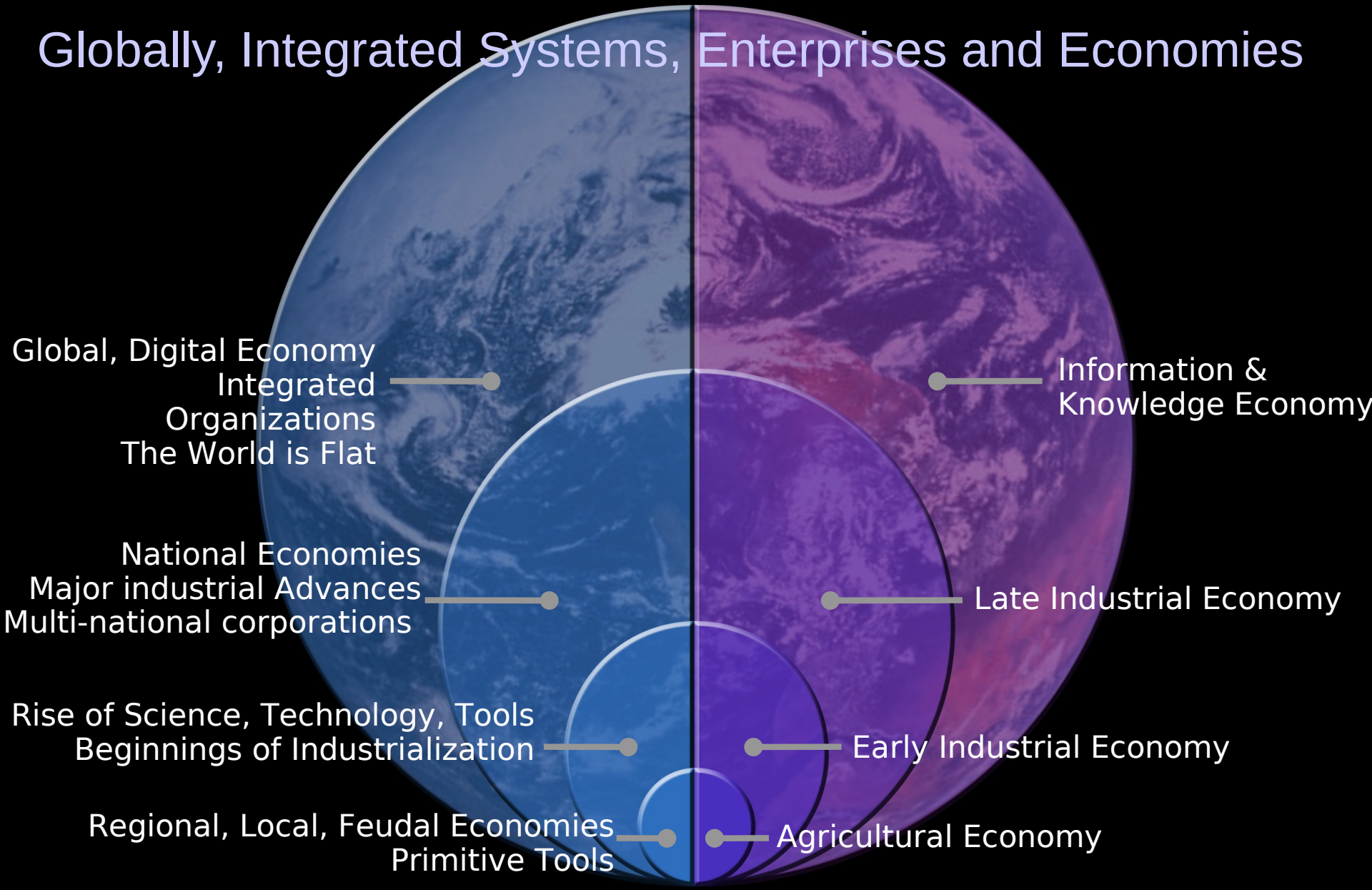
Queensland Motorways uses Linux solutions to reduce bottlenecks for smarter tollway management

Astellas Pharma has decreased new drug development time by 90% with Linux HPC

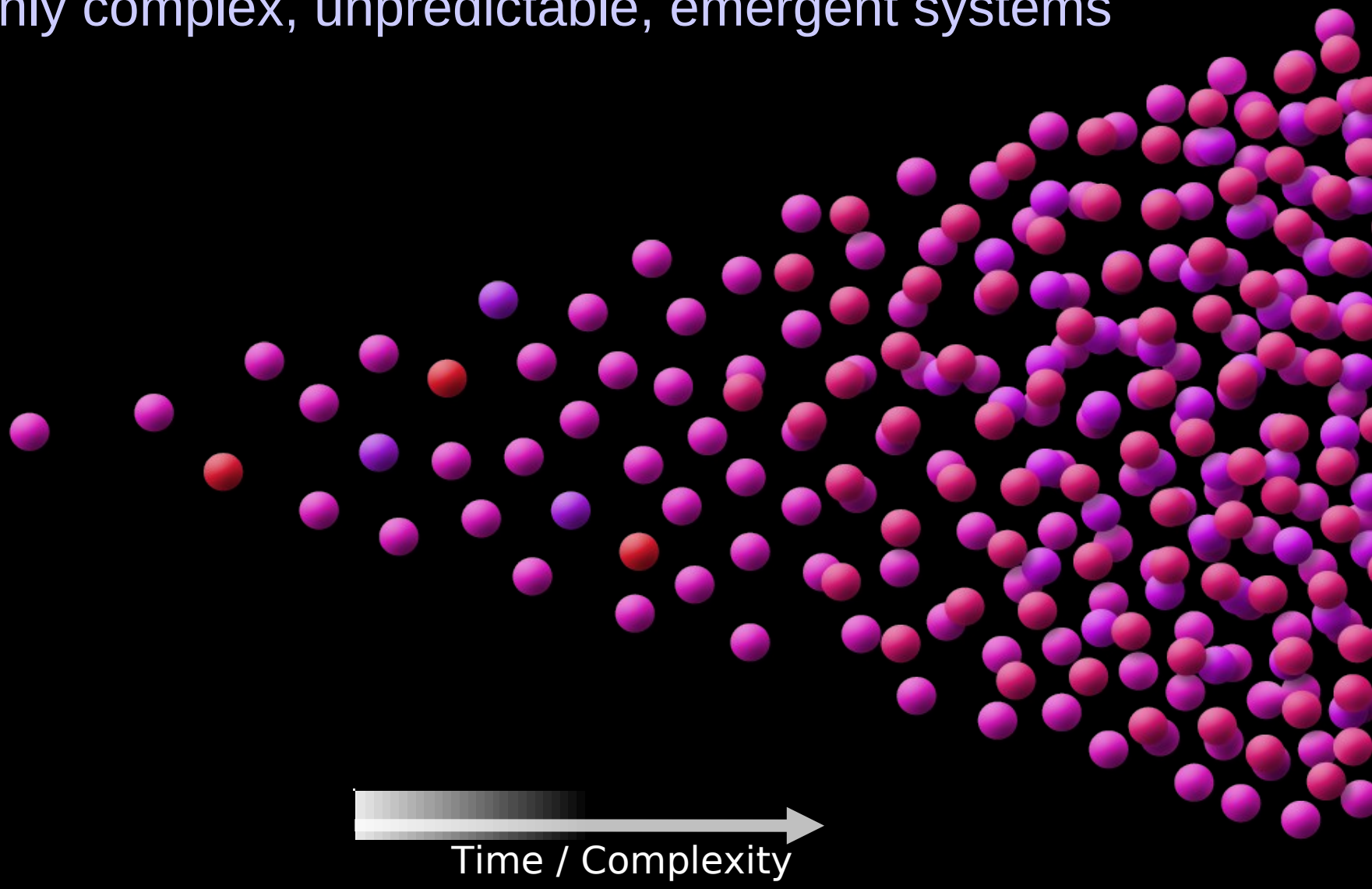
Agenda

- Linux then
- Linux now
- Linux in the future
  - Analytics
  - Supercomputing
- Call to action

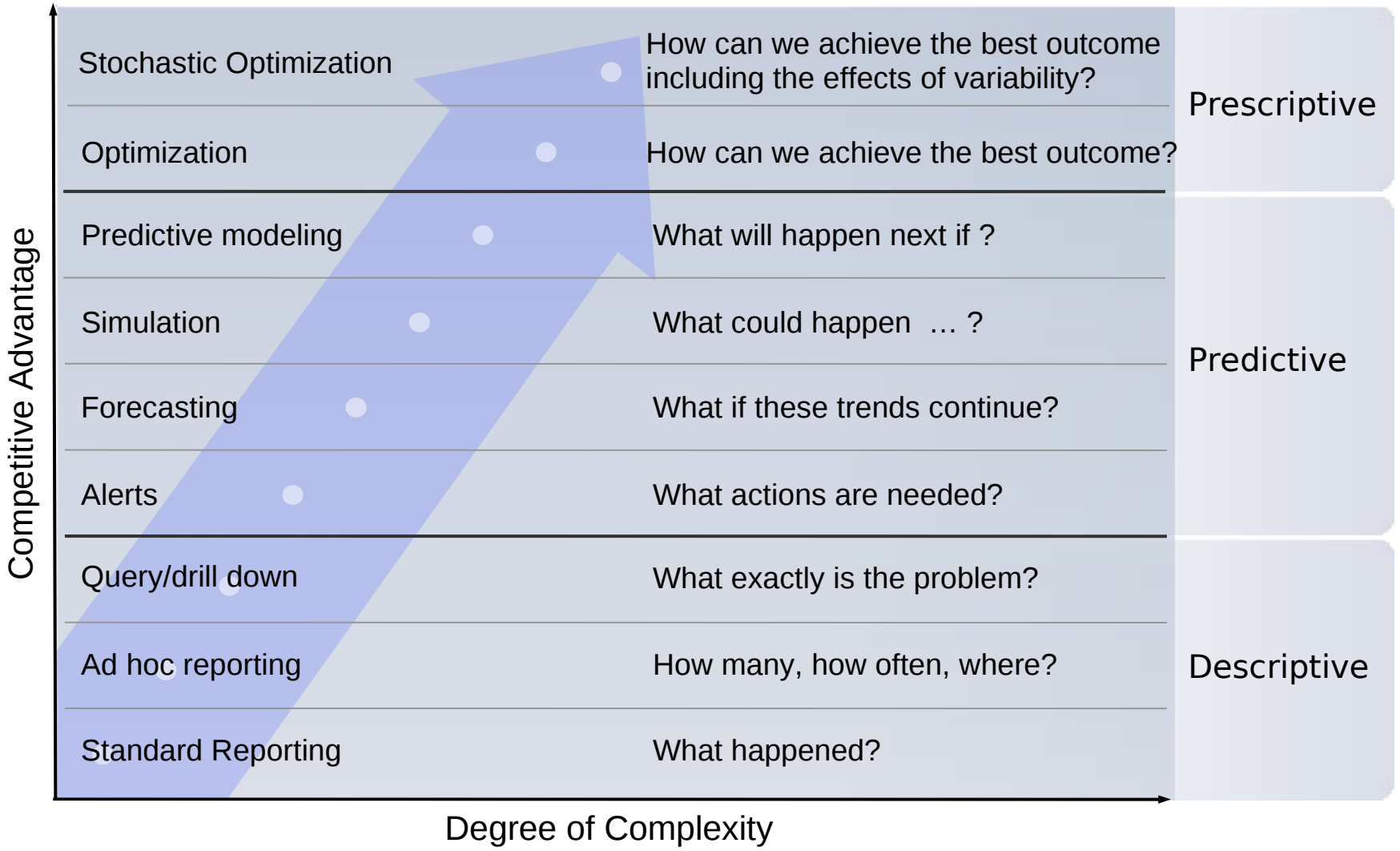
Globally, Integrated Systems, Enterprises and Economies



Highly complex, unpredictable, emergent systems

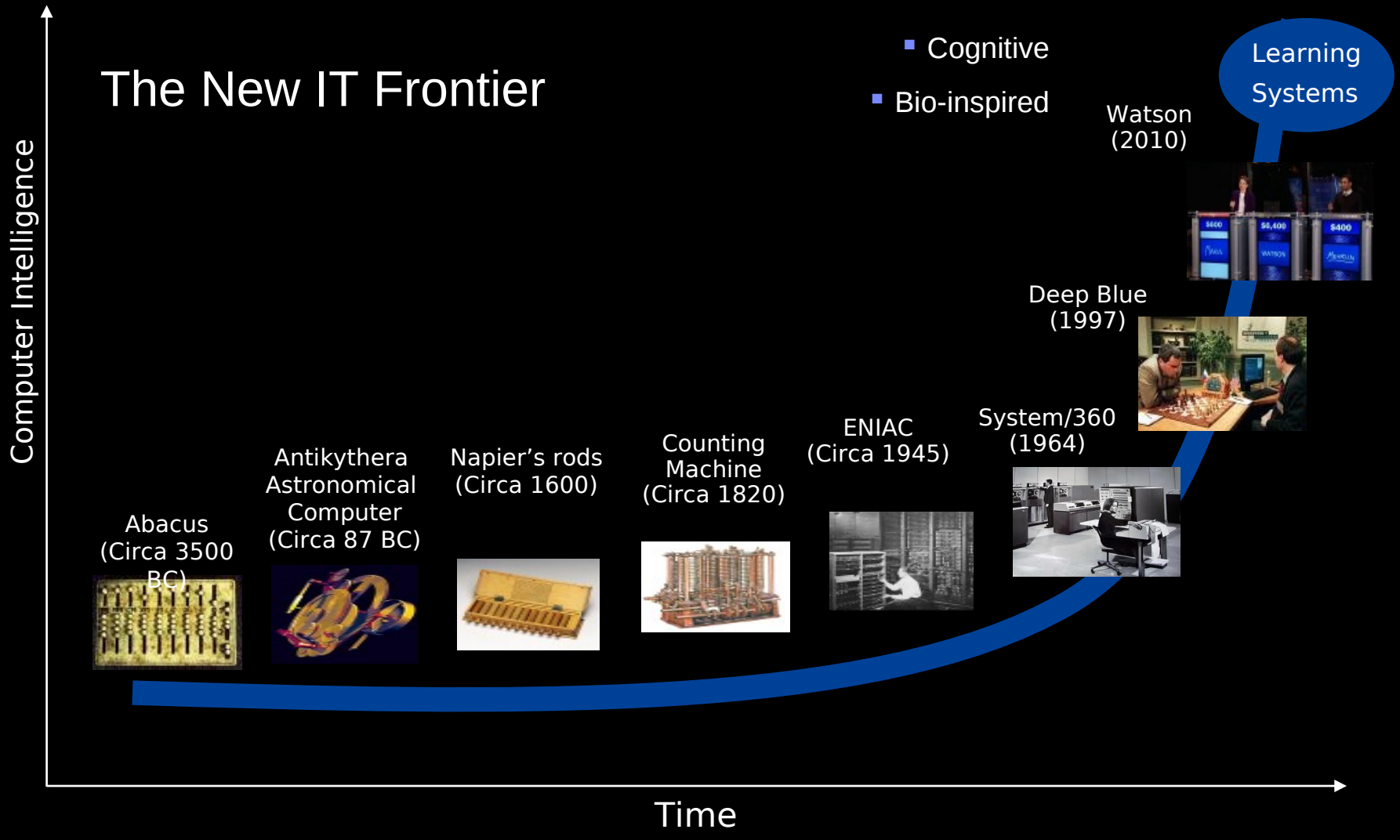


Advanced Analytics, Modeling and Optimization



Based on: Competing on Analytics, Davenport and Harris, 2007

The Evolution of “Intelligent” Machines



Information-based Intelligence

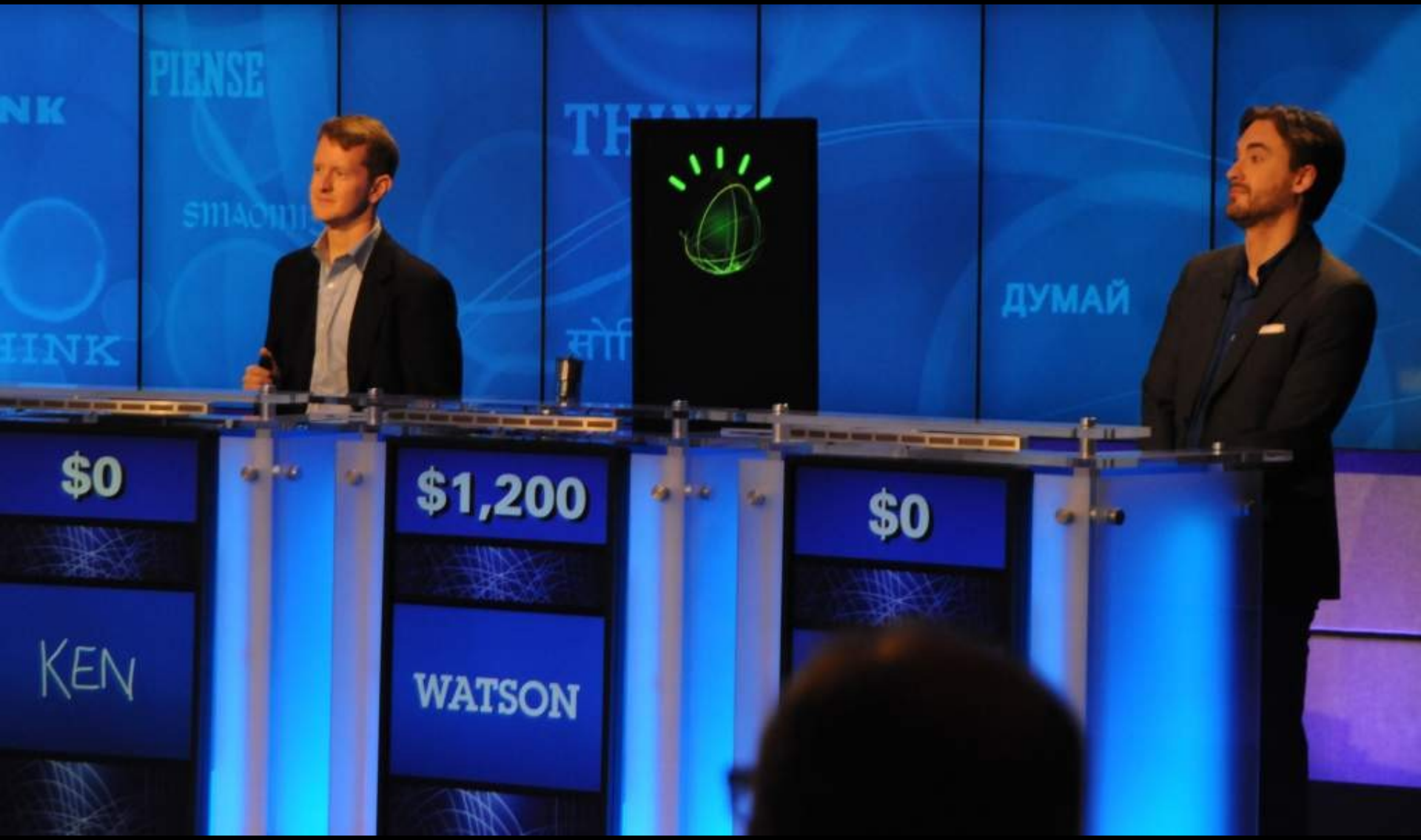
- Statistical, brute force approach based on analyzing vast amounts of information using powerful computers and sophisticated algorithms
- Scales very nicely: the more information you have, the more powerful the computer, the more sophisticated the analytical algorithms . . . the better the results
- Originated in science, especially high energy physics
- Data mining in 1990s
- Deep Blue (1997)
- Watson (2011)

Want to Play Chess or Just Chat?

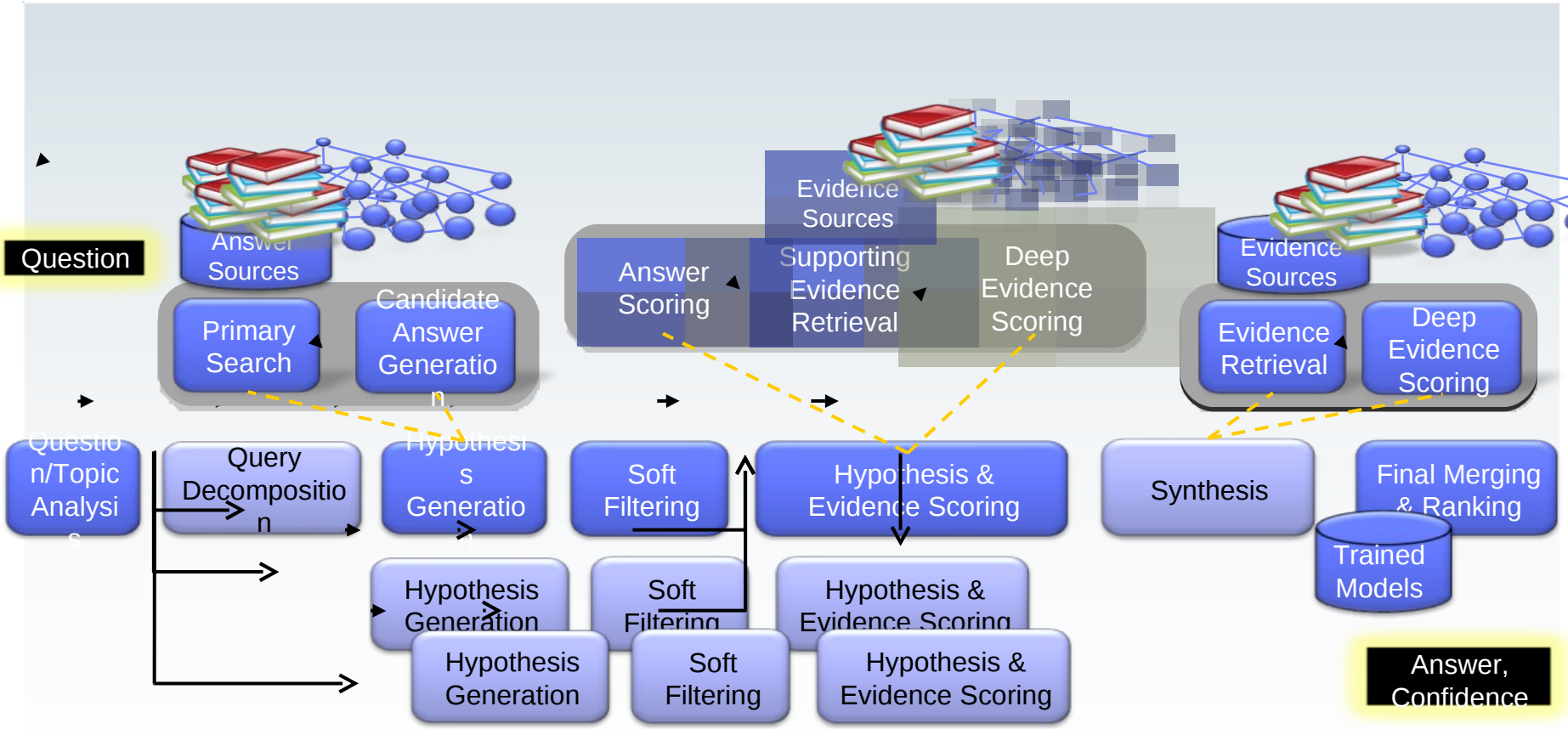
- Chess
  - A finite, mathematically well-defined search space
  - Limited number of moves and states
  - All the symbols are completely grounded in the mathematical rules of the game

- Human Language
  - Words by themselves have no meaning
  - Only grounded in human cognition
  - Words navigate, align and communicate an infinite space of intended meaning
  - Computers can not ground words to human experiences to derive meaning

IBM Watson is a computing system that rivals a human's ability to answer questions posed in natural language, interpreting meaning and context and retrieving, analyzing and understanding vast amounts of information in real-time



DeepQA is Massively Parallel Probabilistic Evidence-Based Architecture. Generates and Scores Many Hypotheses Using an Extensible Collection of Federated NLP and Reasoning Algorithms



. . .

Business analytics and optimization solutions can help organizations…

Enhance Customer Understanding

- Customer Churn
- Marketing Spend
- Sales Productivity

Optimize Real-Time Decisions

- Trading Advantage
- Fraud Protection
- Health Monitoring

Foster Collaborative Decisions

- Customer Service
- Channel Management
- Loan Origination

Enable Enterprise Visibility

- Risk Management
- Demand Visibility
- Strategy Alignment

Potential Business & Professional Applications

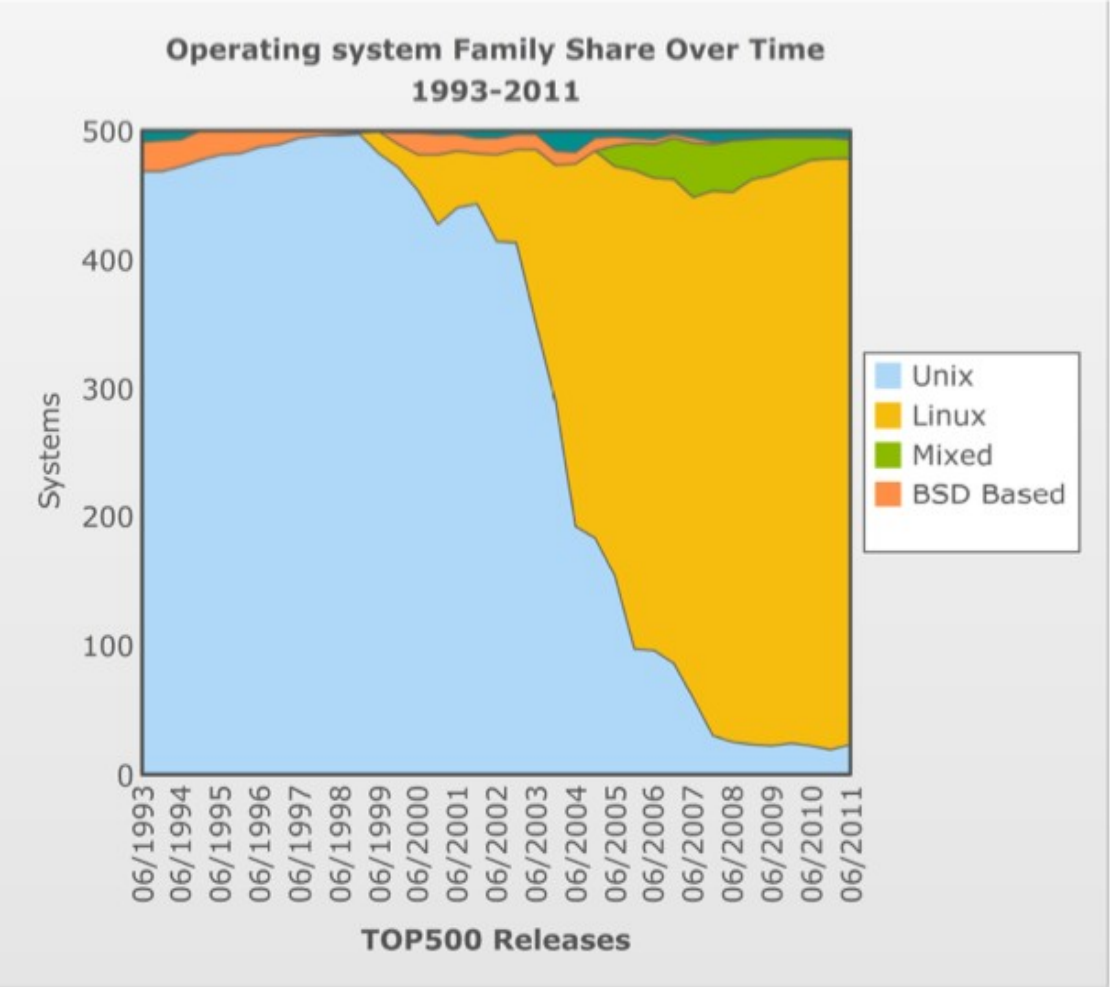
Healthcare / Life Sciences: Diagnostic Assistance, Evidenced-Based, Collaborative Medicine

Tech Support: Help-desk, Contact Centers

Enterprise Knowledge Management and Business Intelligence

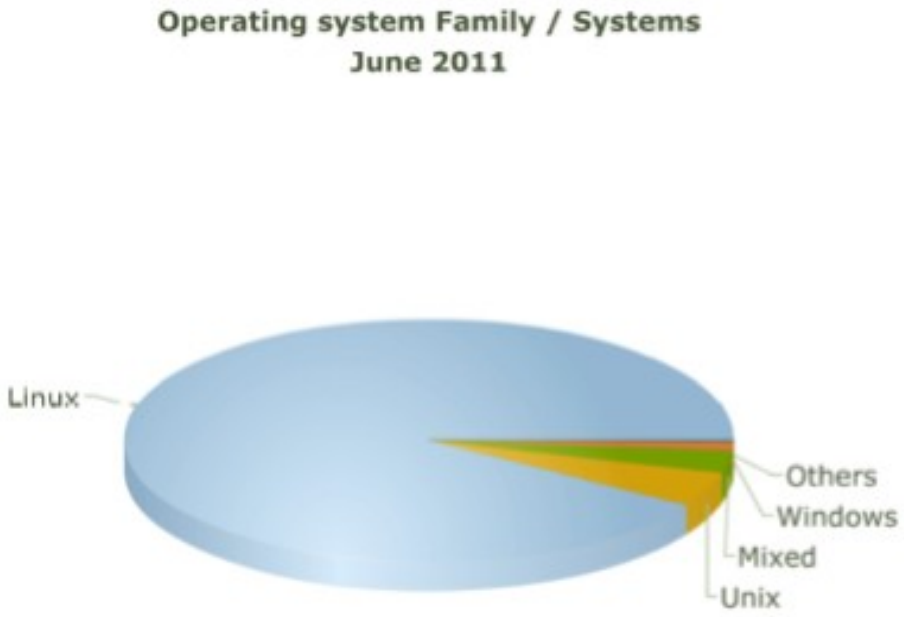
Government: Improved Information Sharing and Security

Linux & HPC: Top500 – OS Distribution over Time



Source: Top500.org

Linux & HPC: Top500 – OS Distribution



Source: Top500.org

Breaking the Petaflop Barrier

World's Most Powerful Supercomputer

- One thousand trillion calculations per second
- Designed to safeguard nuclear stockpile
  - Commercial applications include financial modeling, energy and human genome research
- Hybrid format delivers world-leading efficiency

Los Alamos NATIONAL LABORATORY

DEPARTMENT OF ENERGY • UNITED STATES OF AMERICA •

IBM

Breaking the Exascale Barrier

1,000,000,000,000,000,000 operations/second

100-fold improvements in energy efficiency

Simulation game-changers will accelerate the timeline for meeting serious energy and environmental challenges

Leverage expertise in applied mathematics, computational methods and algorithms and apply them to science and engineering problems throughout DOE

- **Optimization and control of nation's power grid through advanced simulation**
- **Advances to boost building energy-efficiency**
- **Simulation-based discovery of cost-effective photovoltaic materials**
- **Innovative design of combustion devices able to burn advanced bio-fuels**
- **Effective carbon sequestration strategies**
- **Simulation-based analysis and control of water resources**
- **Improved nuclear reactor safety**
- **Increased fidelity of extreme climate event prediction**
- **Mitigation of large-scale instabilities in advanced fusion devices**

Berkeley Lab

U.S. Department of Energy

Office of Science

Agenda

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Innovative Linux solutions start with collaboration

Filesystems

Security

Kernel Summit

FREE SOFTWARE FOUNDATION

LinuxCon

THE LINUX FOUNDATION

LWN.net

frdm Software Freedom Law Center

Linux Plumbers Conference

System Management

RAS

Eclipse

Kernel Summit

Scalability

open source

PHP

The Apache Software Foundation

Network Management

OpenOffice

samba

ODF Alliance

openinventionnetwork

Linaro

GNOME

OASIS Advancing open standards for the information society

OSU Open Source Lab

Linux Standard Base

Yocto

GIMP

DAISY

Python

mozilla

Groklaw

Memory Management

Performance

Ruby on Rails

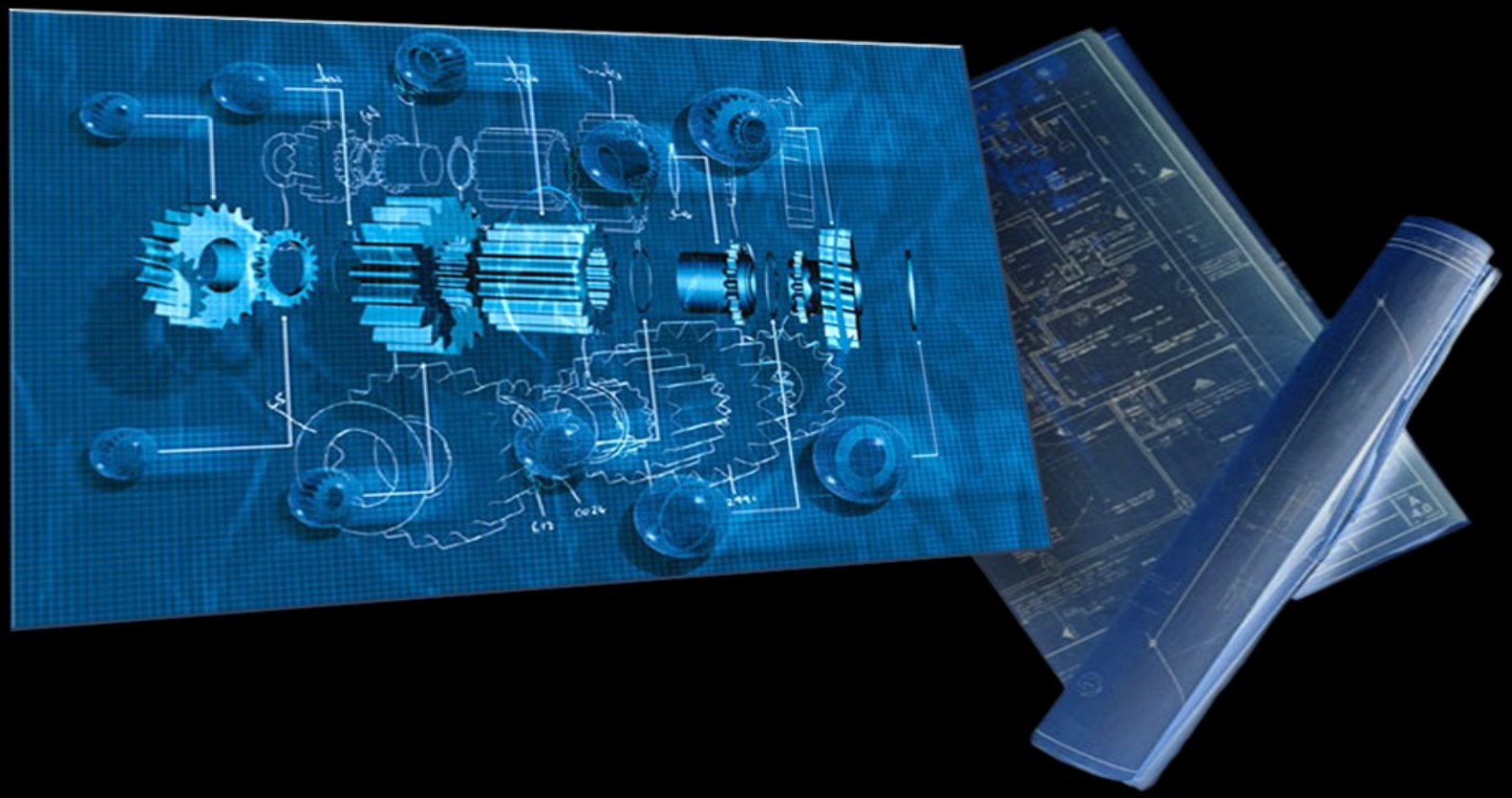
Open Virtualization Alliance

Ensuring the continued growth of the Linux ecosystem

- Drive capabilities for ever more workloads onto Linux
- Ensure Linux is the premier guest OS for cloud environments
- Target Linux as the greenest of OSs
- Continue focus on simplification of the Linux environment
- Focus on collaborative innovation
- Above all, avoid fragmentation — sustain the community spirit!

Key Challenge in the 21st Century

Leverage technology, engineering, science and innovation to make major improvements in business, society and the very way the world works



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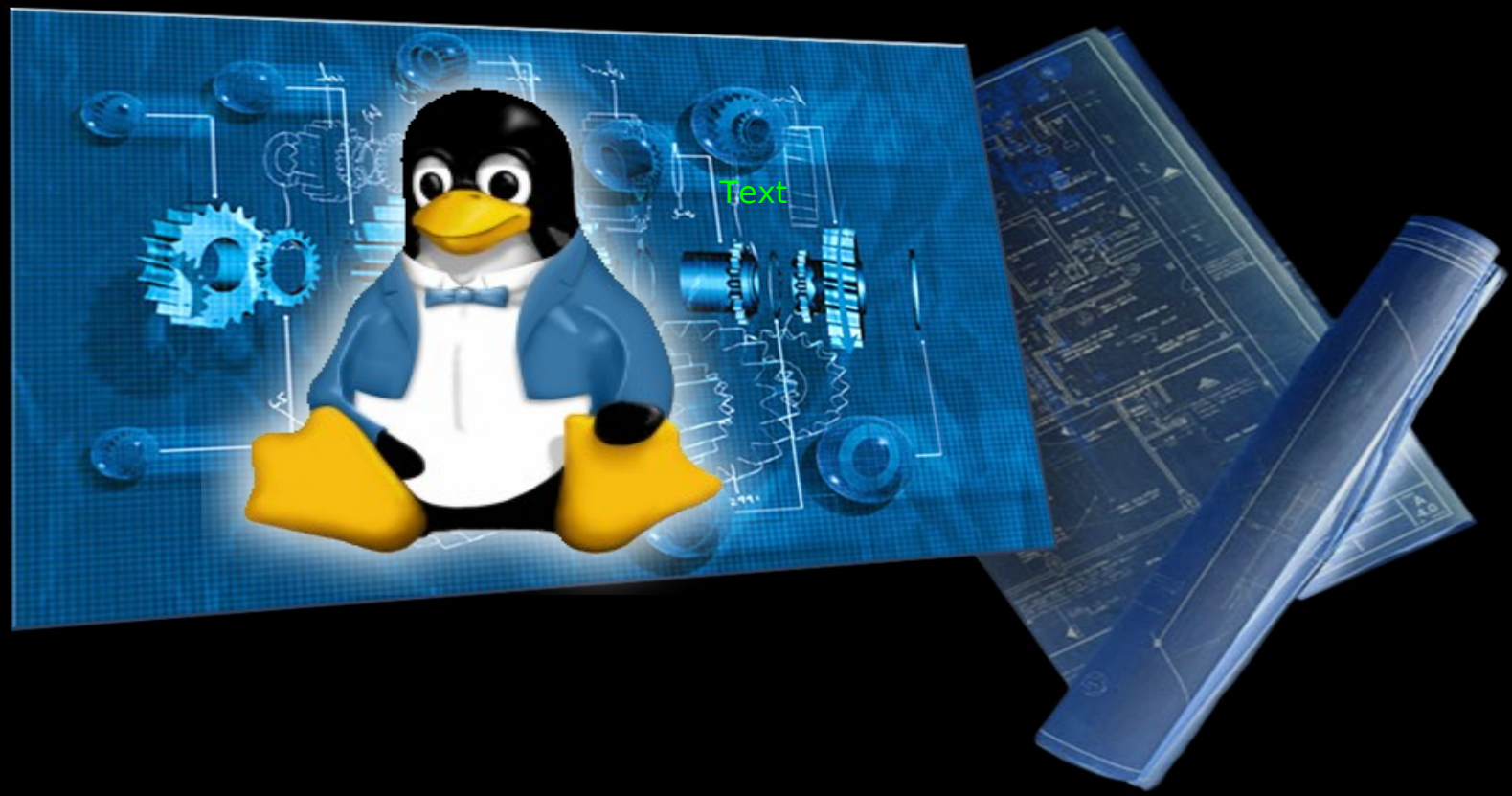

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