



7 Kasım 2012 - Çırağan Palace Kempinski

IBM Connected 2012 Istanbul

Learn. Collaborate. Innovate.

The Future of Computing Systems and Technology

Bijan Davari

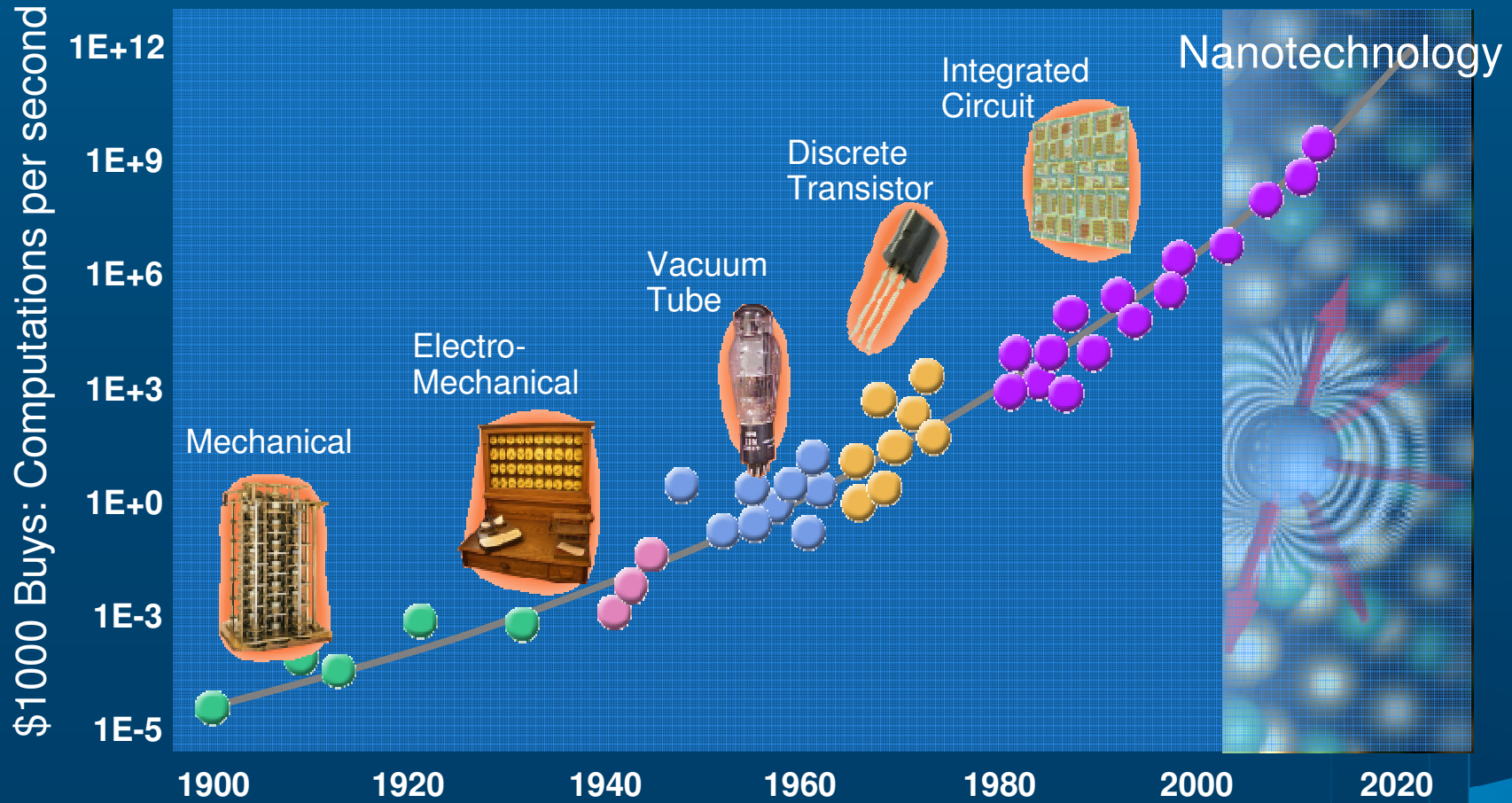
IBM Fellow, Vice President

IBM Research

Next Generation Computing Systems and Technology



Log of Compute Power

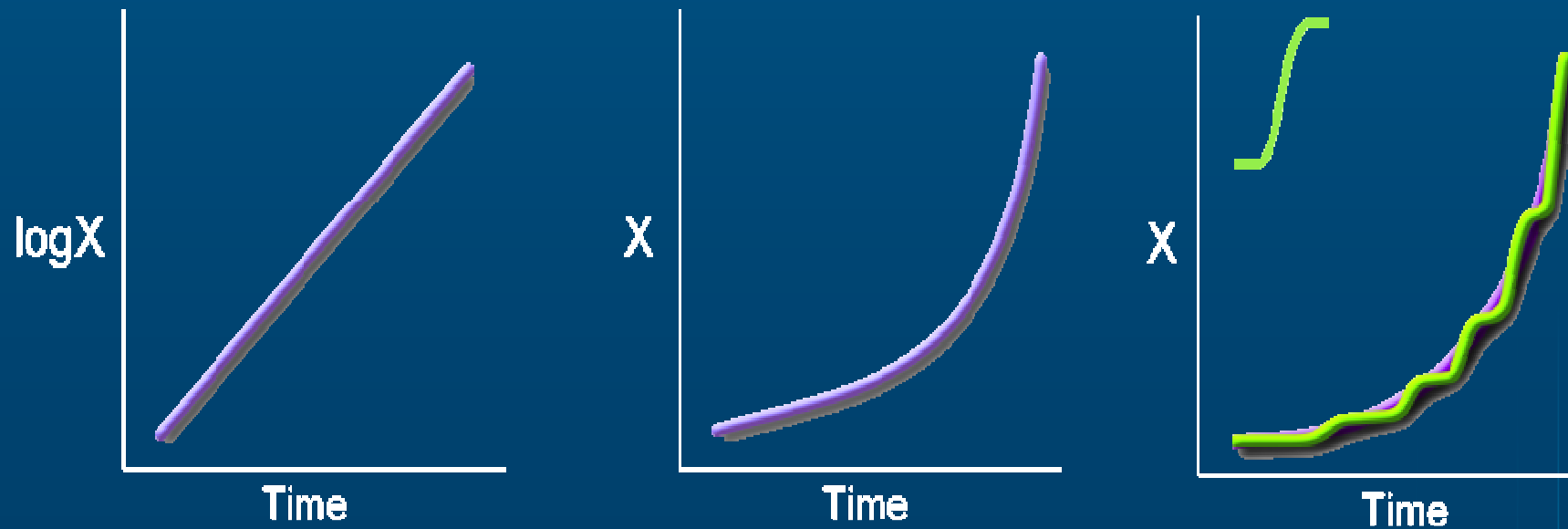


Source: Kurzweil 1999 – Moravec 1998

Exponential growth and client value
in our industry have been achieved by

Continual Improvement
& **Disruptive** Innovation

The Reality



Case Studies

Exponential growth has occurred in:

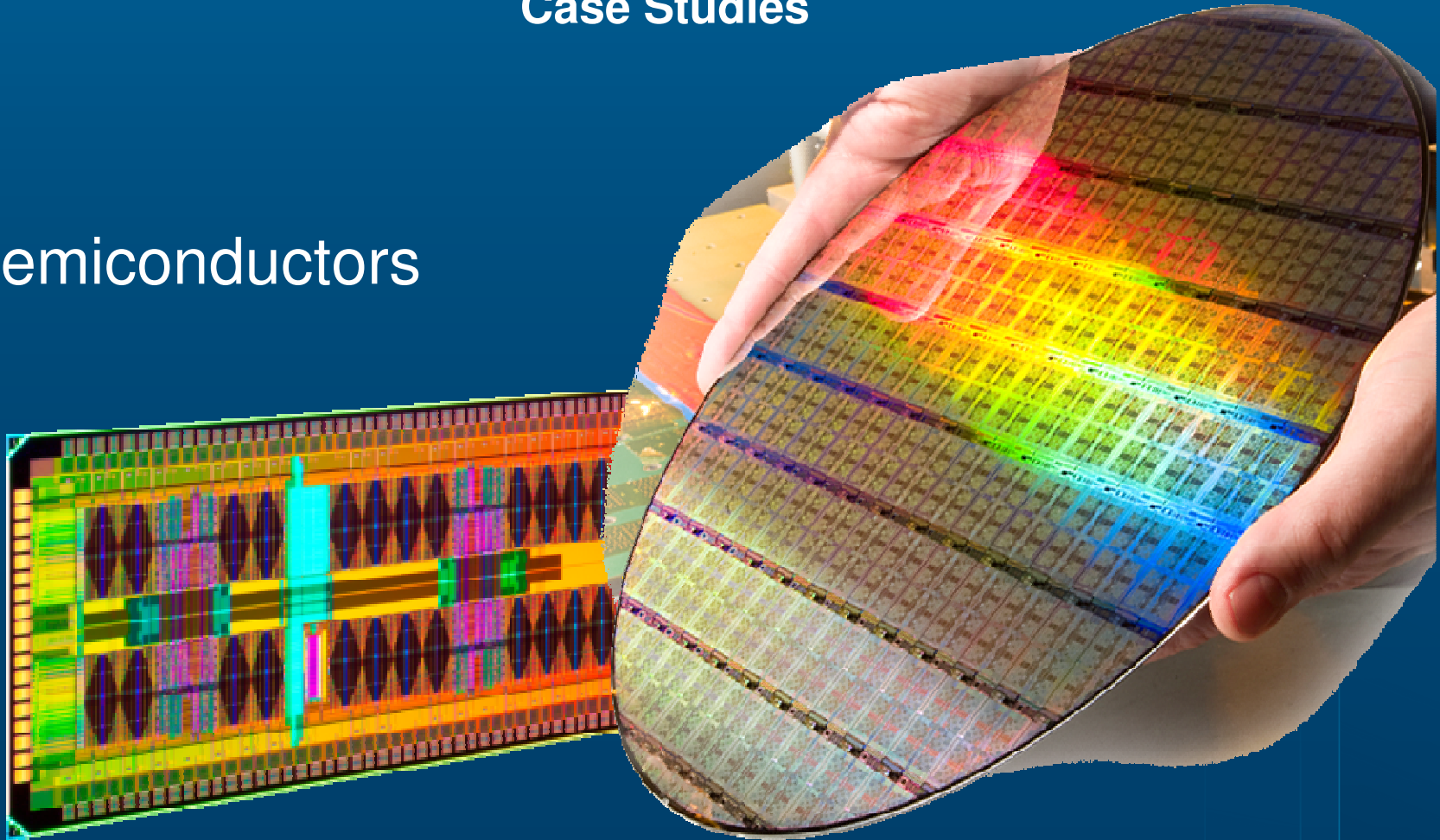
Semiconductors

Systems

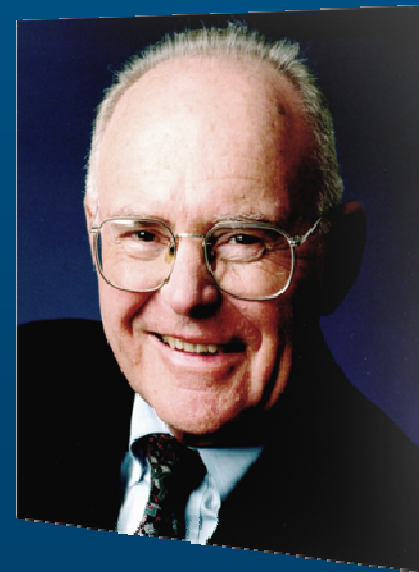
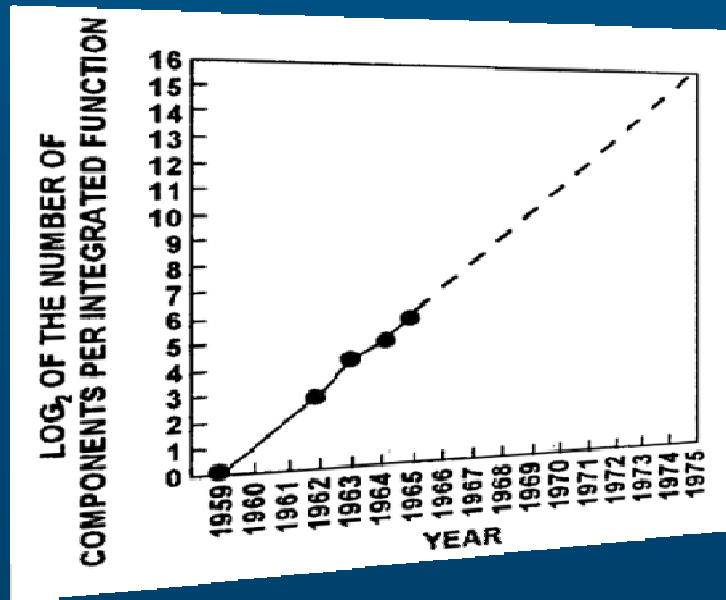


Case Studies

- Semiconductors



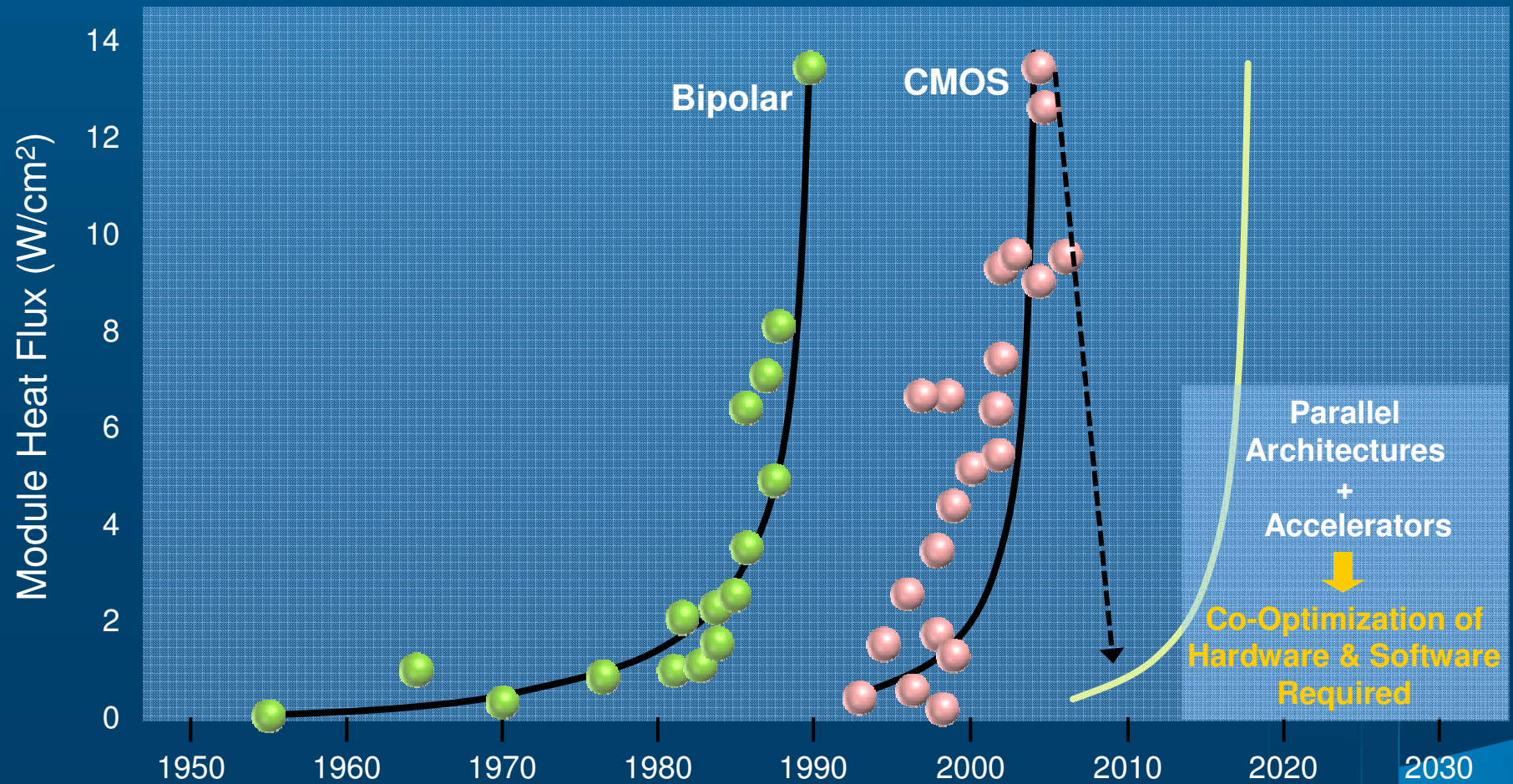
Gordon Moore's Observation – 1965



Populist version of Moore's Law:

Any parameter related to semiconductors must form a straight line when plotted on exponential graph paper.

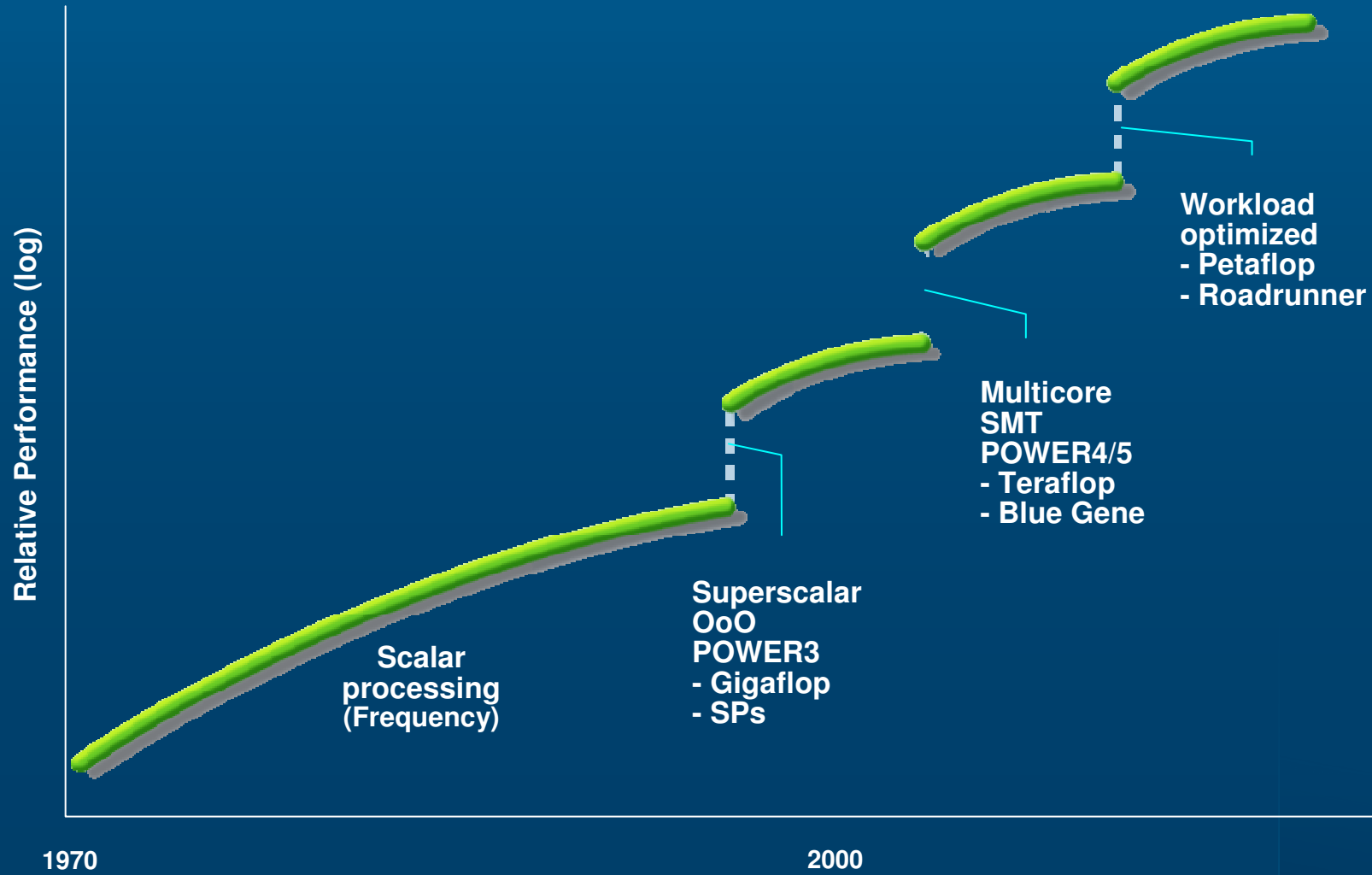
Key Technology Inflection Points



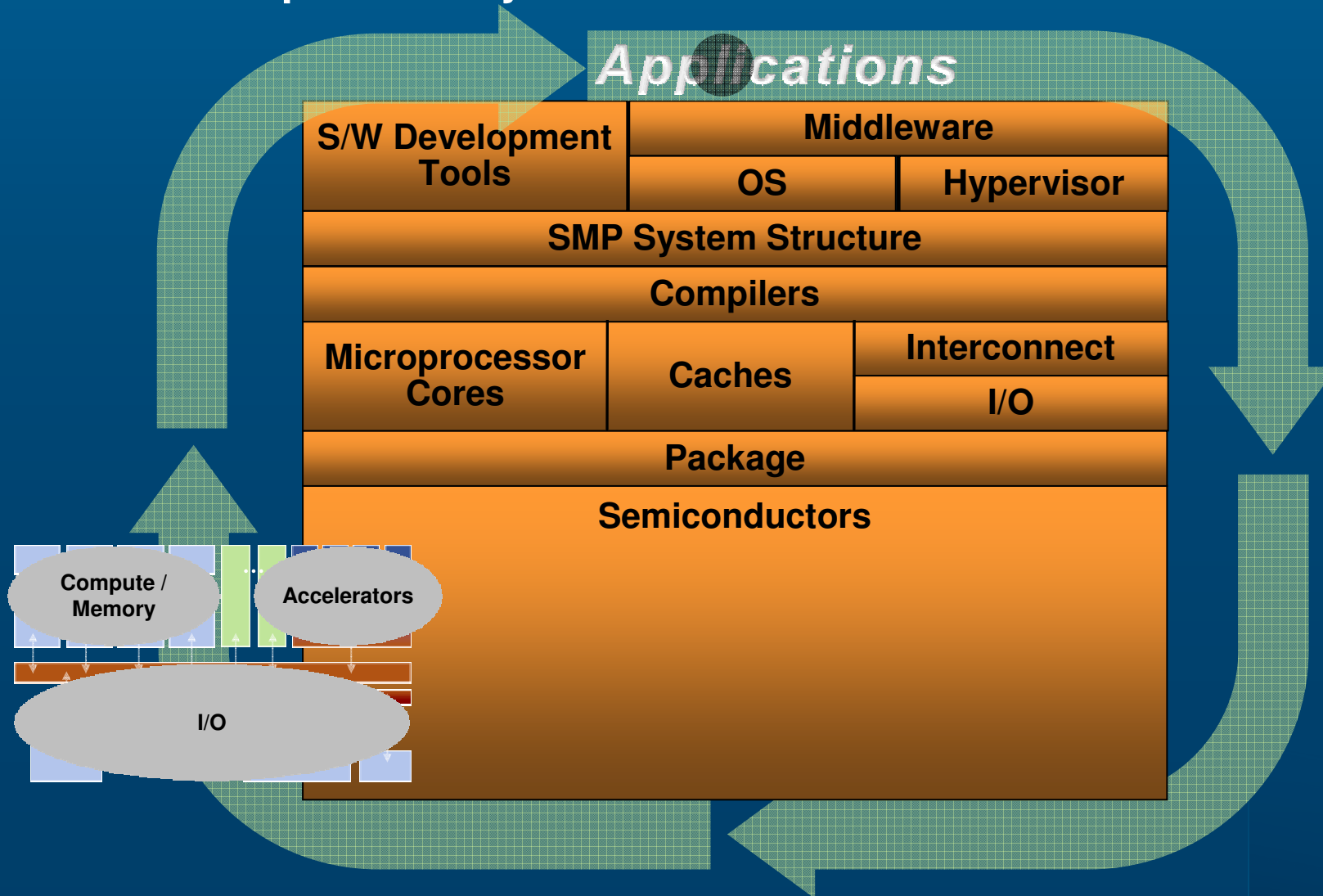
Systems



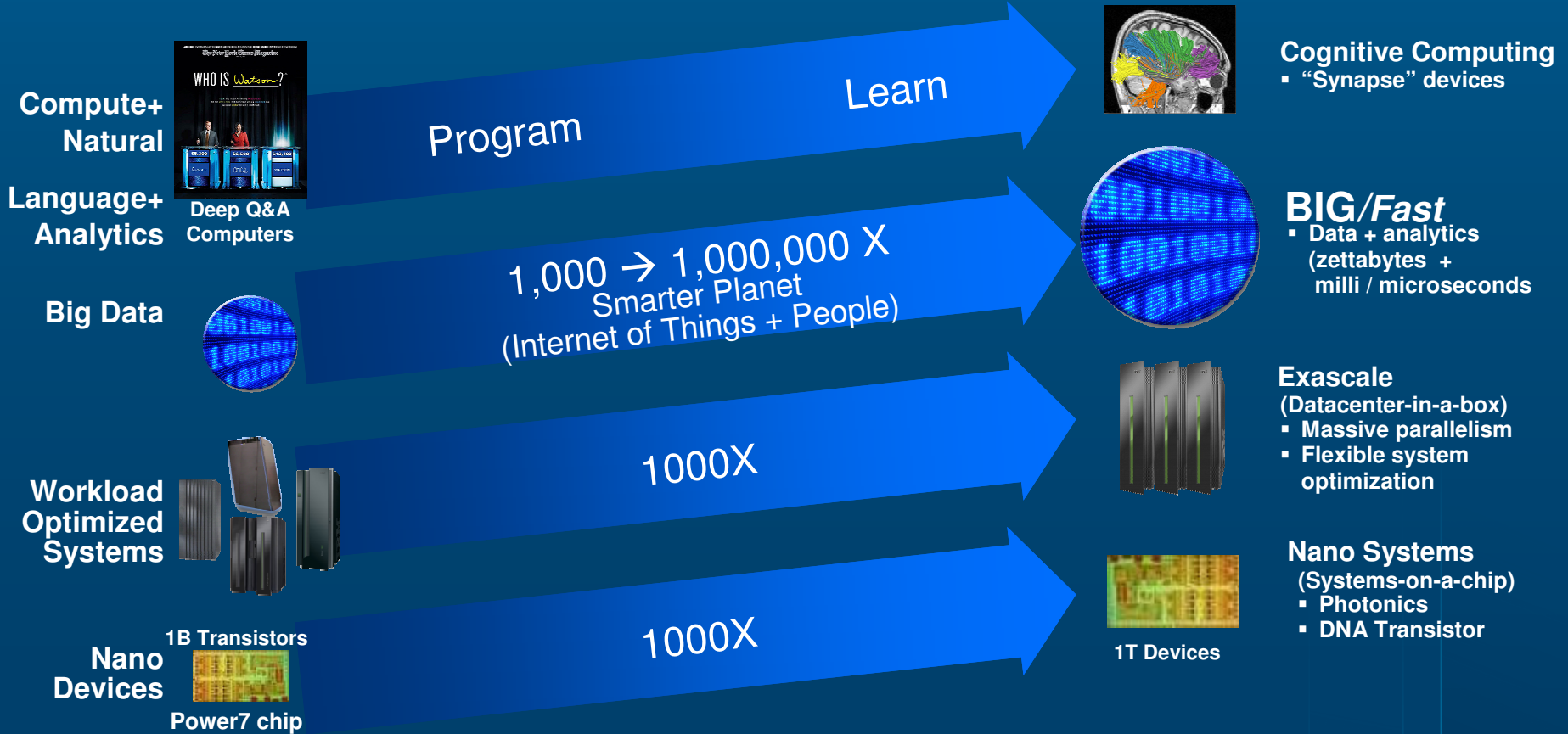
Architectural Enhancements



Workload Optimized Systems: Hardware and Software Co-design



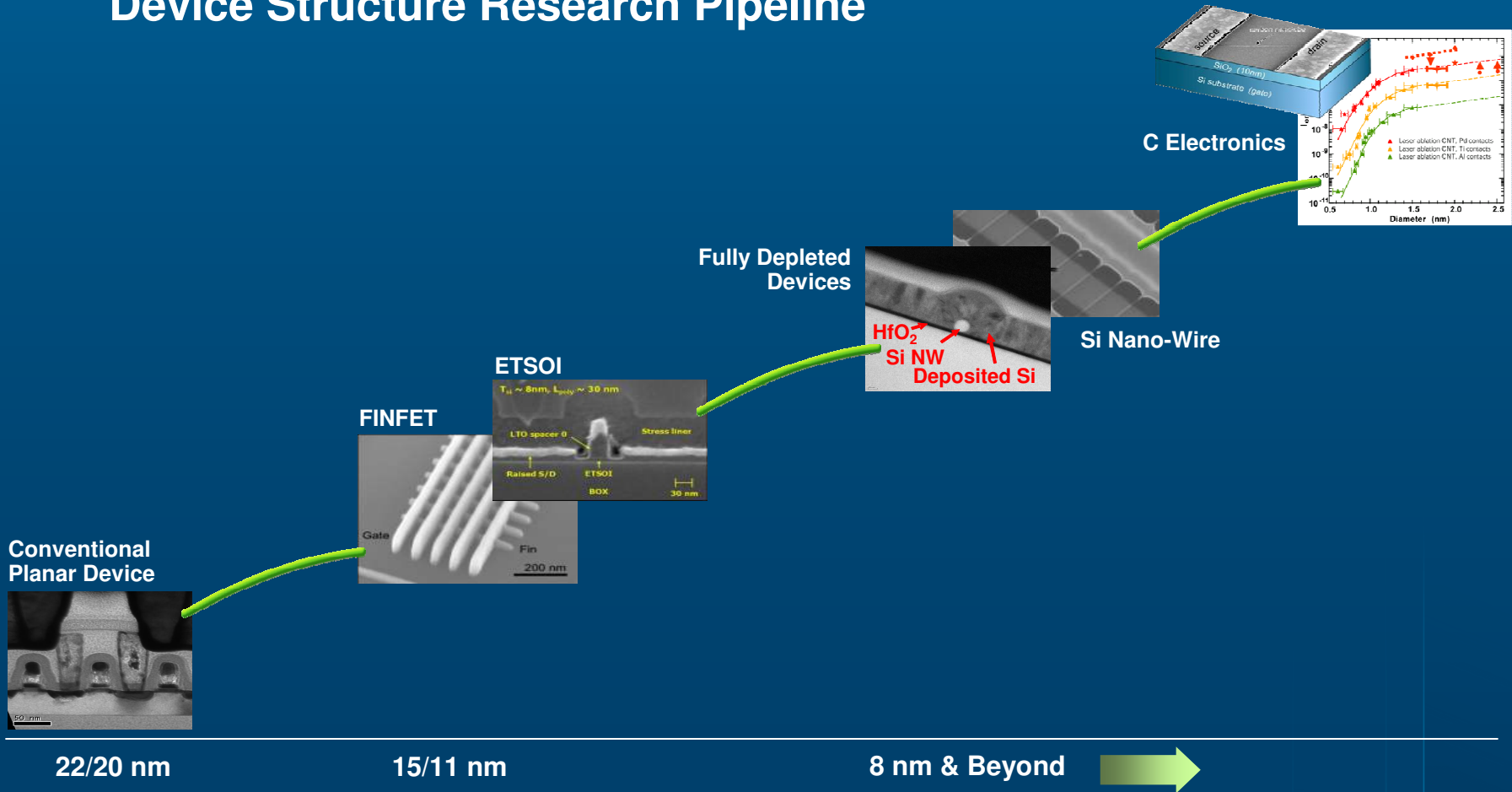
4 Technologies that Will Change the World



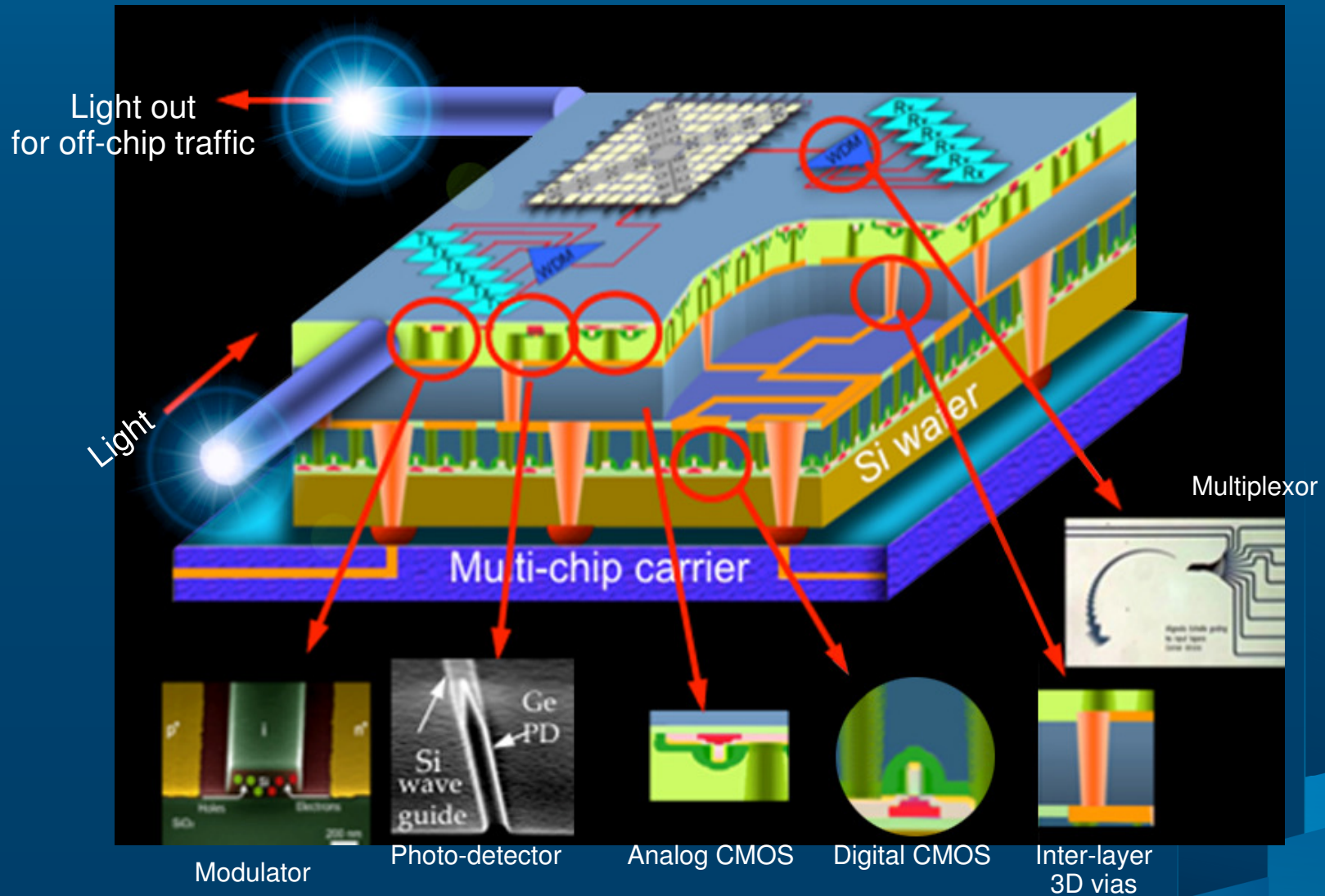
From Nano Devices to Nano Systems



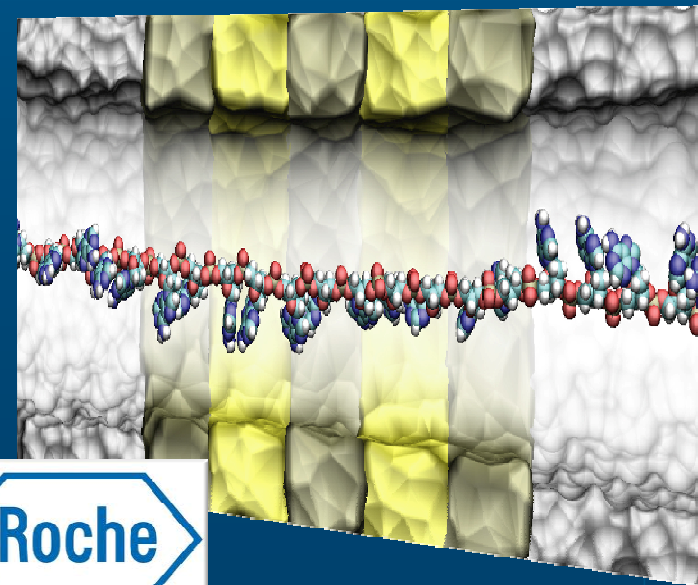
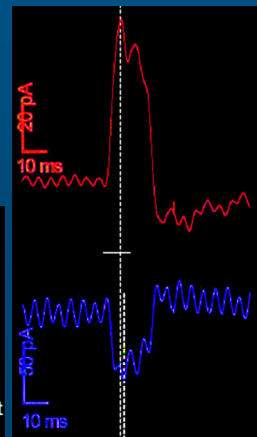
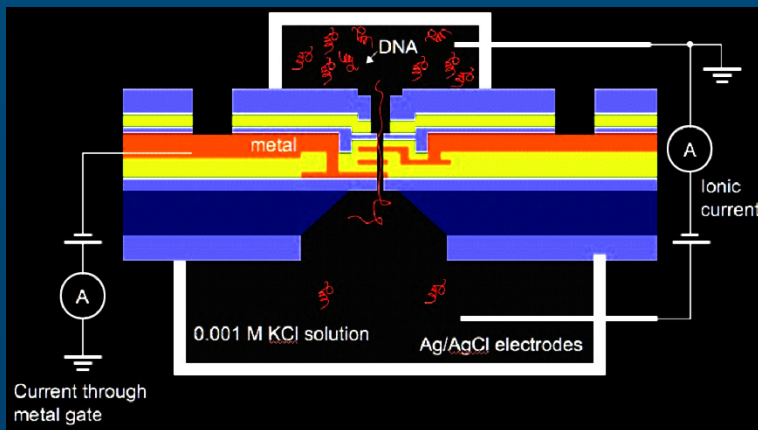
Device Structure Research Pipeline



Vision: >1 Tbps on a 3D chip



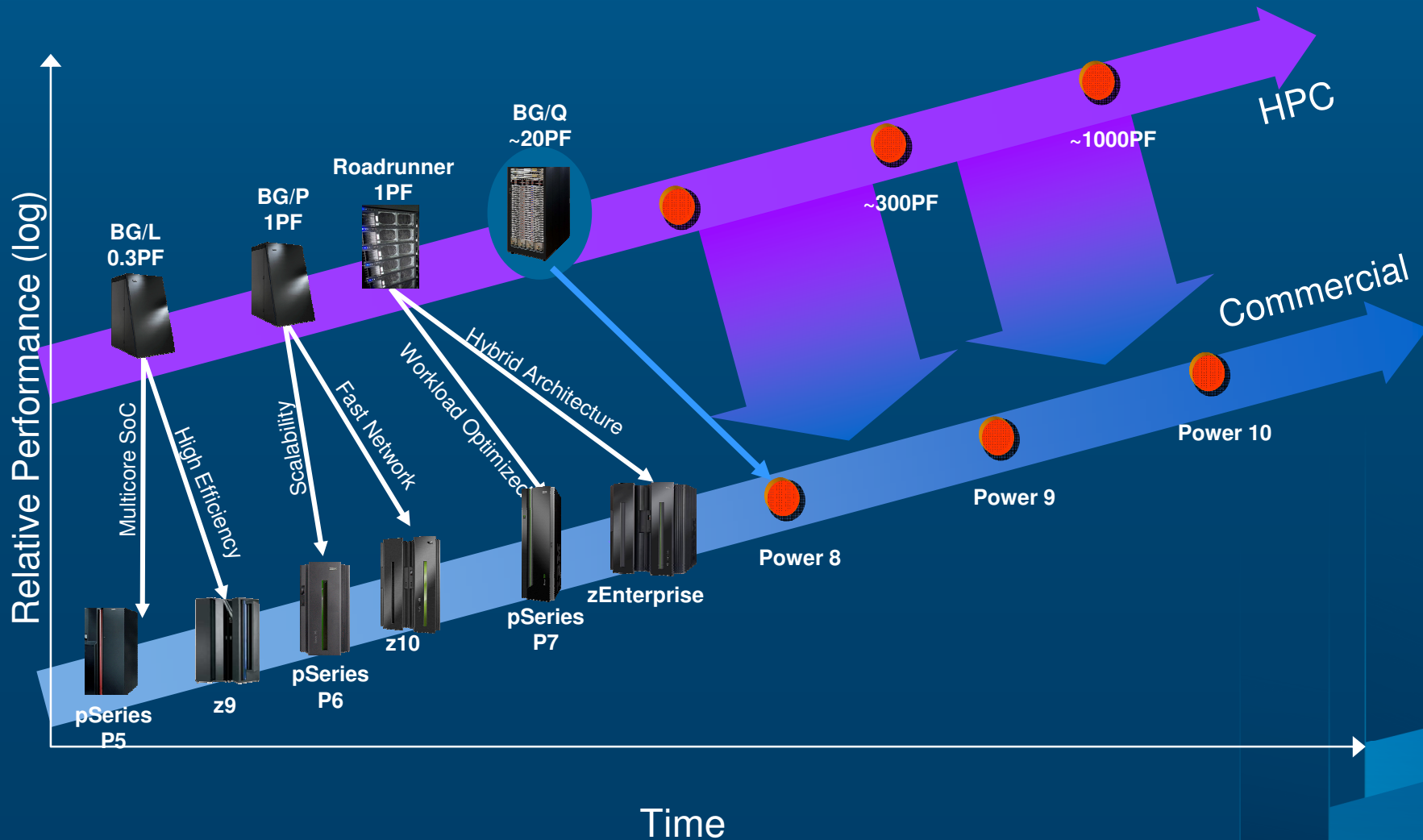
DNA Transistor Experimental Setup



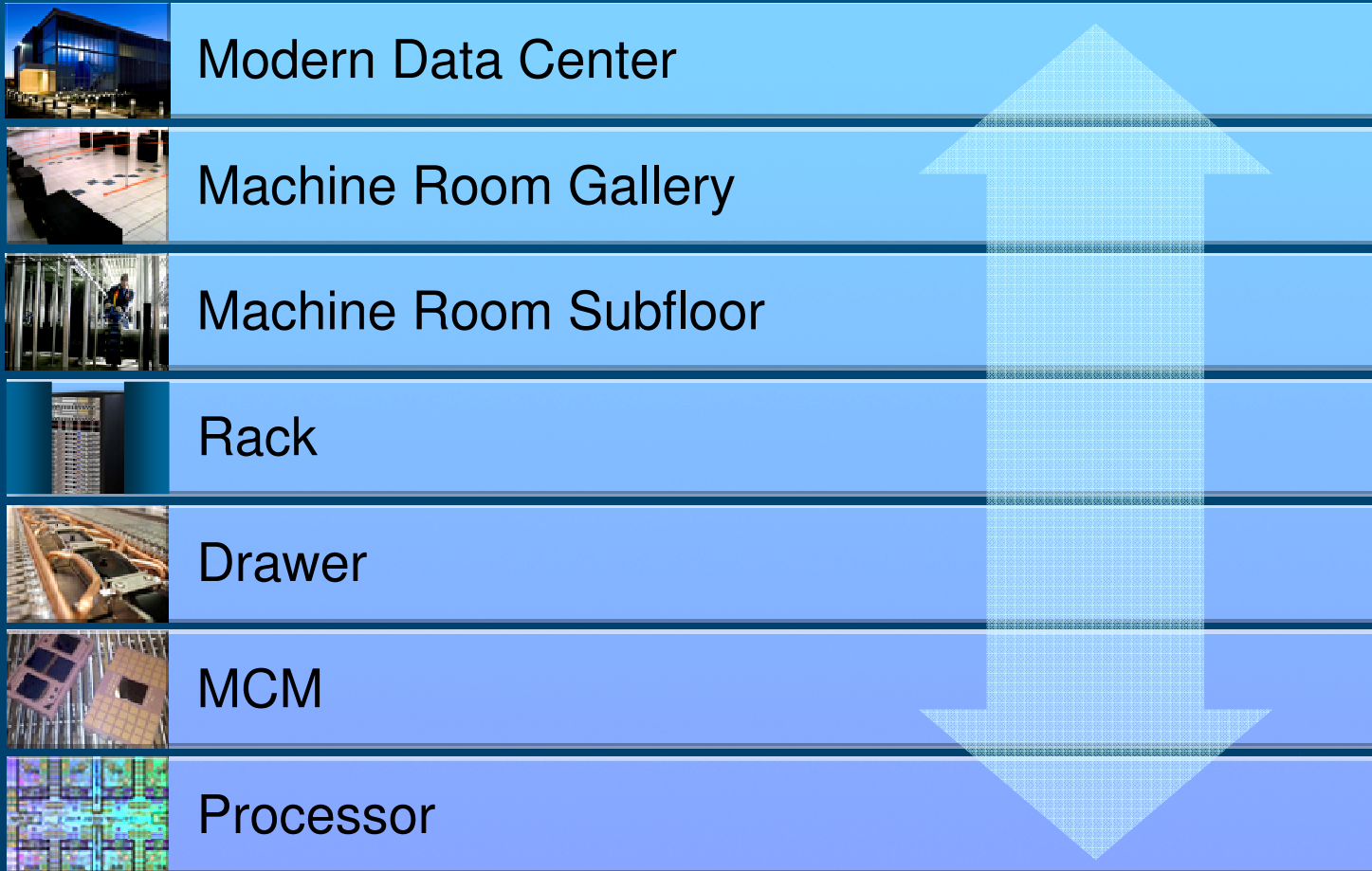
From Petascale to Exascale



From Disruptive Technologies in HPC to Transfer to Commercial Leadership



From Silicon to Structure: A Holistic Approach



The Charge to Exascale: Future Technologies

Overall Performance = 1000X
Performance / watt = 135X
Performance / \$ = 1000X
Footprint = <2%
Referenced to 1PF system

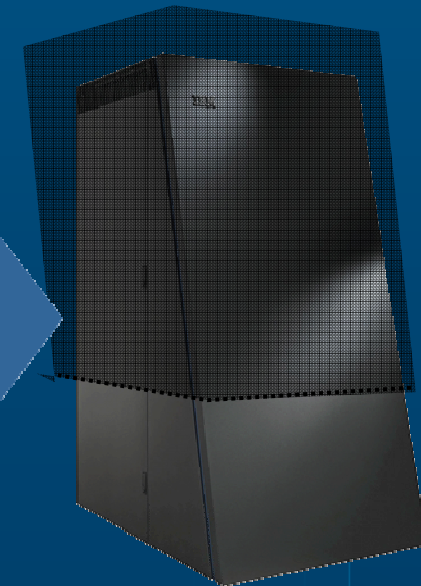
1 PetaFlop
72 BG/P Racks



CPU Phase Change Memory Silicon Photonics
Software 3D

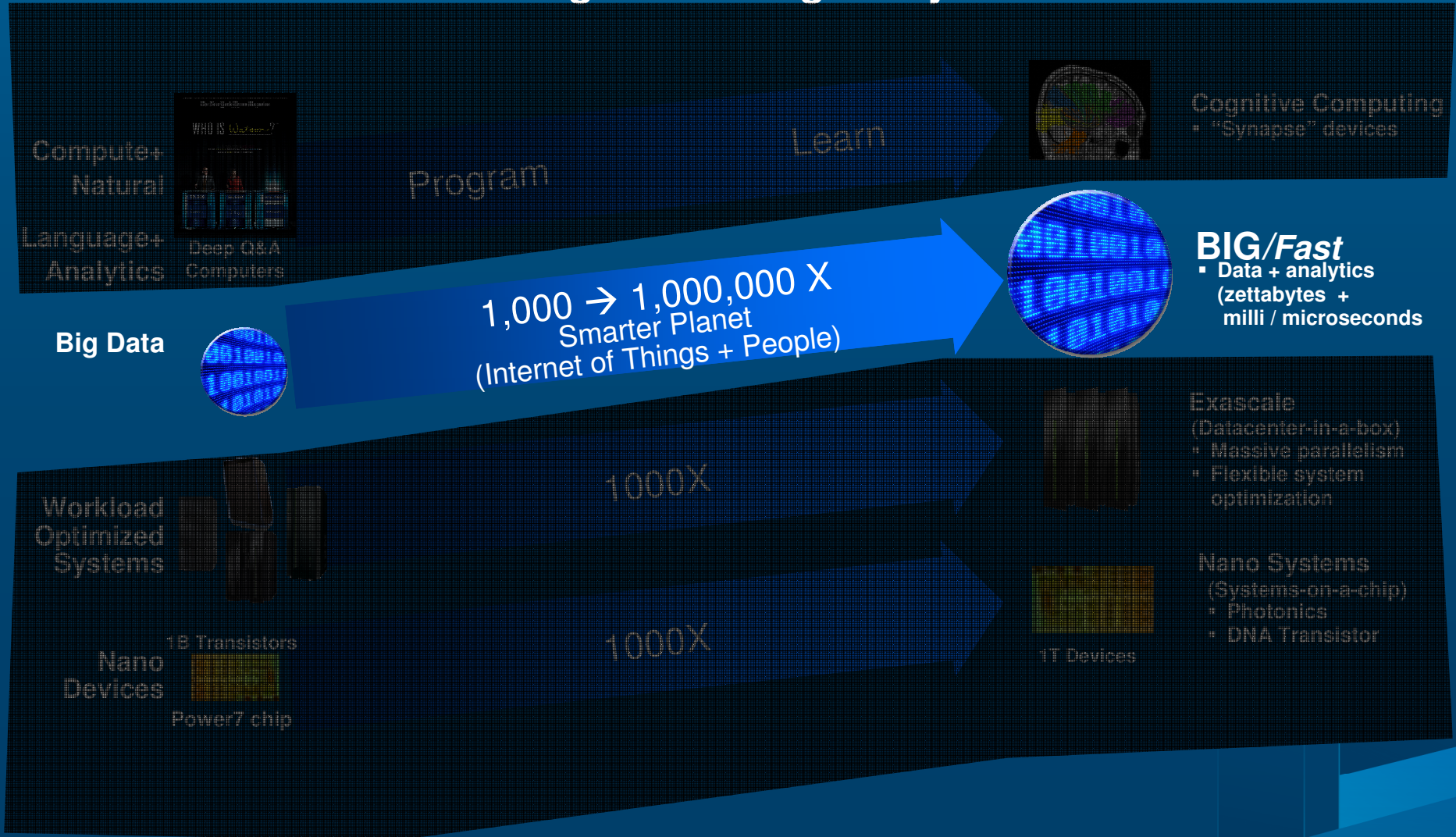
The Next Ten Years

10 PetaFlop
100 P7IH Racks

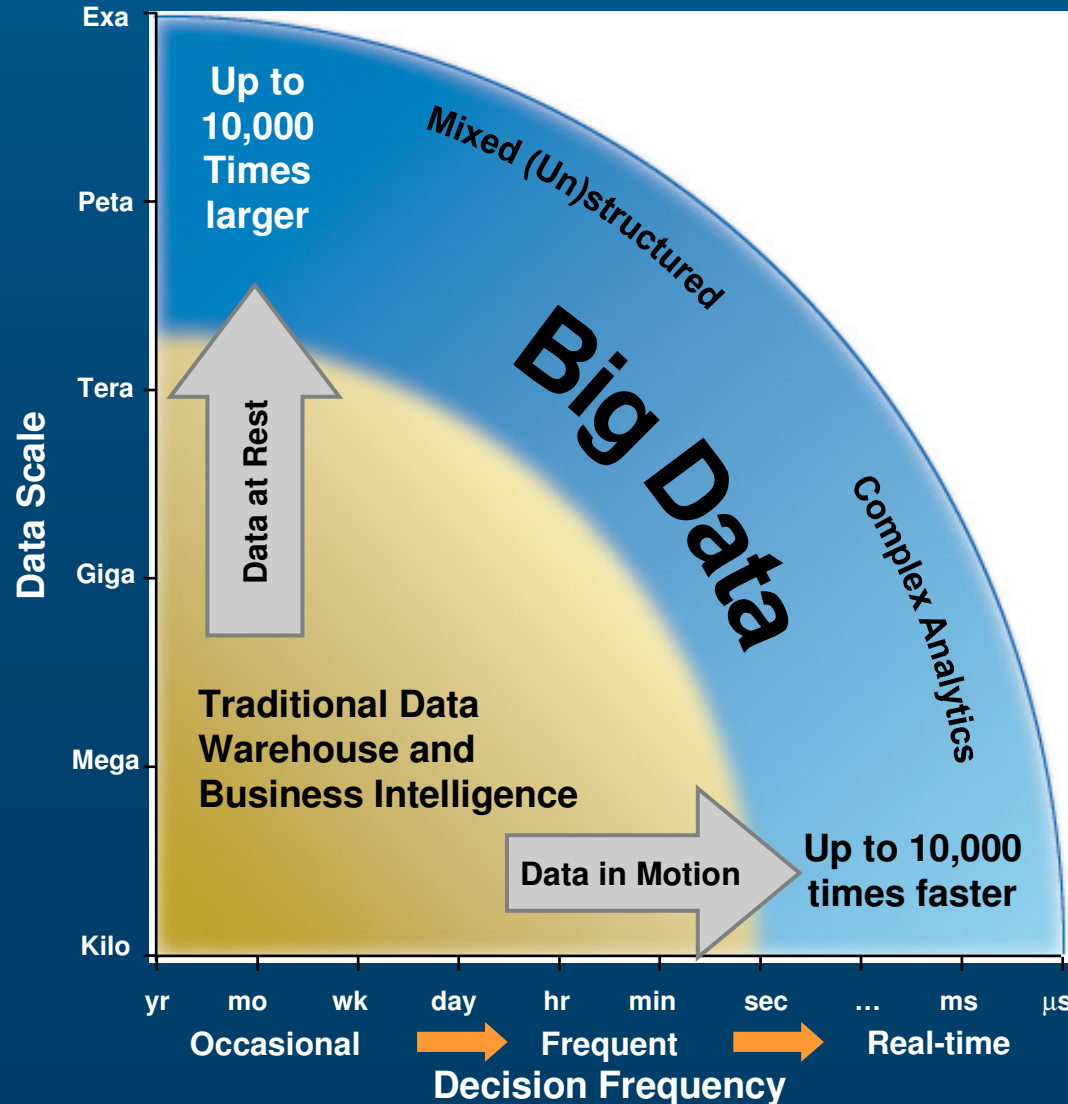


1 PetaFlop = 1/3 rack

From Big Data to Big Analytics

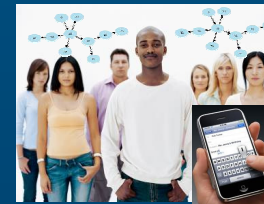


New **Big/Fast** Data Brings New Opportunities, Requires New Analytics



Homeland Security

600,000 records/sec, 50B/day
1-2 ms/decision
320TB for Deep Analytics



Telco Promotions

100,000 records/sec, 6B/day
10 ms/decision
270TB for Deep Analytics



DeepQA

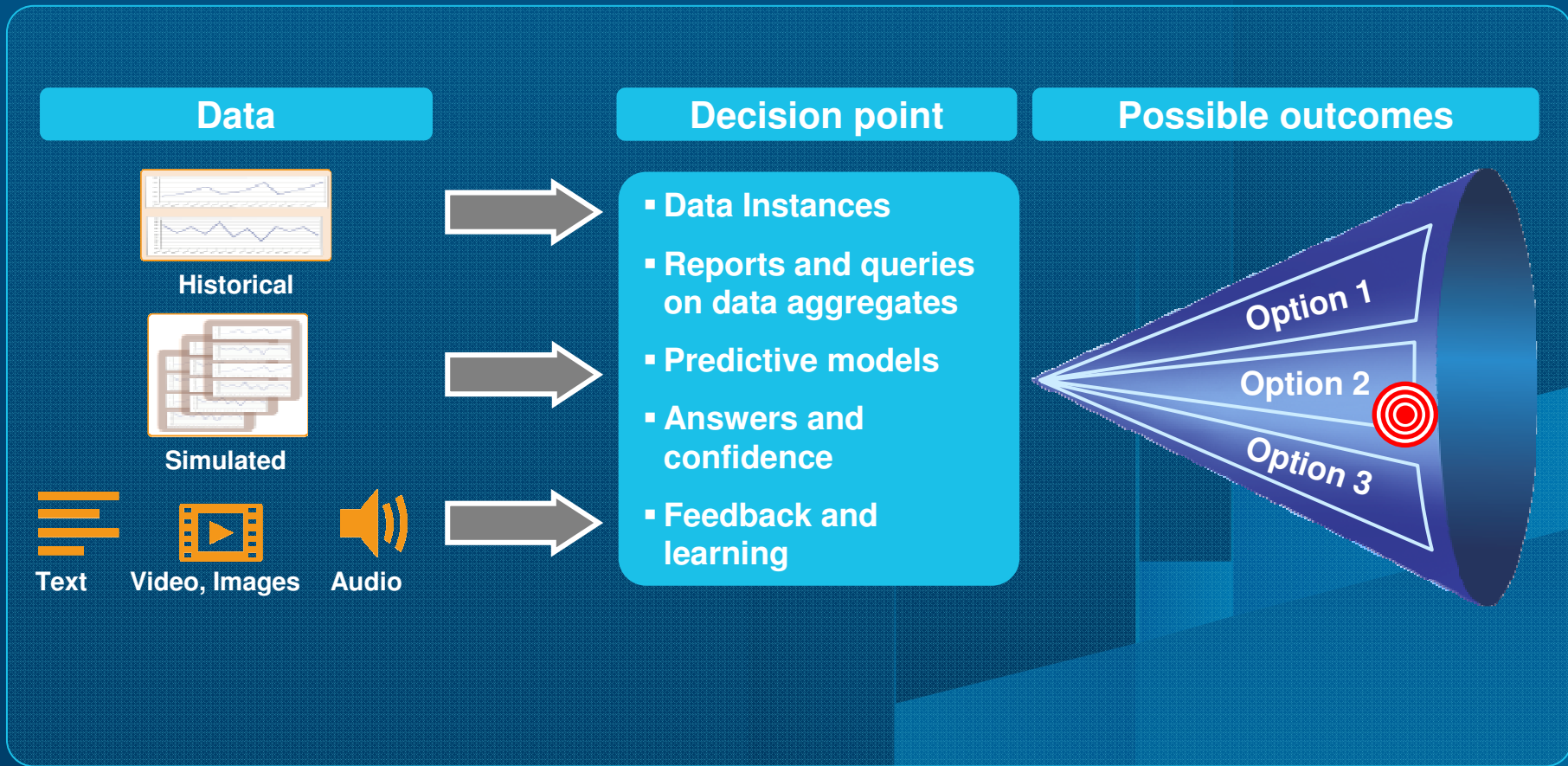
100s GB for Deep Analytics
3 sec/decision



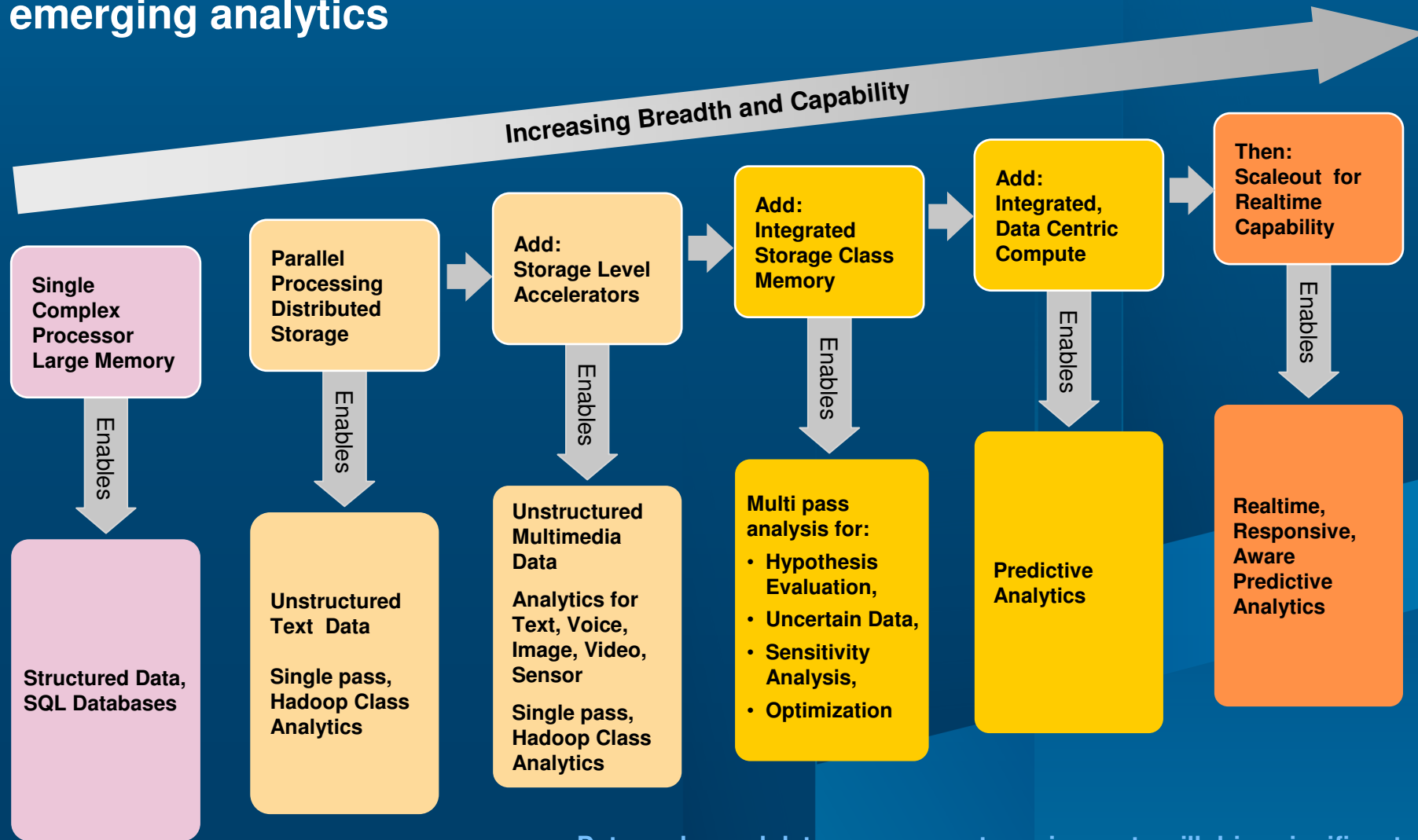
Smart Traffic

250K GPS probes/sec
630K segments/sec
2 ms/decision, 4K vehicles

Analytics is broadly defined as the use of data and computation to make smart decisions



Data centric, workflow optimized systems will evolve to support emerging analytics



Data scales and data management requirements will drive significant innovation in systems architecture

From Programming to Systems that Learn



Cognitive Systems: *A new era of computing*

Programmable Systems Era

- Processor-centric
- Fixed calculation
- Fixed output

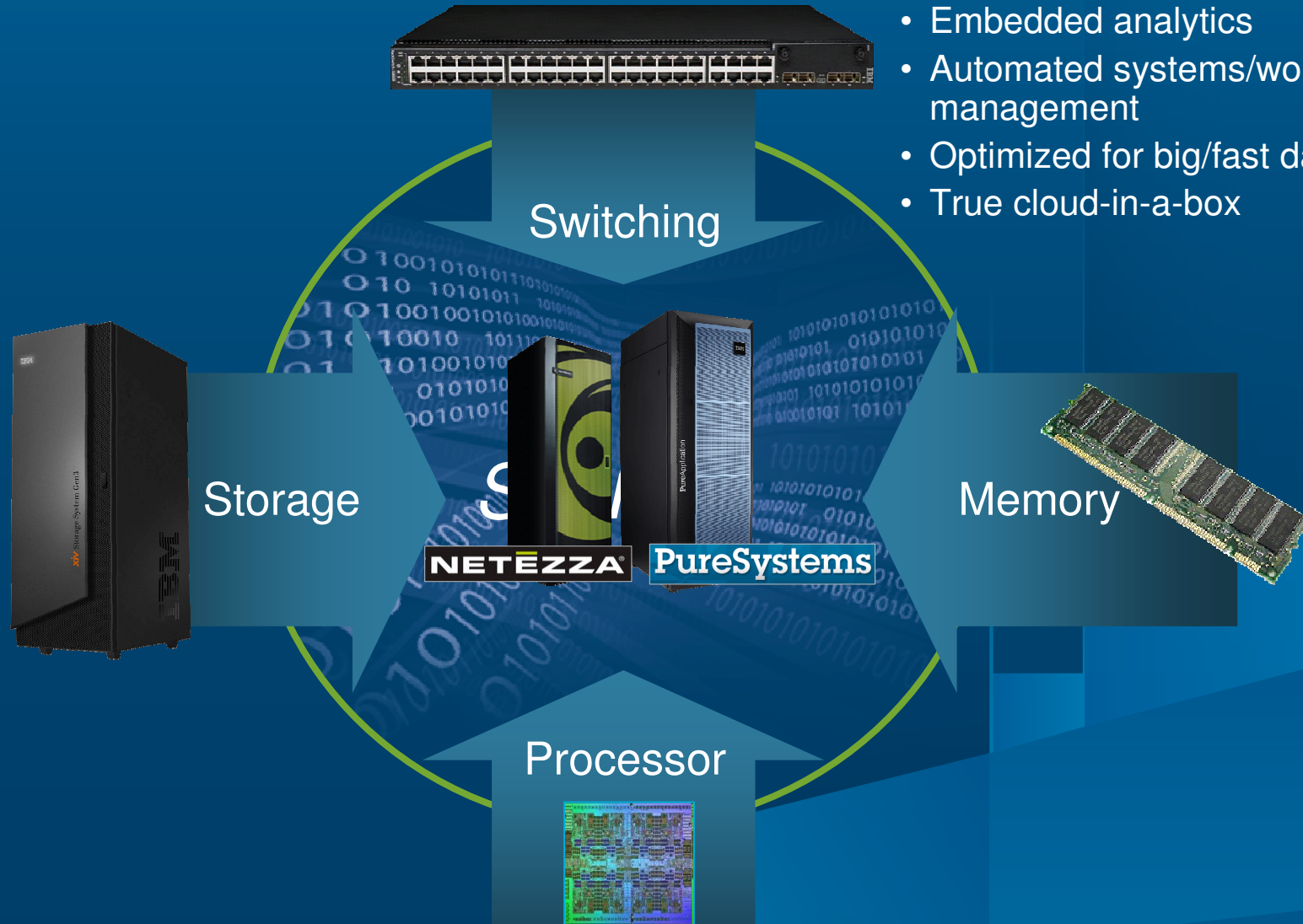
Cognitive Systems Era

- Data-centric
- Statistical analytics
- Scale in
- Automated systems/
workload management

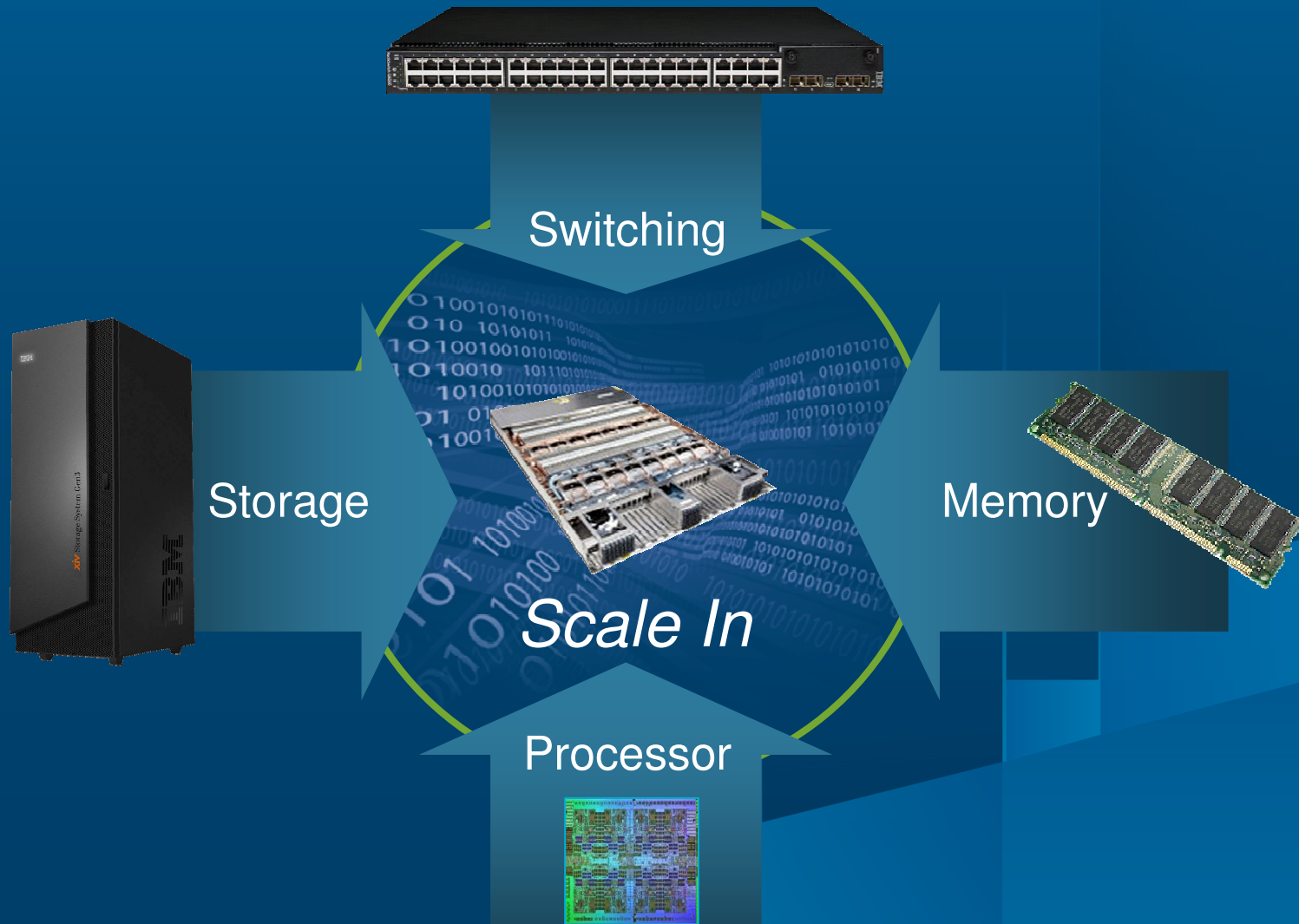
A new paradigm for cognitive systems

Cognitive Systems Attributes

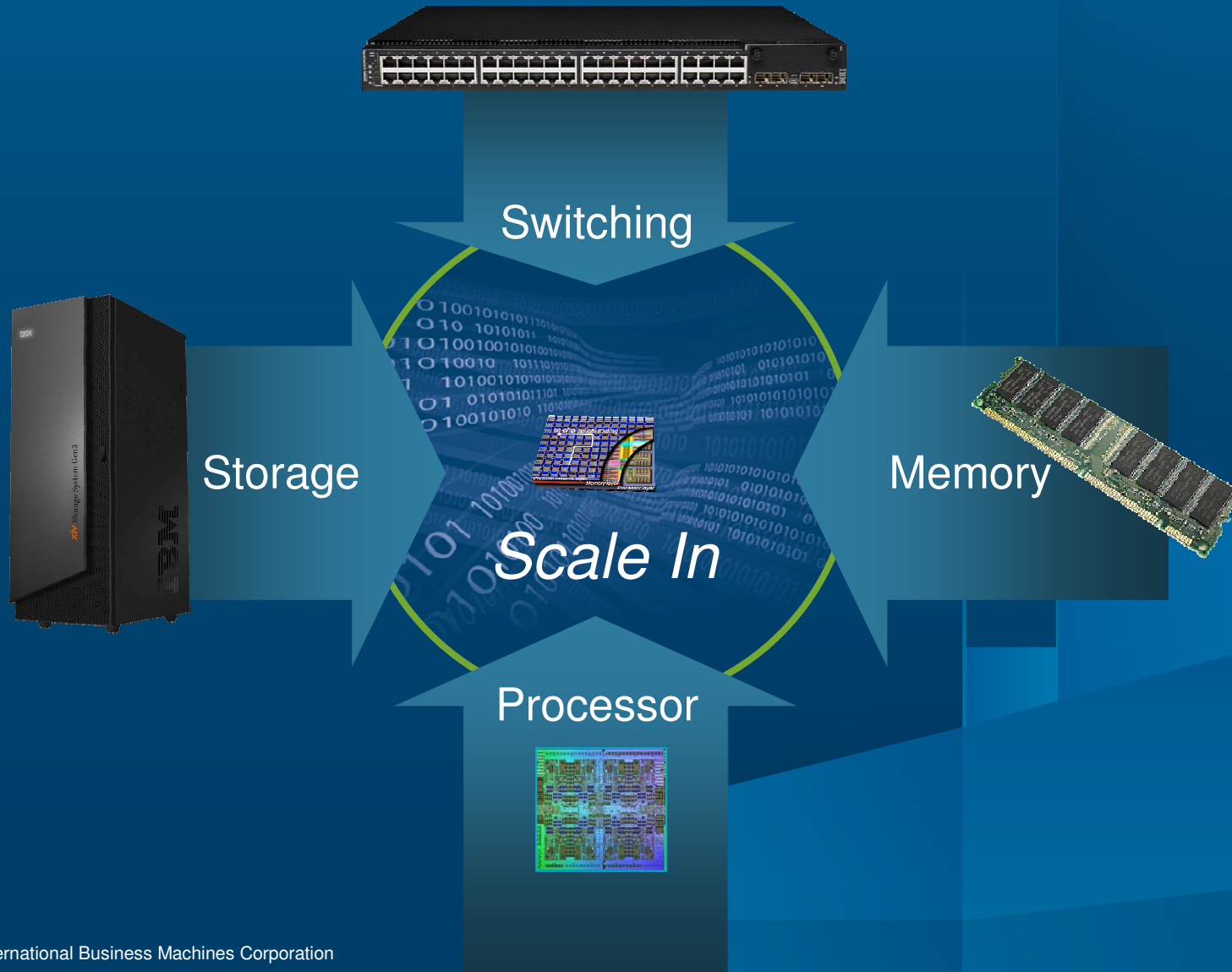
- Embedded analytics
- Automated systems/workload management
- Optimized for big/fast data
- True cloud-in-a-box



A new paradigm for cognitive systems



A new paradigm for cognitive systems



Exploring the future of cognitive systems

Cognitive Systems Era

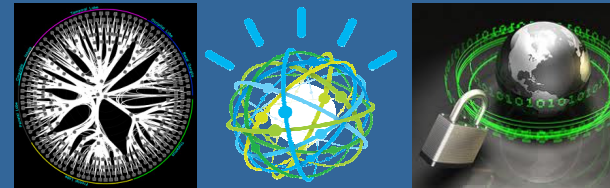


Far-reaching research

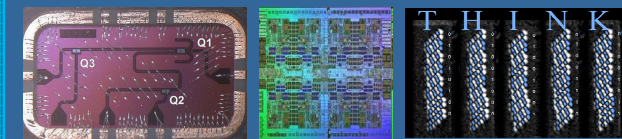
Applications



Architectures



Core Technology



An analytical system: *Taking Watson beyond Jeopardy!*

Current

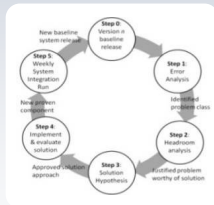
Specific questions

This poet wrote to a friend, "We are by September and yet my flowers are as bold as June. Amherst has gone to Eden."

Statistical analytics



Batch training



Statistical ranking

Emily Dickinson	<div style="width: 99%;"></div>	99%	
Walt Whitman	<div style="width: 60%;"></div>	60%	
Barnard	<div style="width: 10%;"></div>	10%	

Future

Rich problem scenarios



Interactive dialogue



Continuous learning

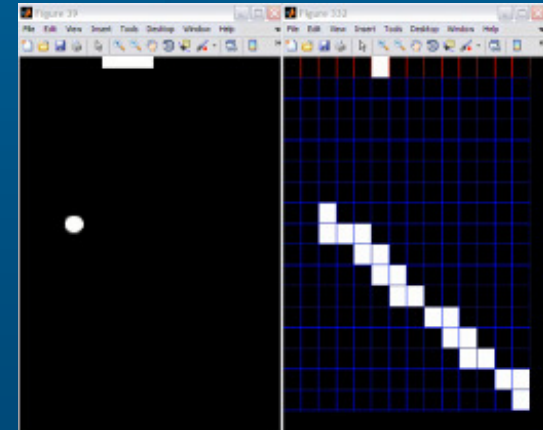


Evidence profiles

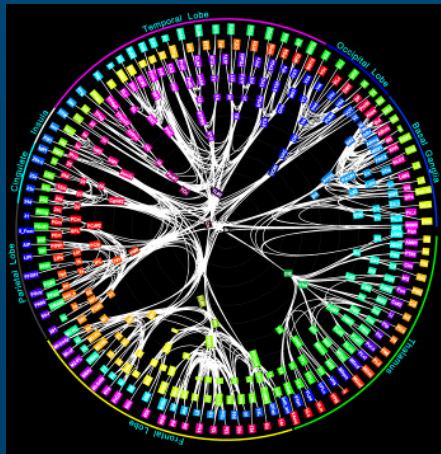


Cognitive Systems: *SyNAPSE*

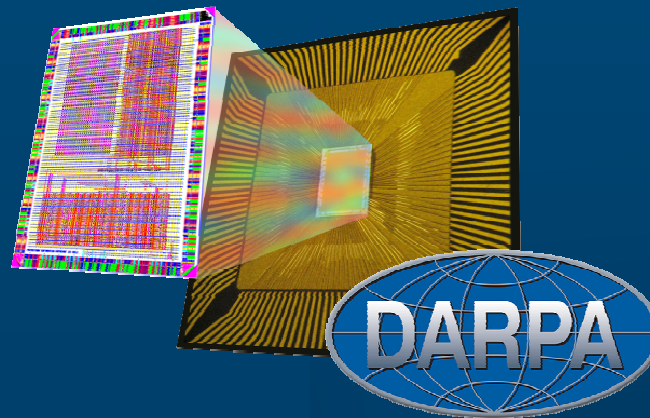
- “Neuron” and “synapse”-like computing model
- Systems learn through analytics / experience
- Advantages: Ultra energy-efficient, flexible, learning



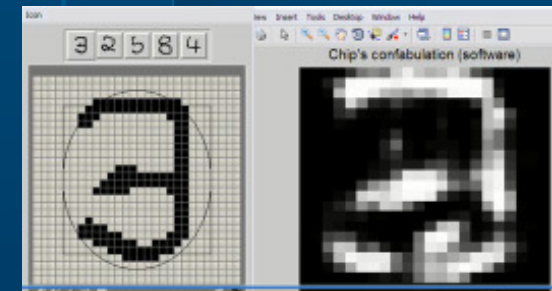
Learning Pong



Wiring diagram – monkey brain



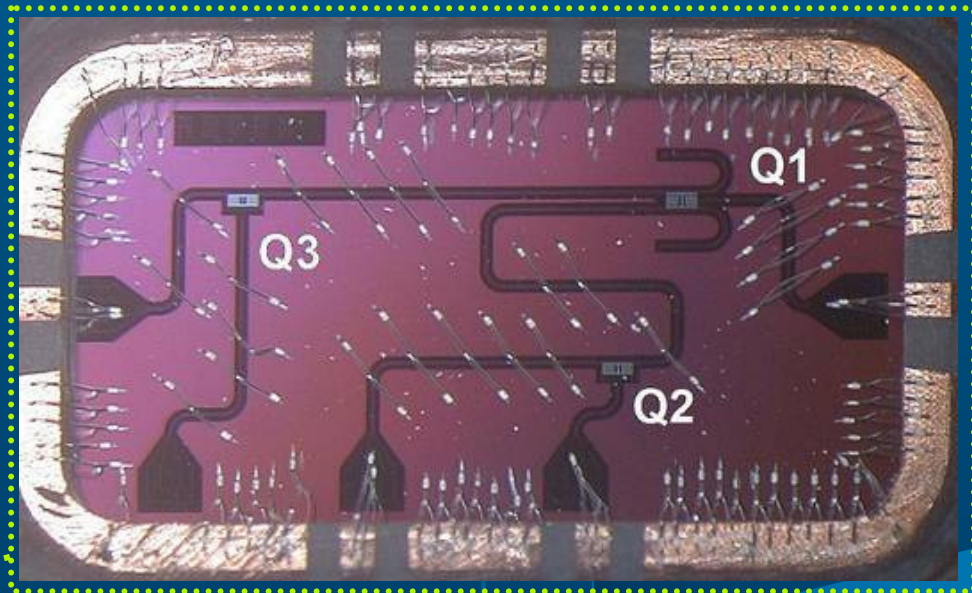
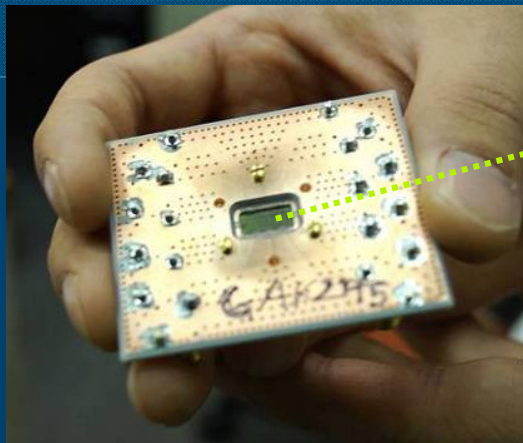
‘True North’



Character ID

Cognitive Systems: *Quantum computing*

Extraordinary capabilities are expected...factoring a 3,000 digit number 10^{40} faster than today



Silicon chip with three qubits

Superconducting qubits use established manufacturing techniques for silicon technology

Potential for dramatic advances in cryptanalysis, database sorting, pharmaceutical research

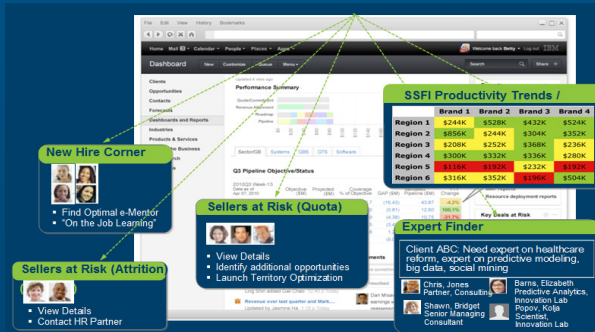
IBM is the world leader in this technology

Cognitive Systems: Applications

Social Business

Human and knowledge capital analytics

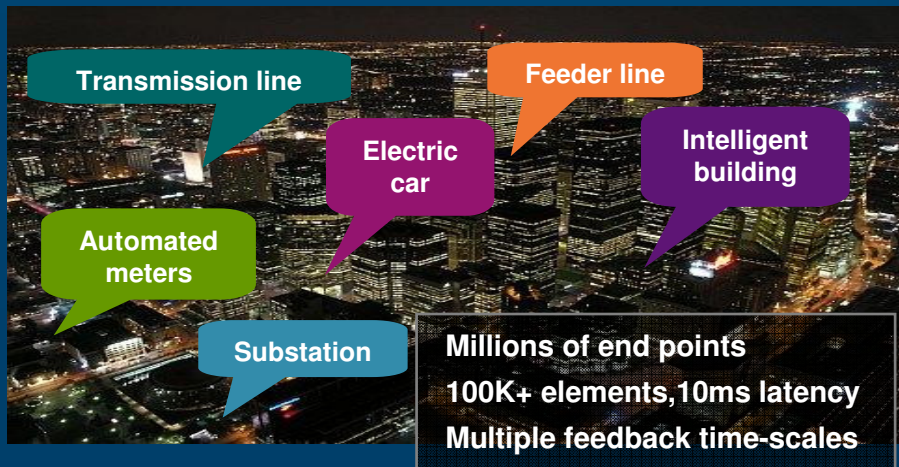
Optimize sales through insights about sellers, teams, deals, clients, and performance.



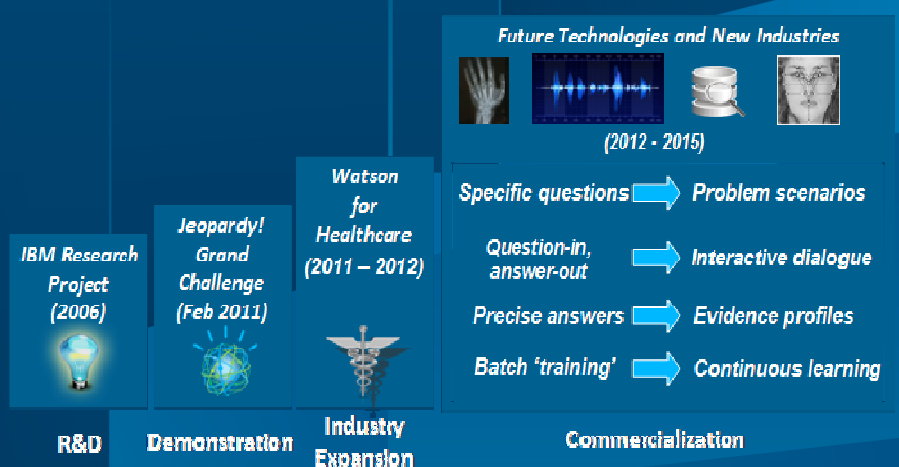
Smarter Cities



Sensor Networks

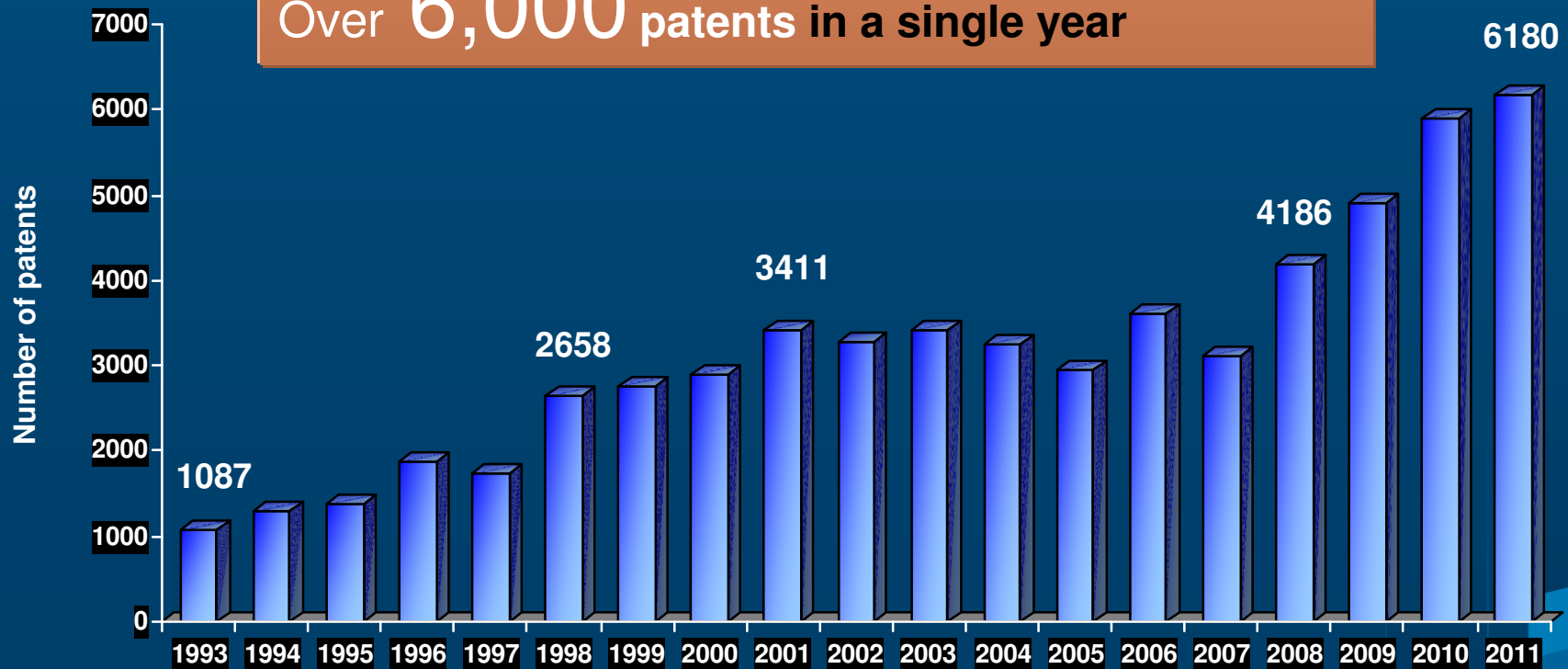


Watson

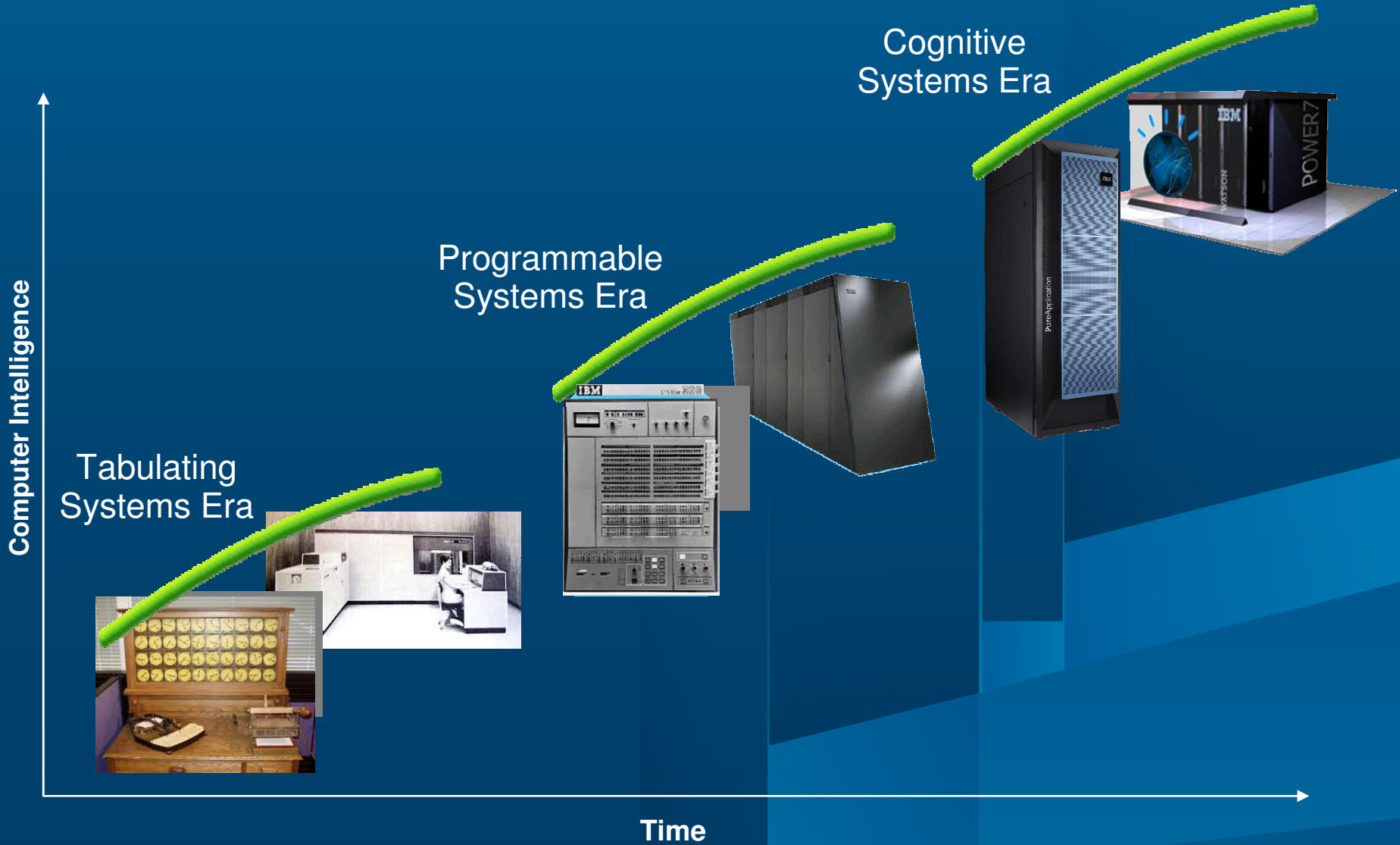


19 years of Patent Leadership

For **19** consecutive years
IBM inventors have received the most U.S. patents
Over **6,000** patents in a single year



Leading IBM: *Eras of computing*





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IBM Connected 2012 Istanbul

Learn. Collaborate. Innovate.

The Future of Computing Systems and Technology

Bijan Davari

IBM Fellow, Vice President

IBM Research

Next Generation Computing Systems and Technology

