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The future of IT technologies

CCDSC **3-6 Octobre 2016**

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Distinguished Technologist EG EMEA

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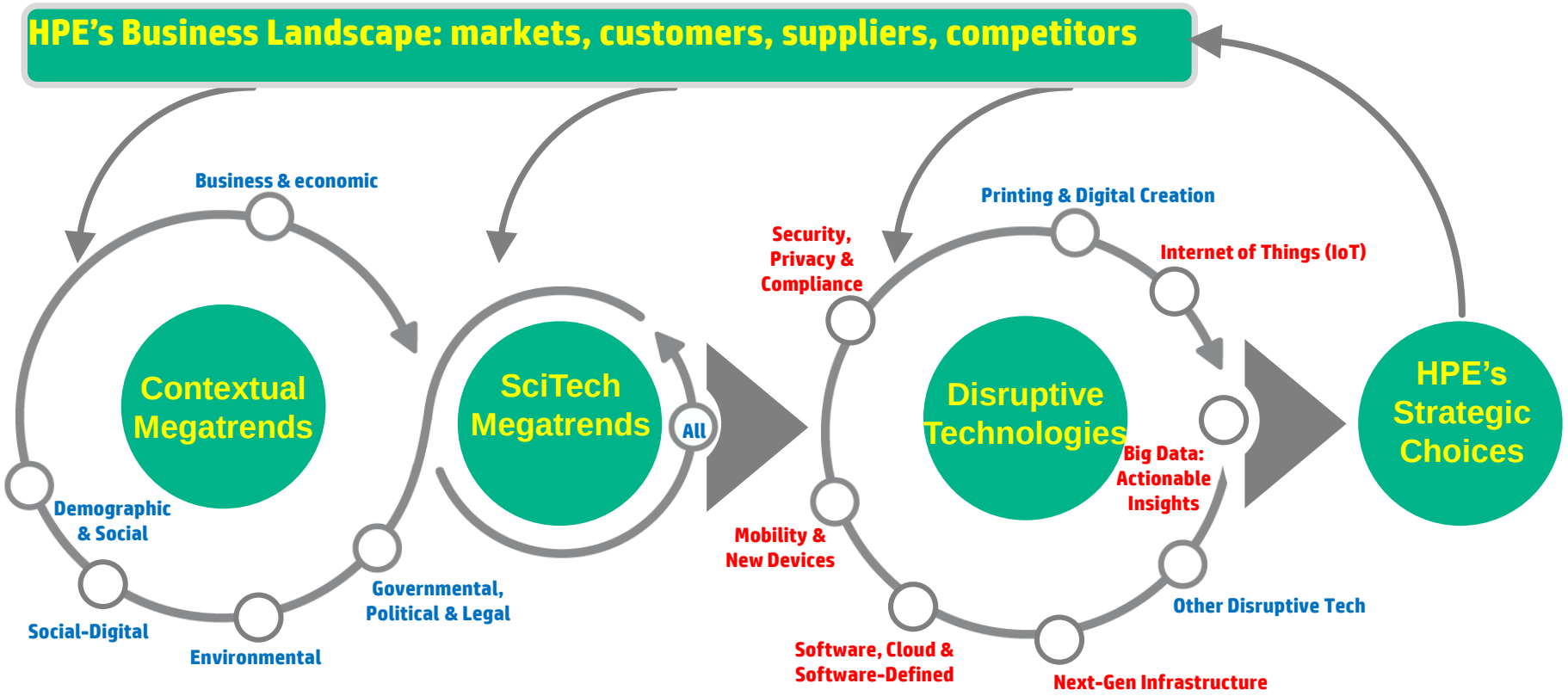
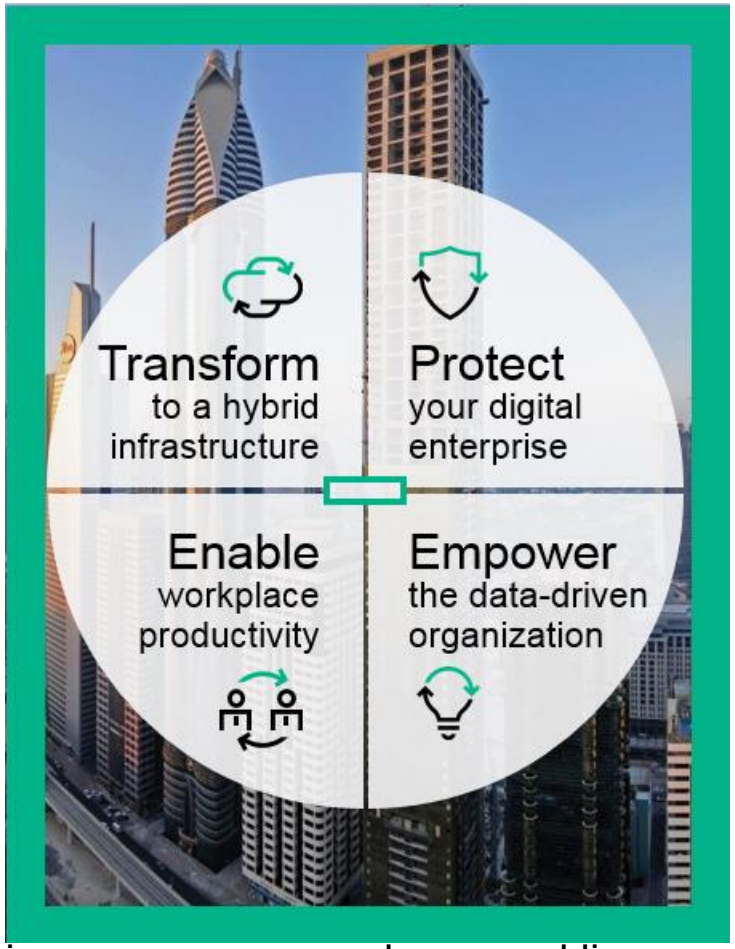
- State of our Industry, Mega Trends and vision
- HPC, Big Data, IoT innovations
- The Machine
- Machine Learning
- Use cases

Our context : multiple Megatrends in action

The Feedback Loops: trends, disruptive tech & HPE strategy : the Idea Economy





Mega Trends are global, sustained and macroeconomic forces of development that impact business, economy, and personal lives, thereby defining our future world and its increasing pace of change.
These Mega Trends set the stage for visionary thinking by identifying the most important global macro forces, potential scenarios of specific trends in 2020 and beyond, and the implications of these Mega Trends in transforming market and society.

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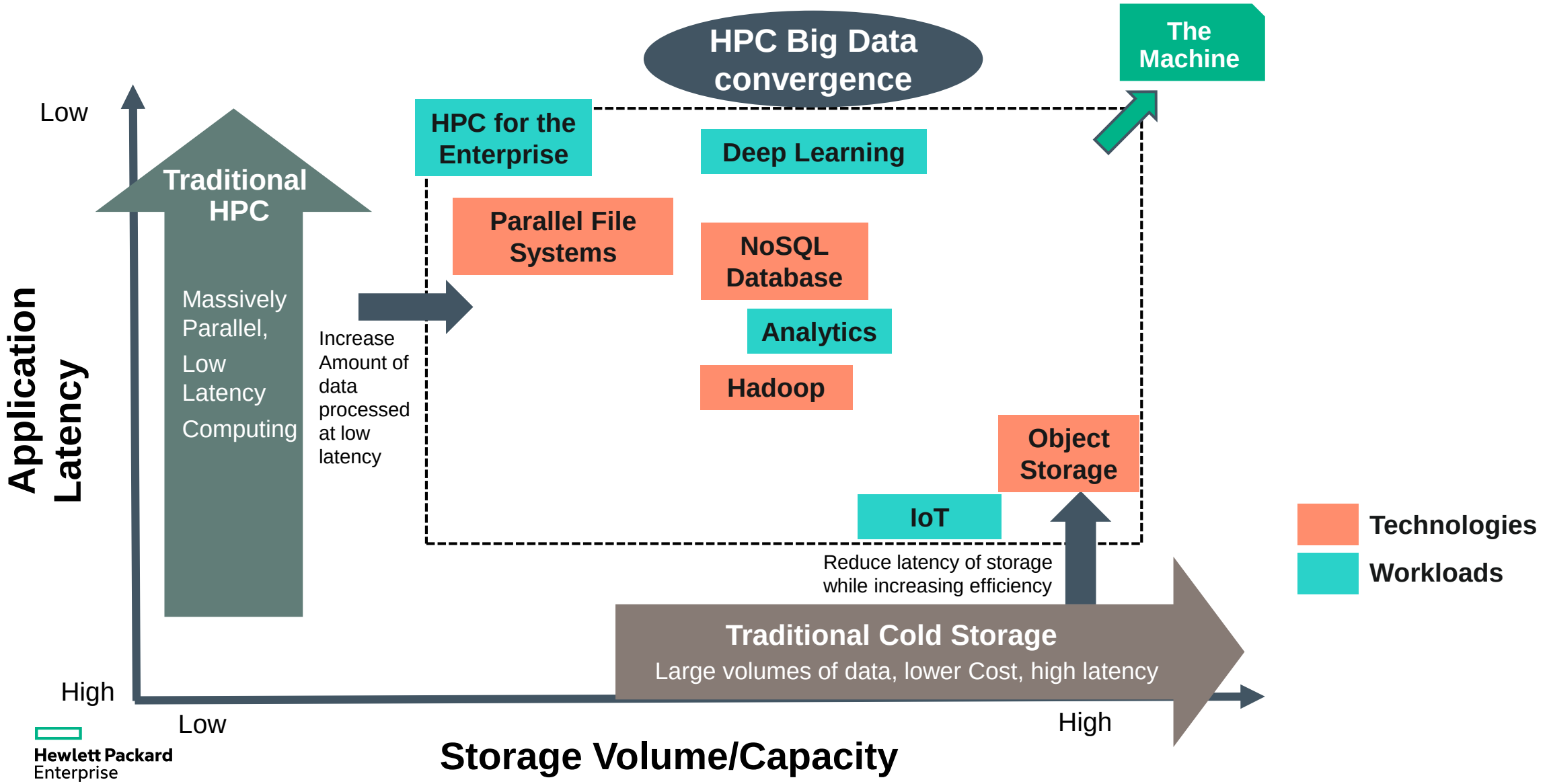
https://www.hpematter.com/content/welcome-idea-economy

HPC and Big Data technology context and The Machine

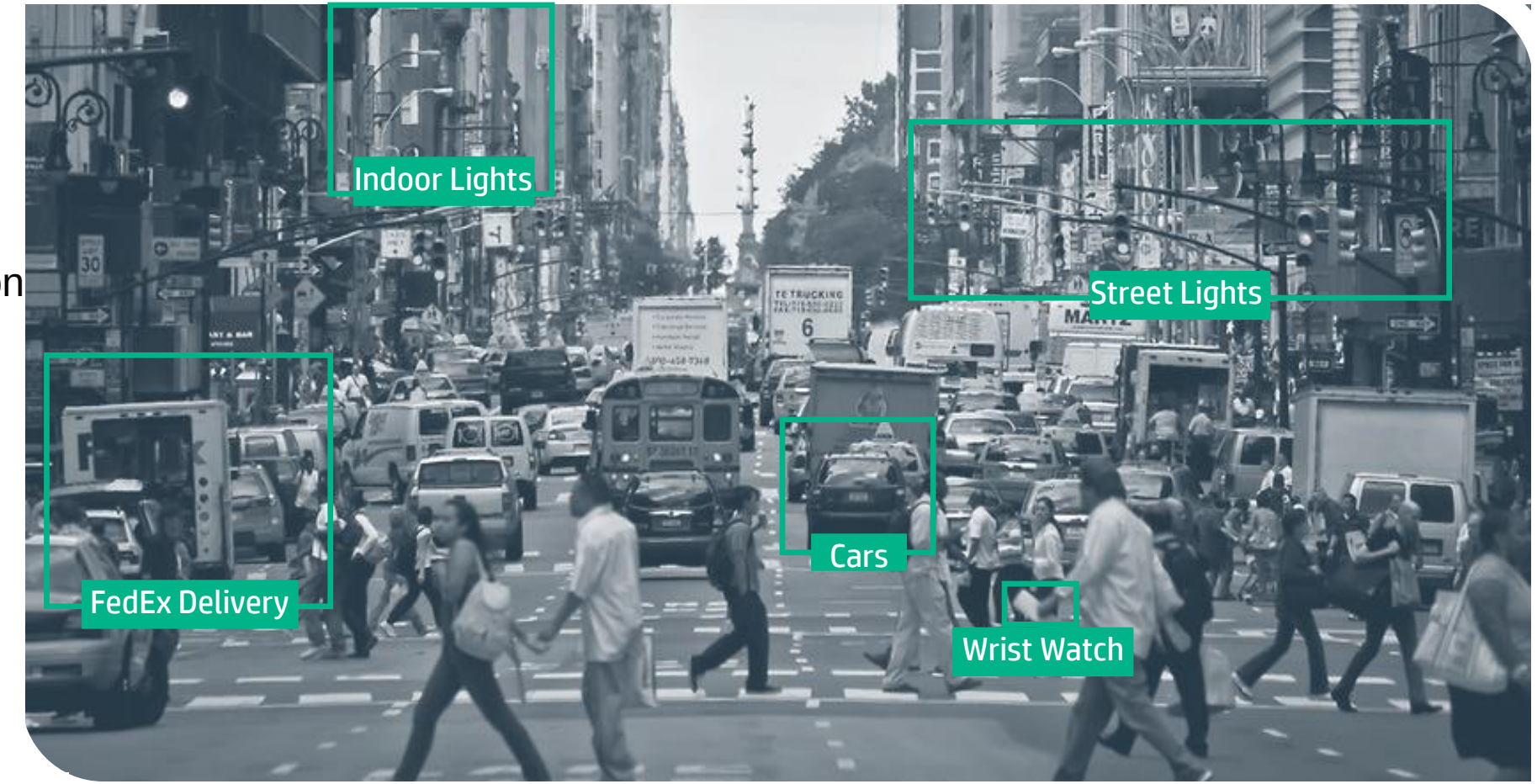


Connected Devices Are Changing Our World

An unlimited potentiality of new business, of high value services to end users

Magnitude of the data
Velocity of data
Unable to secure
Time-consuming data integration
Real-time insight needed
Insufficient resources
The end of cheap hardware

What do we do with all this data!



A big challenge for our infrastructures

Current technologies will not respond to the challenge

Deep Learning and Edge Computing

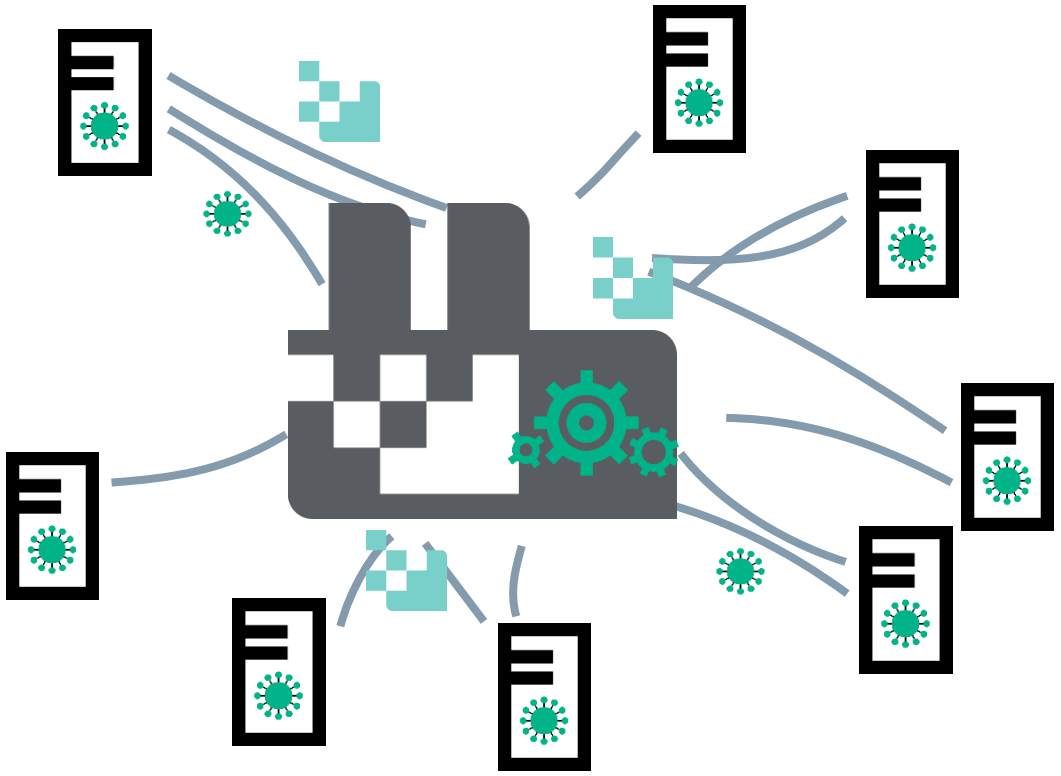
Edge Node

Gets trained model

Uses the model in real-time

Collects data

Sends some data to center



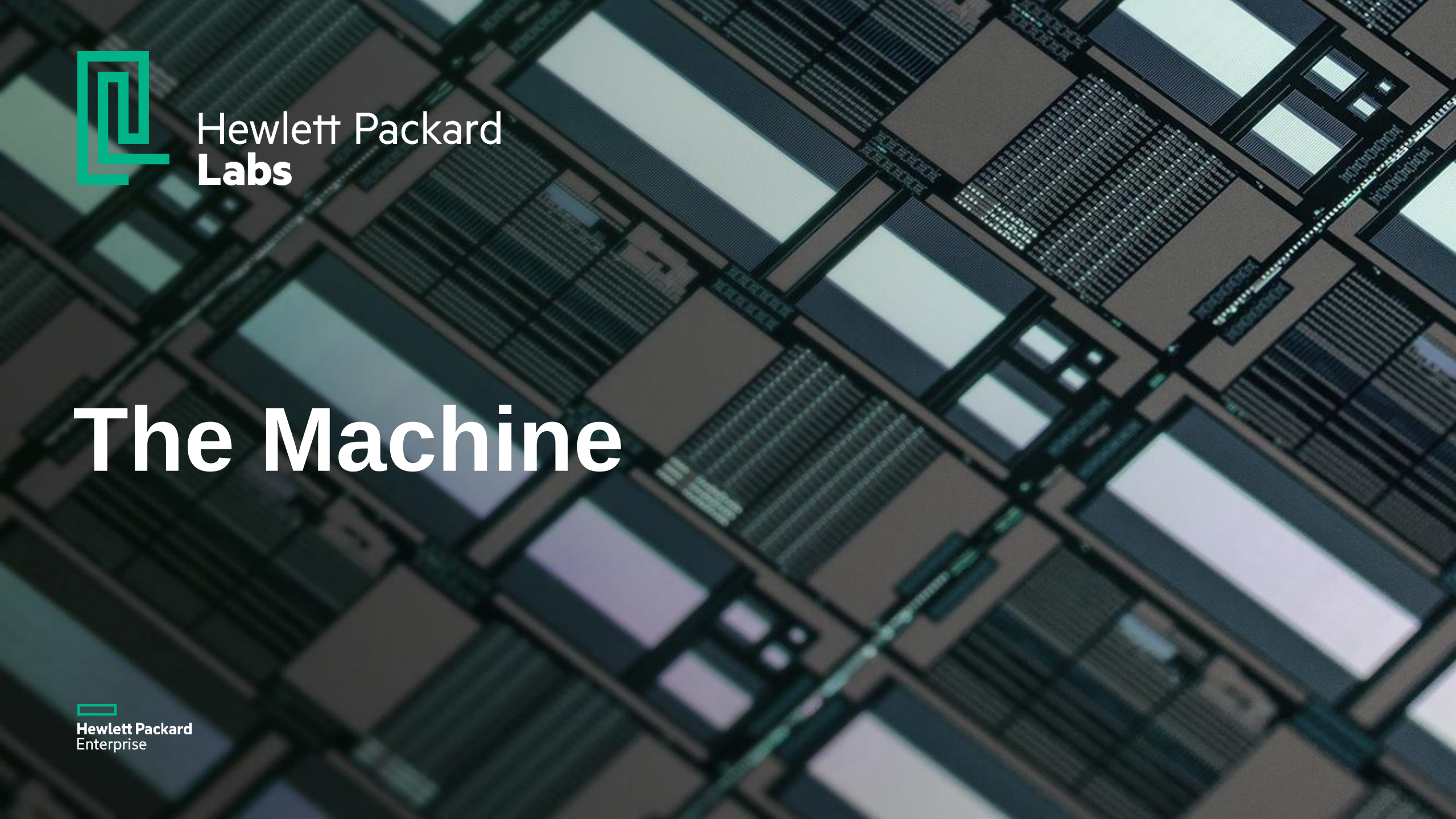
Center

Collects all data

Continously trains models

Sends model to edge nodes

Large scale simulations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Enterprise

The Machine

Powerful

A quantum leap in performance, beyond what you can imagine

Open

An open architecture designed to foster a vibrant innovation ecosystem

Trusted

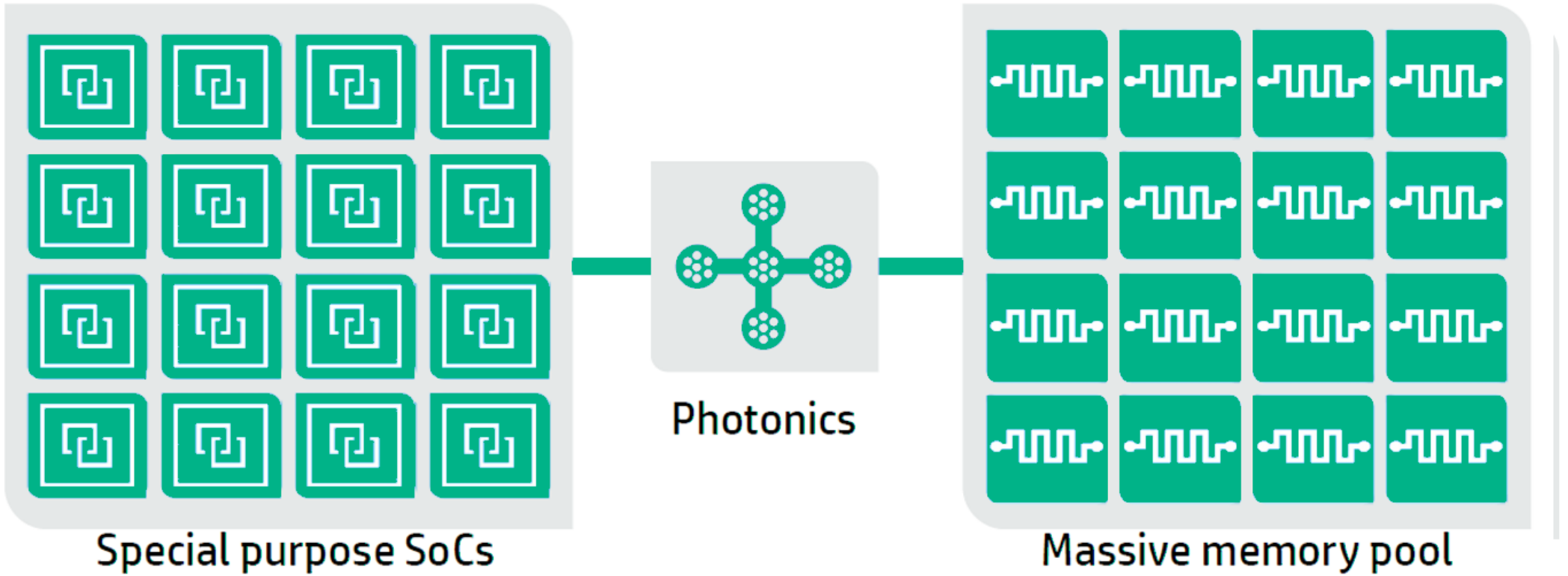
Always safe, always recoverable

All the benefits without asking for sacrifice

Simple

Structurally simple, manageable and automatic, so that “it just works”

3 disruptive technologies to the rescue



Electrons **Photons** **Ions**

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Disruption #1: Non-volatile memories

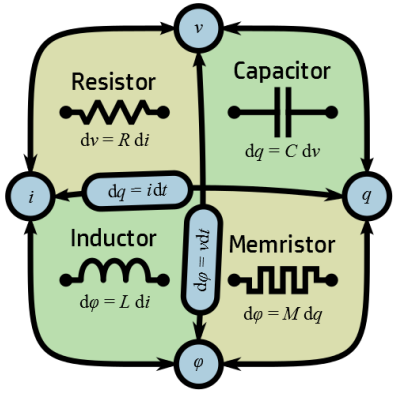
Breakthrough in storage and memory technology

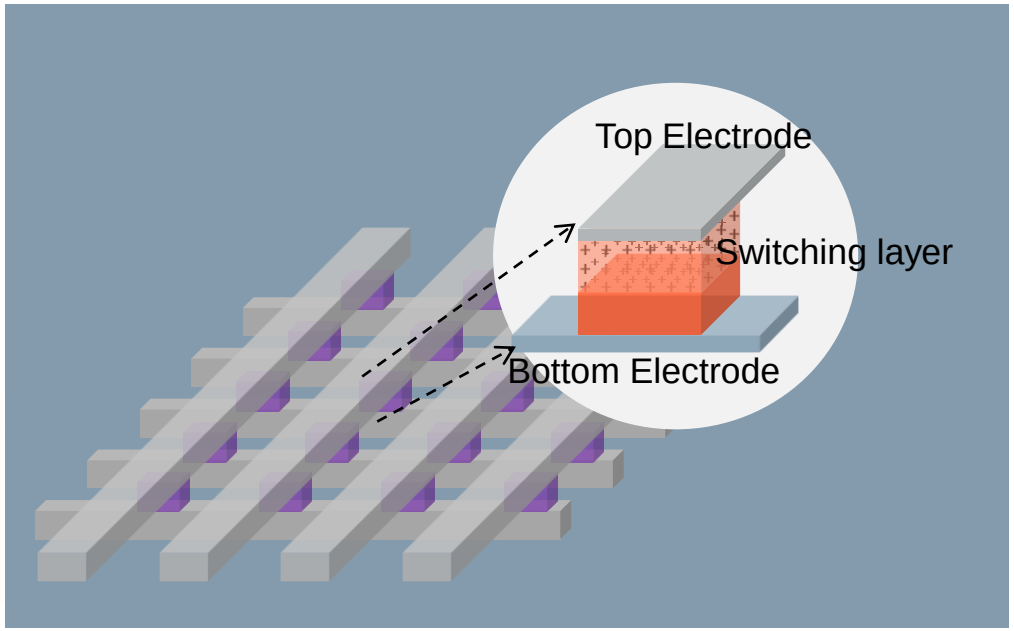
Scientists Create First Memristor: Missing Fourth Electronic Circuit Element

By Bryan Gardiner | April 30, 2008 | 10:03 am | Categories: Uncategorized

Like Send 54 likes. Sign Up to see what your friends like.

Researchers at HP Labs have built the first working prototypes of an important new electronic component that may lead to instant-on PCs as well as analog computers that process information the way the human brain does.





Technology	Density (μm²/bit)	Bandwidth (GB/s)	Latency Read (ns)	Latency Write (ns)	Energy Read (pJ/b)	Energy Write (pJ/b)
Hard Disk	N/A	0.5	3,000,000	3,000,000	2500	2500
Flash SSD [3] [6]	0.0021	1.0	25,000	200,000	250	250
DRAM [6] [30]	0.0038	51.2	55	55	24	24
PCRAM (22nm) [30]	0.0058	variable	48	150	2	19.2
Memristor (22nm) [8]	0.0048	variable	100	100	1-3	1-3

Store large amounts of data permanently like hard disks, but 100,000 times faster, and at much lower energy

Ultimately at cost close to HDD

Emerging NVM Memory Technologies

NVM and high speed memories are critical for extreme computing

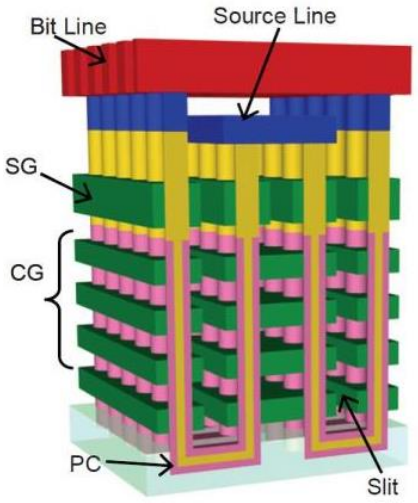
– Flash Memory

– Reaching the physical limits of charge storage

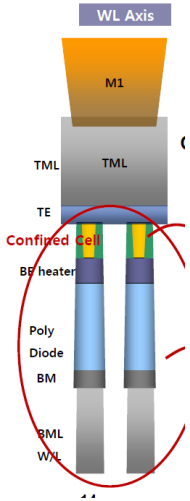
– DRAM

– Reaching the physical limits of charge storage

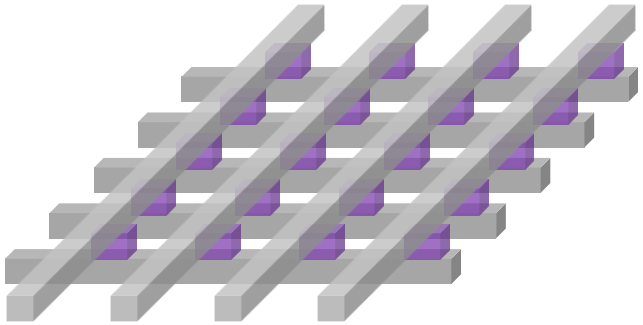
3D Flash



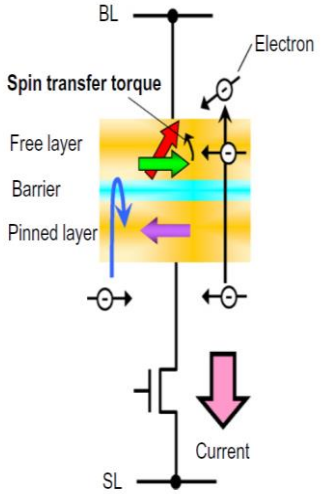
PCRAM



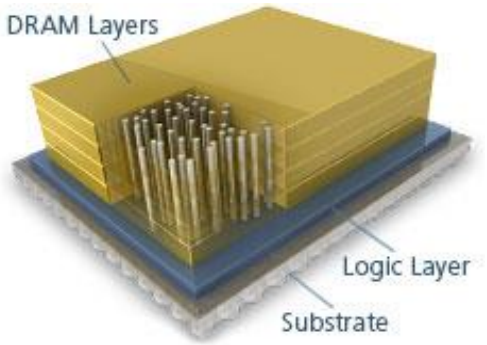
RRAM



STT-RAM



Hybrid Memory Cube



Flash Replacement

Storage Class Memory

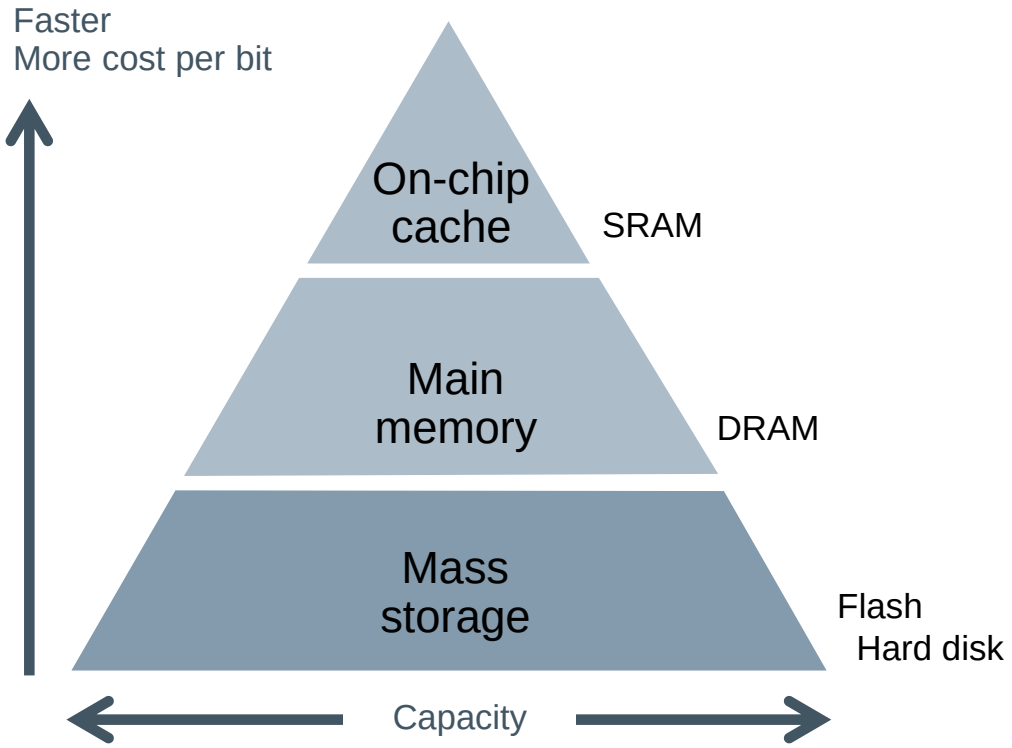
DRAM Replacement

Making the memory hierarchy obsolete

Massive Memory Pool

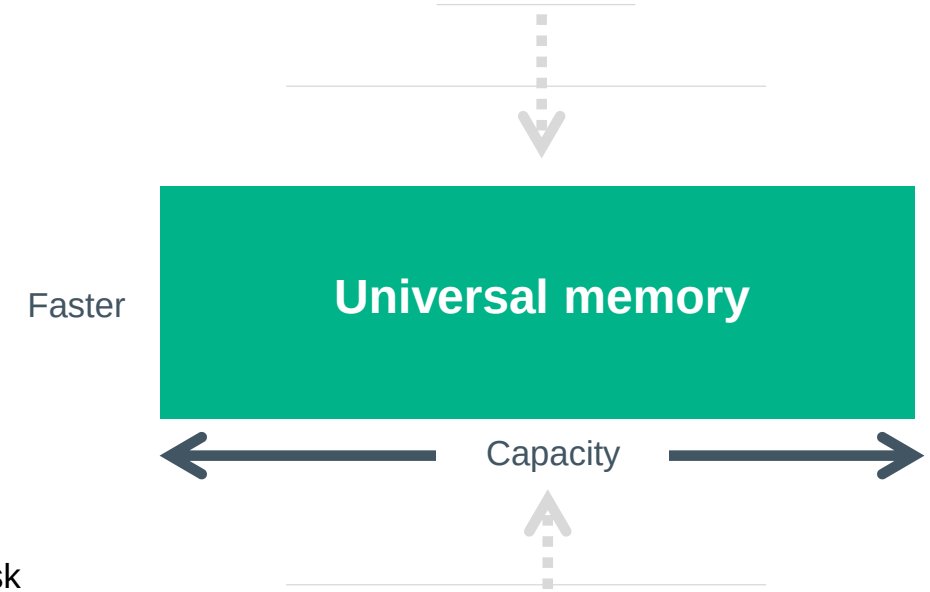
Today

Constant balance between cost and performance



The Machine

Enabling massive data sets



Benefits of universal memory

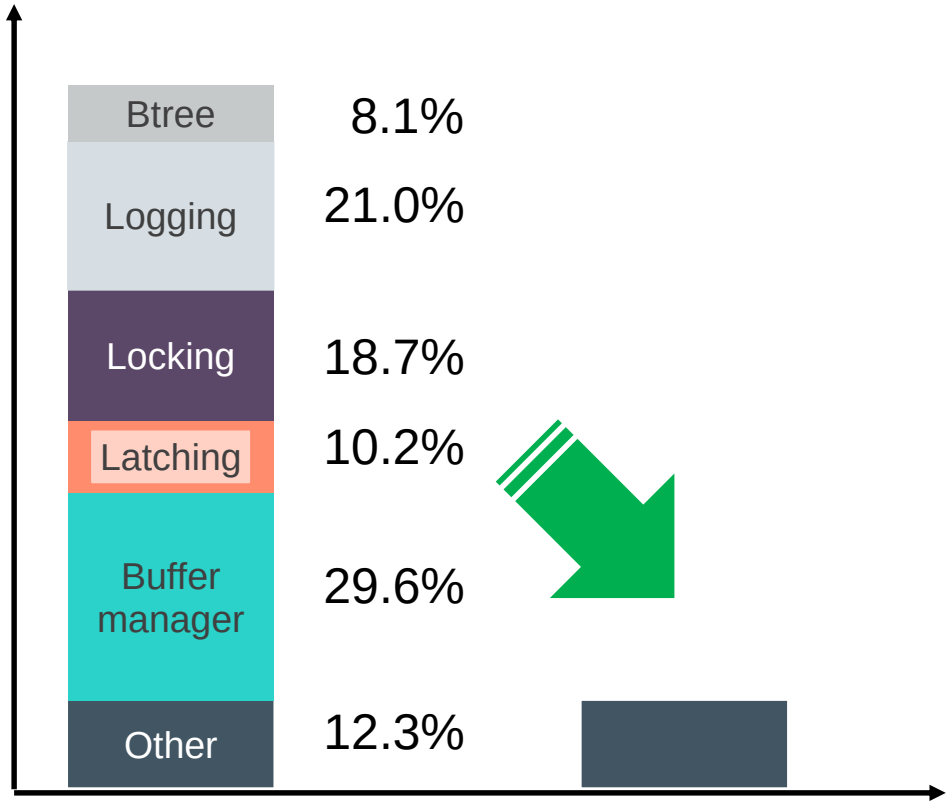
Example: a database transaction

Massive memory pool

– Traditional databases struggle with big & fast data

– 90% of a database transaction is overhead

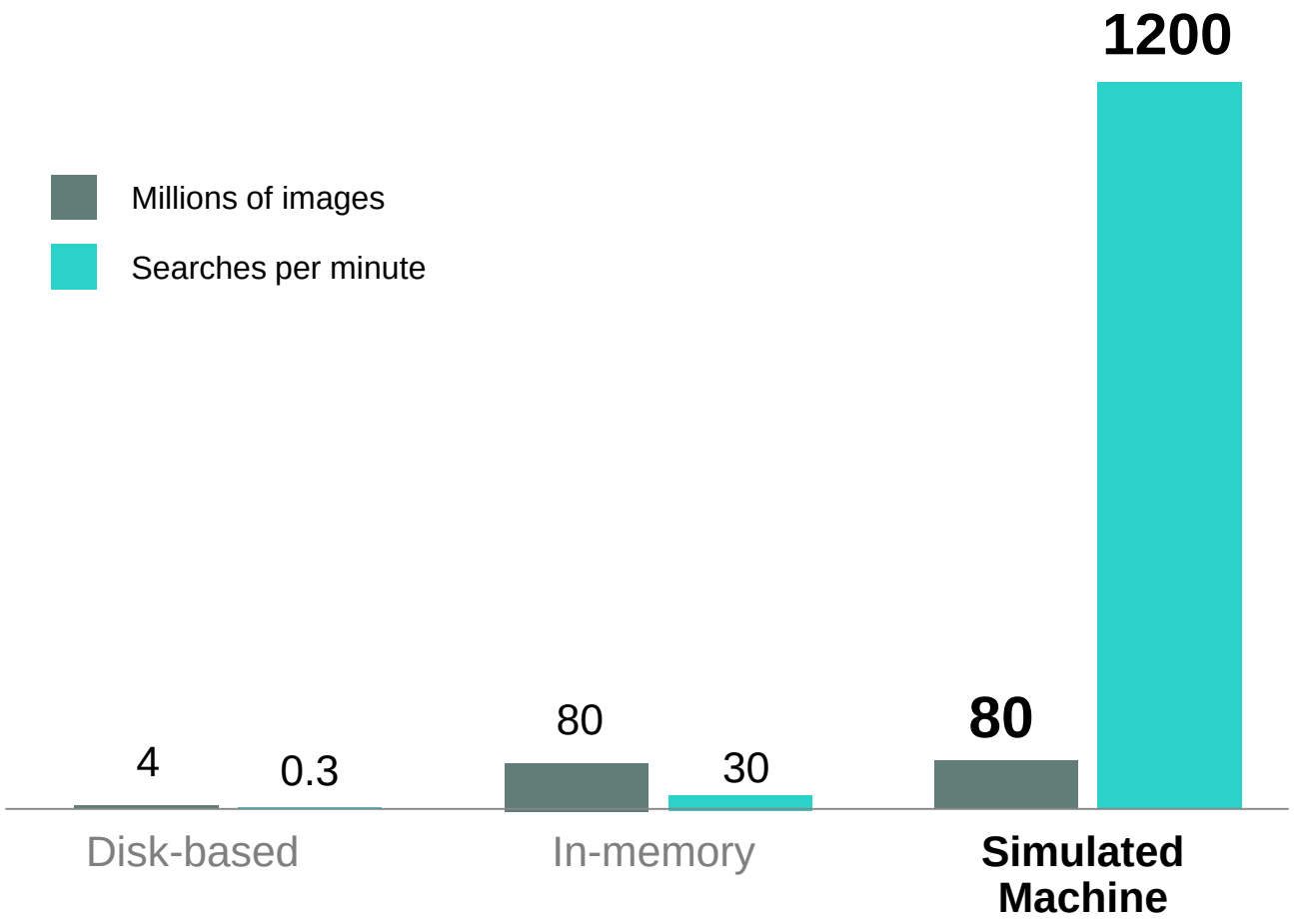
– Memory-semantics nonvolatile memory: up to 10x improvement



Source: S. Harizopoulos, D. Abadi, S. Madden, and M. Stonebraker, "OLTP Through the Looking Glass, and What We Found There," *Proc. SIGMOD*, 2008.

Performance demonstration – similarity search

From offline to real time decisions



Use cases:

Content-based image/video retrieval

Near-duplicate web page detection

Similar document retrieval

Outlier detection for e-commerce fraud mitigation

Fingerprint matching

Scalable object recognition

Nearest-neighbor classification

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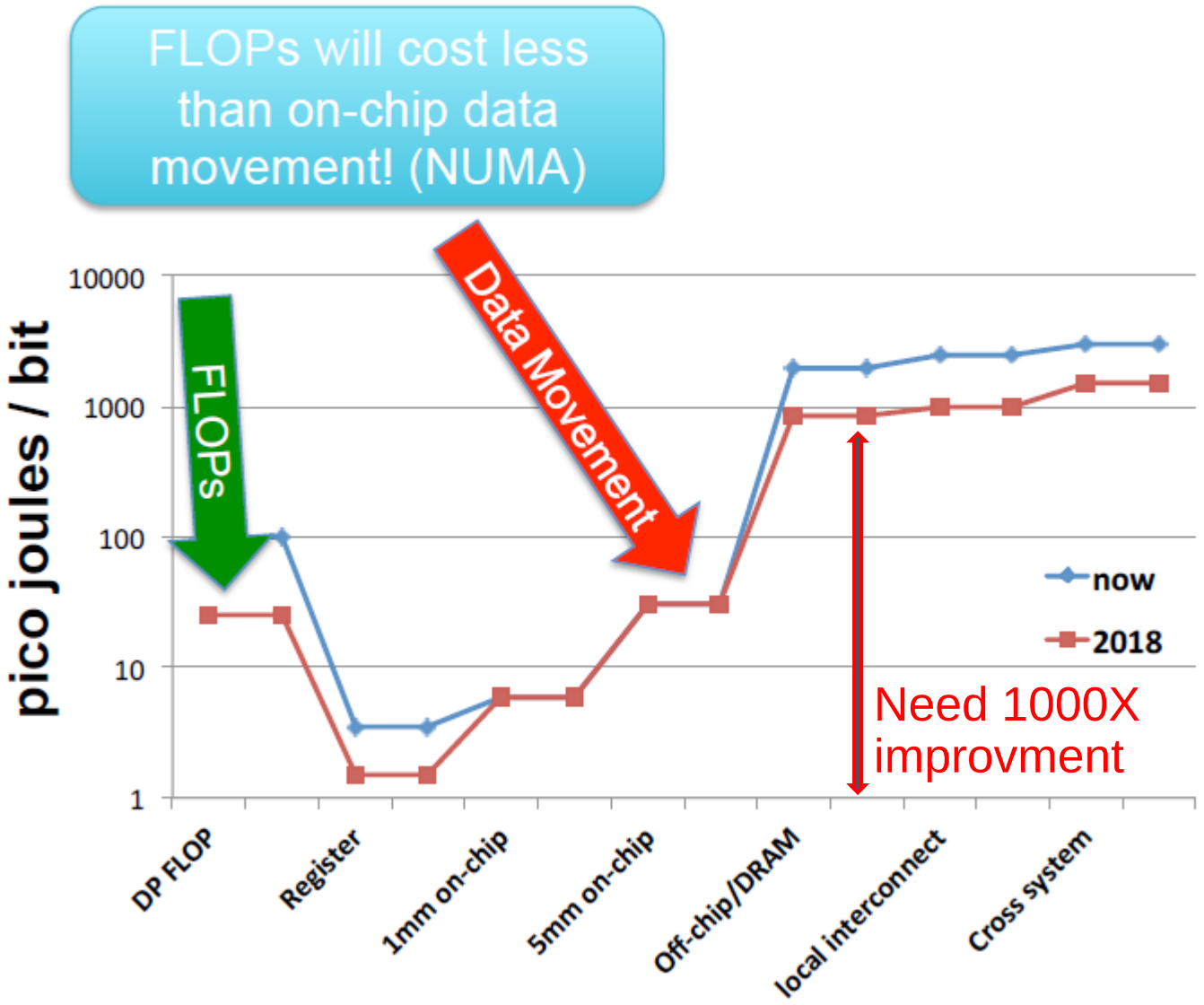
Disruption #2 : Photonics



Photonics

10^18 ops*

1Byte/ops=

10^19bits*

1pj/bit=

10MWatts!!

Katharine Schmidtke, Finisar

HP photonics technologies

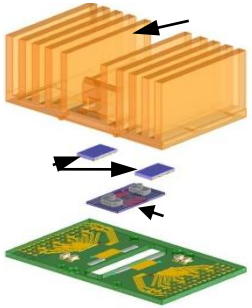
System-level architecture to large-scale integration

Devices

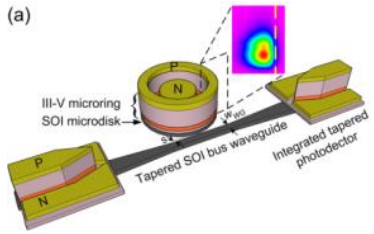
Architectures

Active cable

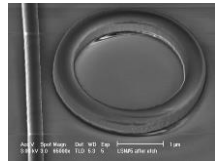
Low cost VCSEL



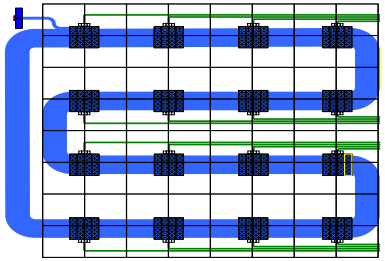
Hybrid laser



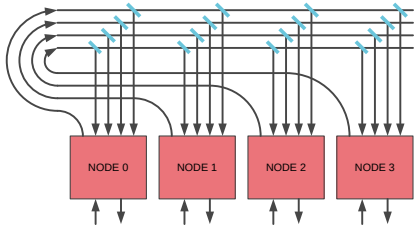
Silicon PIC



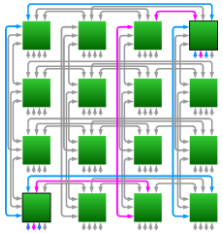
On-chip interconnect



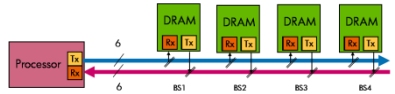
Optical backplane



HyperX & networking



Optically connected memory



Corona

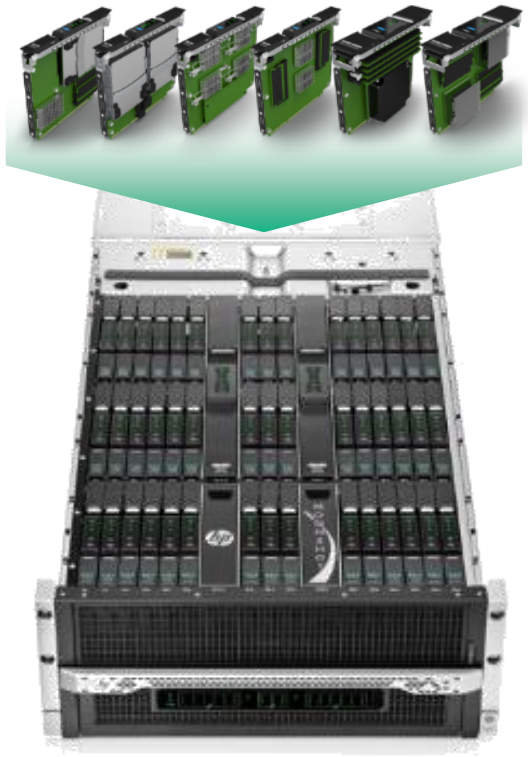
Now → 1 Year → 10 Years

Single wavelength → CWDM → DWDM

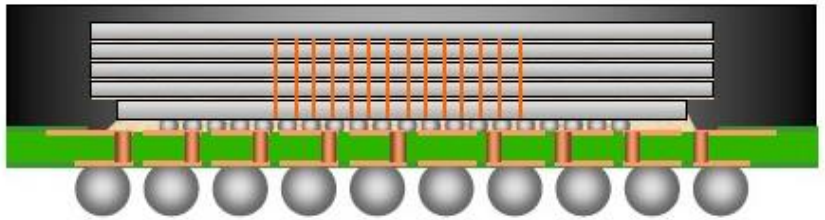
100pJ/bit → >.1 pJ/bit

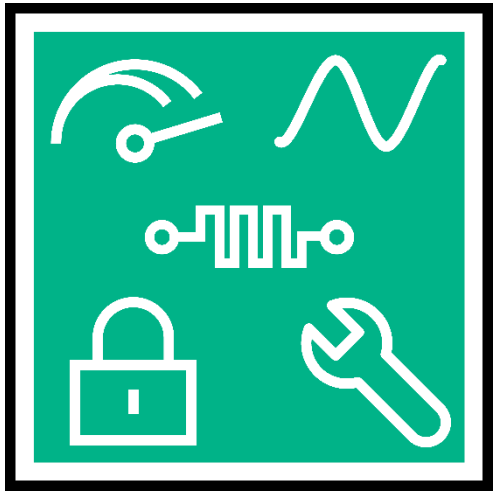
Disruption #3 : optimized architectures

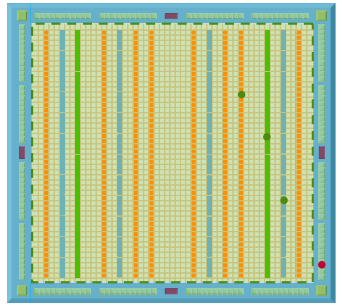
Special Purpose Cores

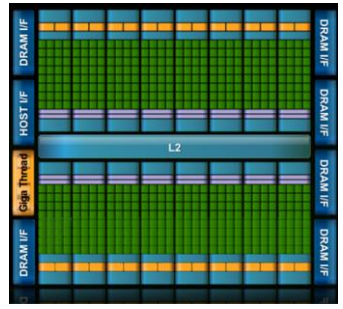


Reduced cost
Less energy
Less space
Less complex



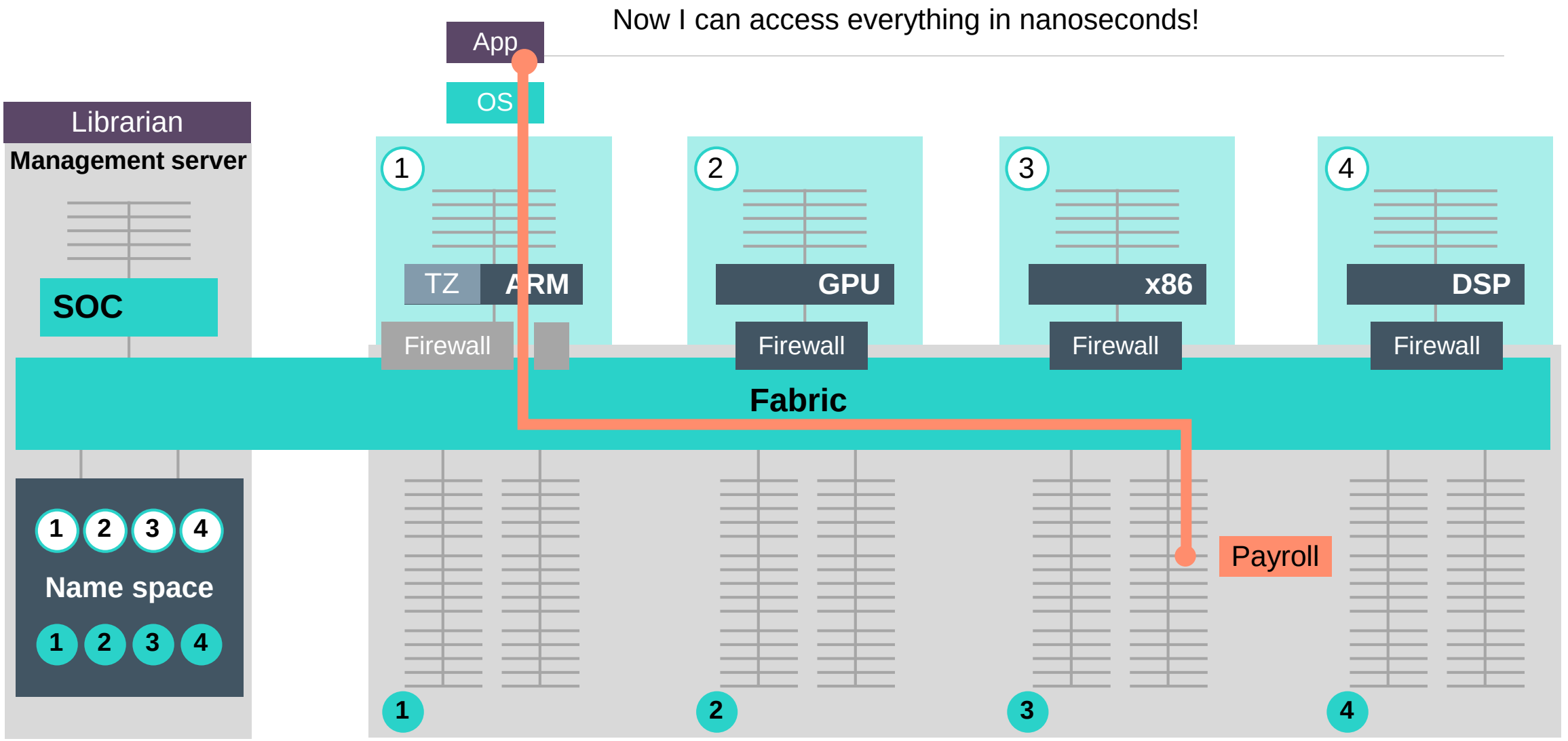






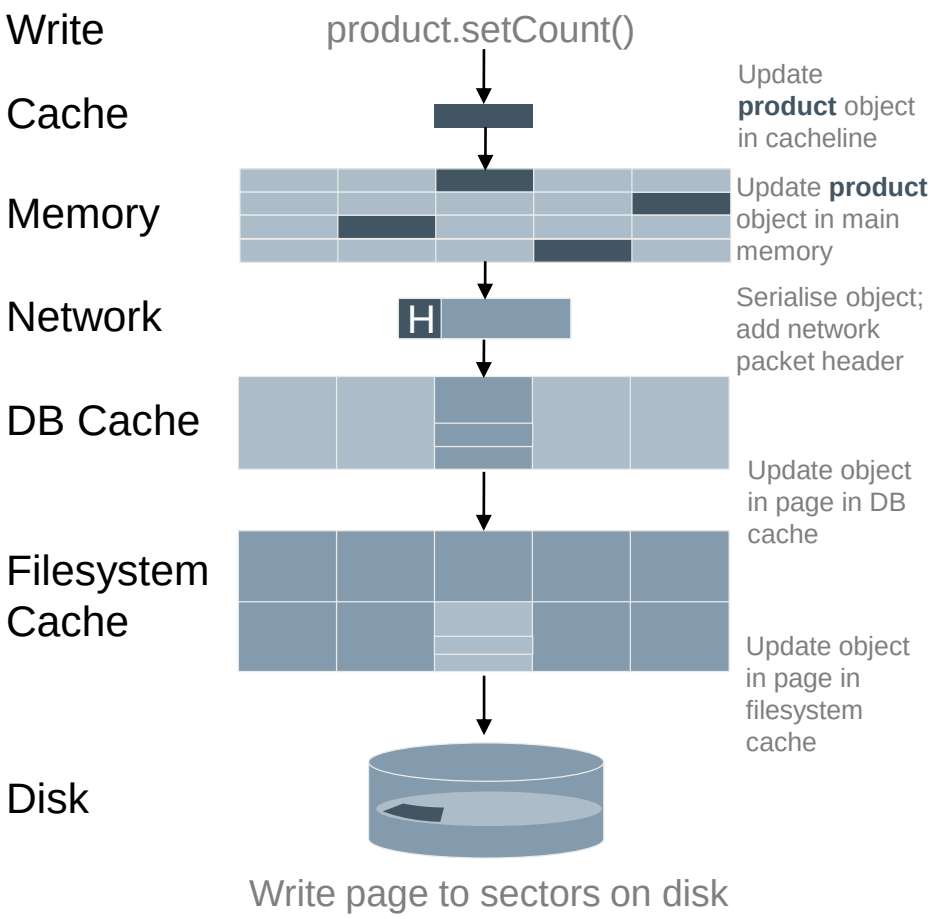
Integrated into a single package

Semantic of access : load/store



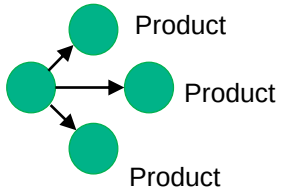
Simplicity: Fewer data layers

Conventional Data Formats



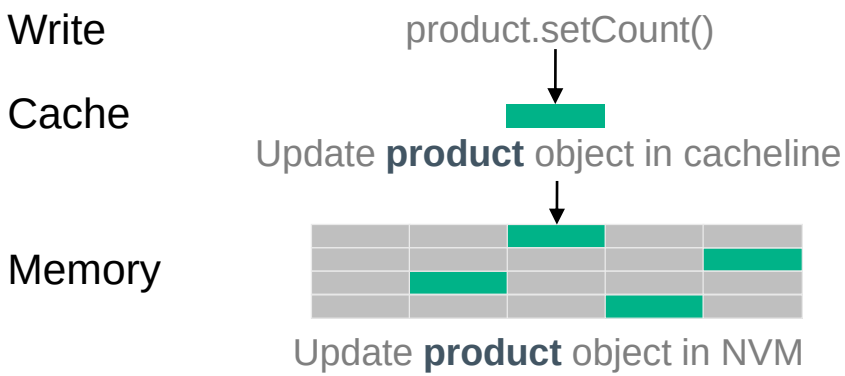
"Track the **products** my company sells."

Product Manager



Application Developer

MDS Data Formats



Update now persists in shared non-volatile memory

Hardware + software stack

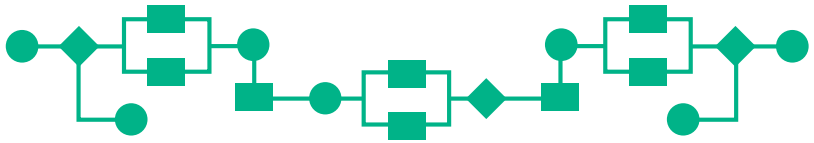
Insight

Data

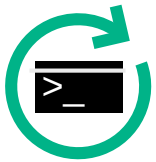
Analytics and visualization

Exabyte-scale algorithms

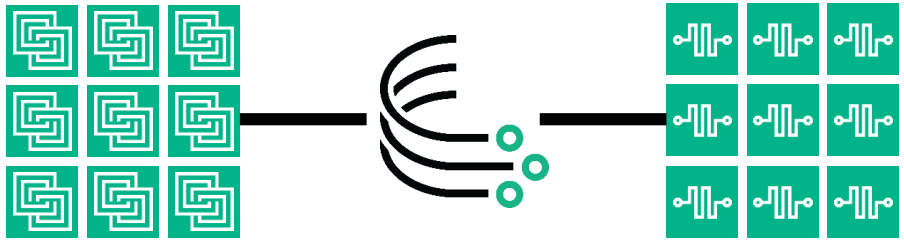
Million-node management

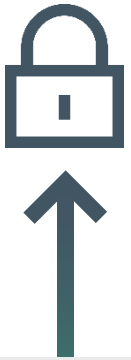


Operating systems and programming models



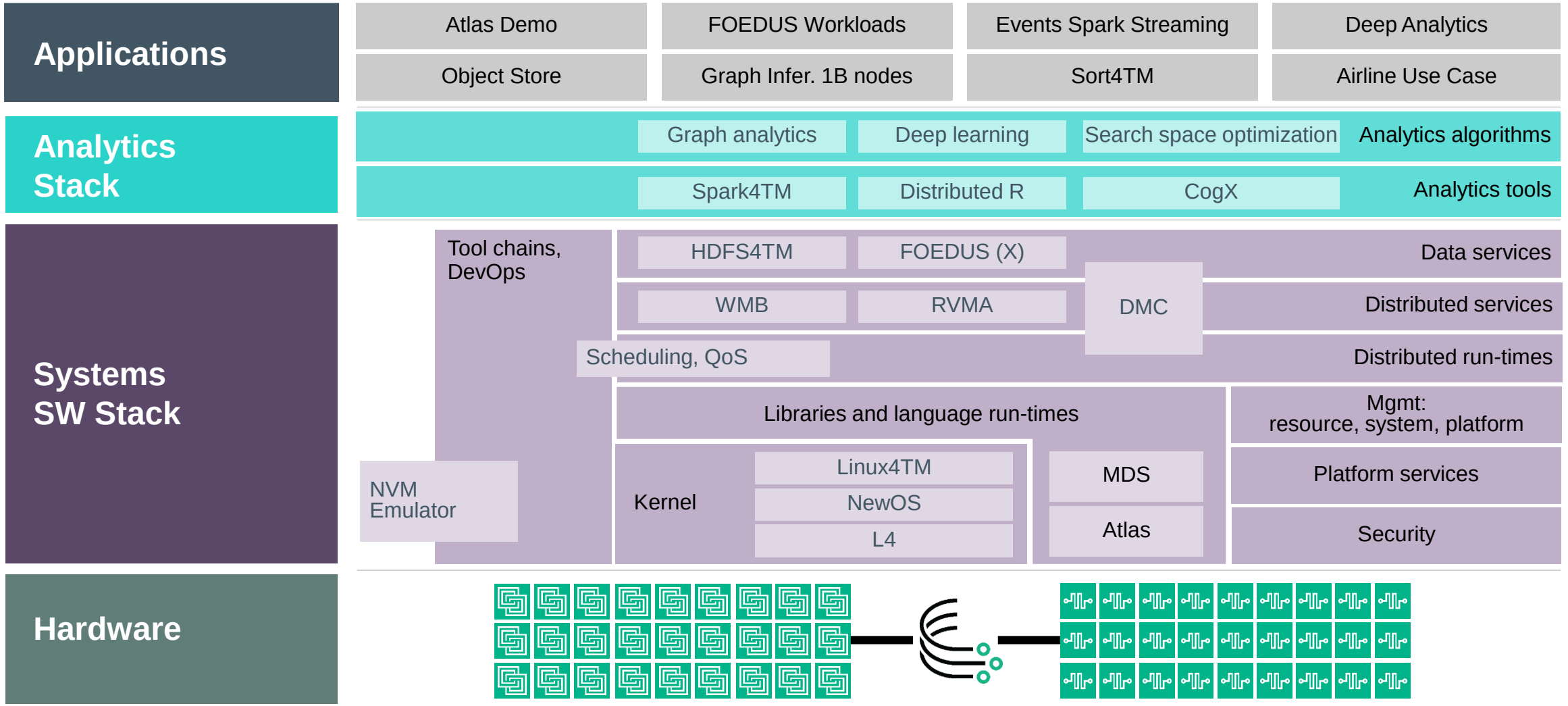
Ultra-efficient hardware





Security built-in from silicon upwards

The Machine Developer Experience



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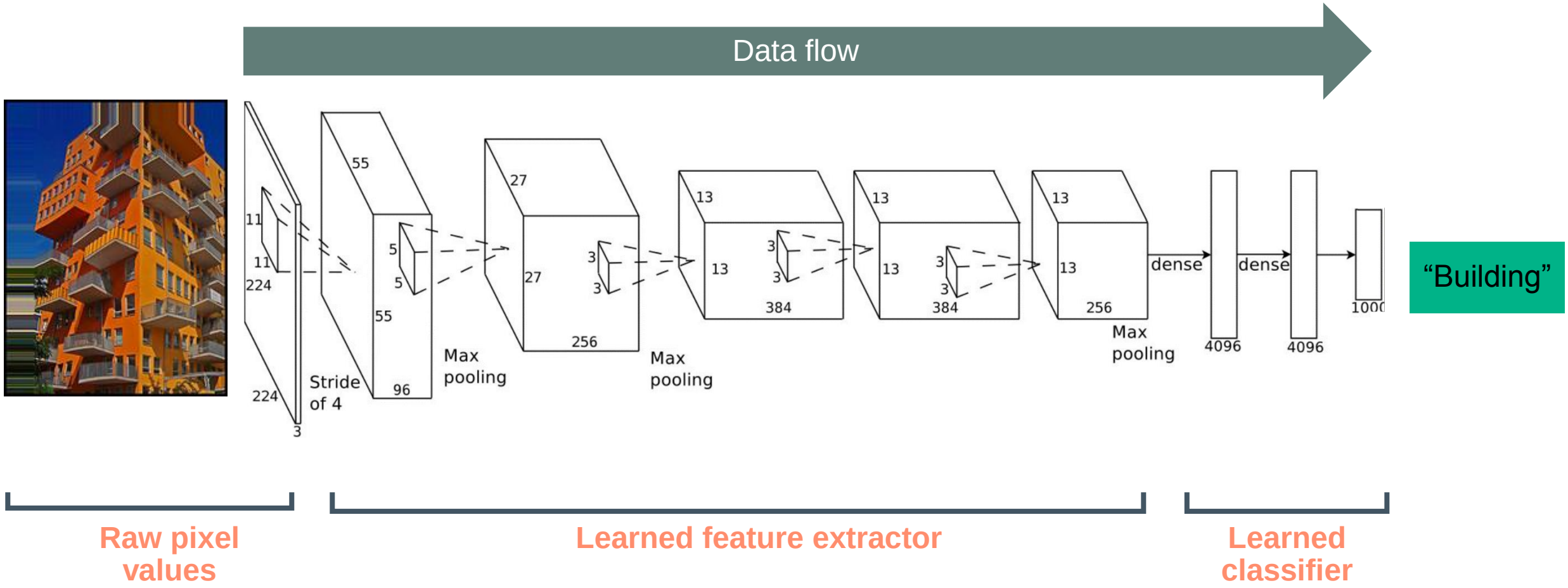
Deep Learning

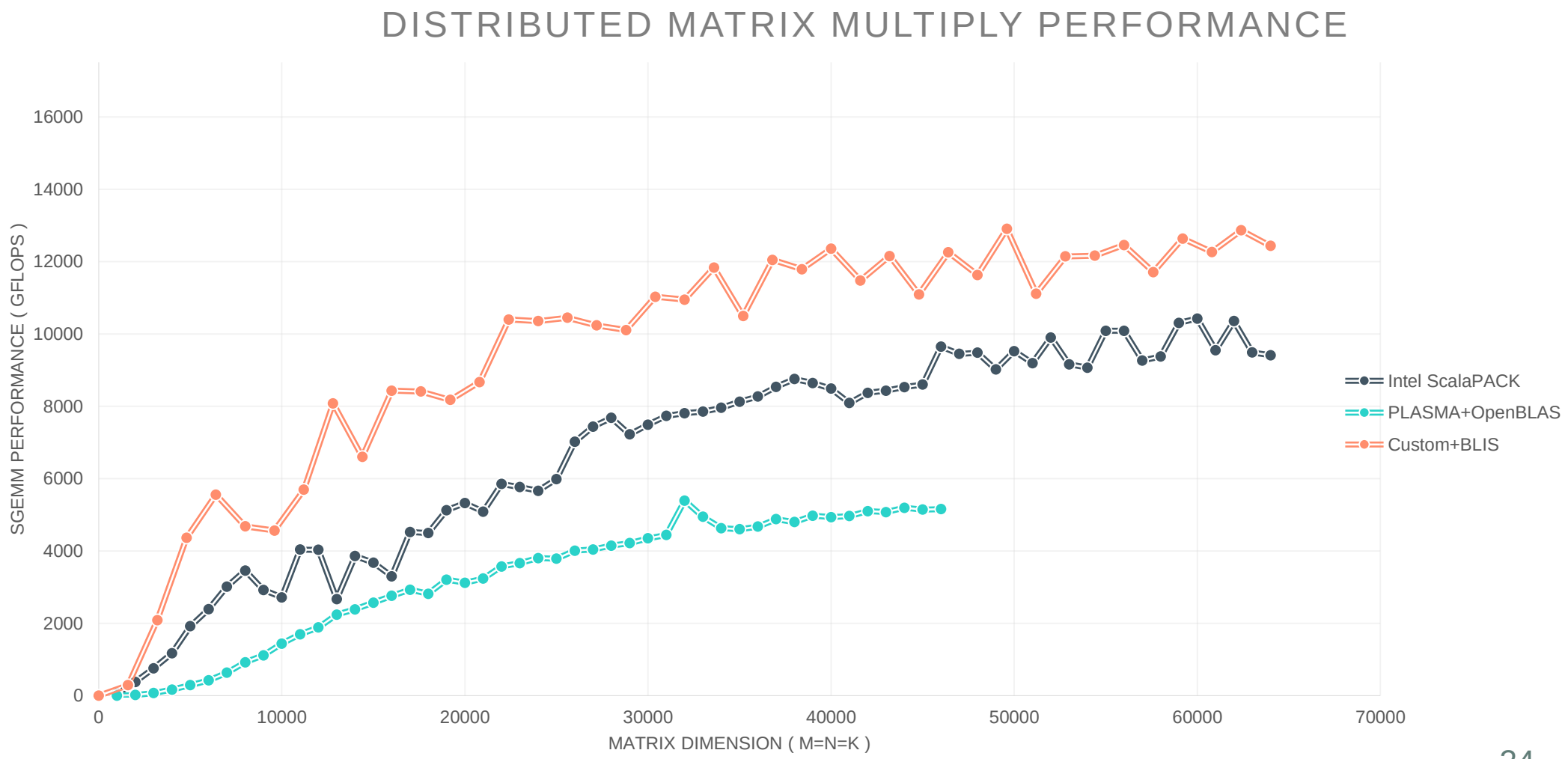
Convolutional Neural Networks (CNN)



Krizhevsky et al. (2012)

Machine Learning Performance

Linear Algebra is the Workhorse




What kind of world becomes possible?

Car Connected Services of the future

Safety	Security	Comfort	Process Optimization New Business Model
Remote Control of Speed	Vehicle Intrusion Protection	Geo-fencing car feature (light, speedometer)	Corporate Fleet Sharing
Micro-Local based warning	End-to-End Encryption V2I, V2V, V2X	Pre-Configuration of driver settings	Intermodal Transportation Services
Driver health monitoring	Holistic Key Management	Smart-Home Integration	Free-Floating-Warehouses (Truck space rental)
Remote Chassis configuration settings	Vehicle Security Operation Center	Smart-Office Integration	Vehicle Lifecycle Operations Center

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http://www.labs.hpe.com/dmc/

Smart City

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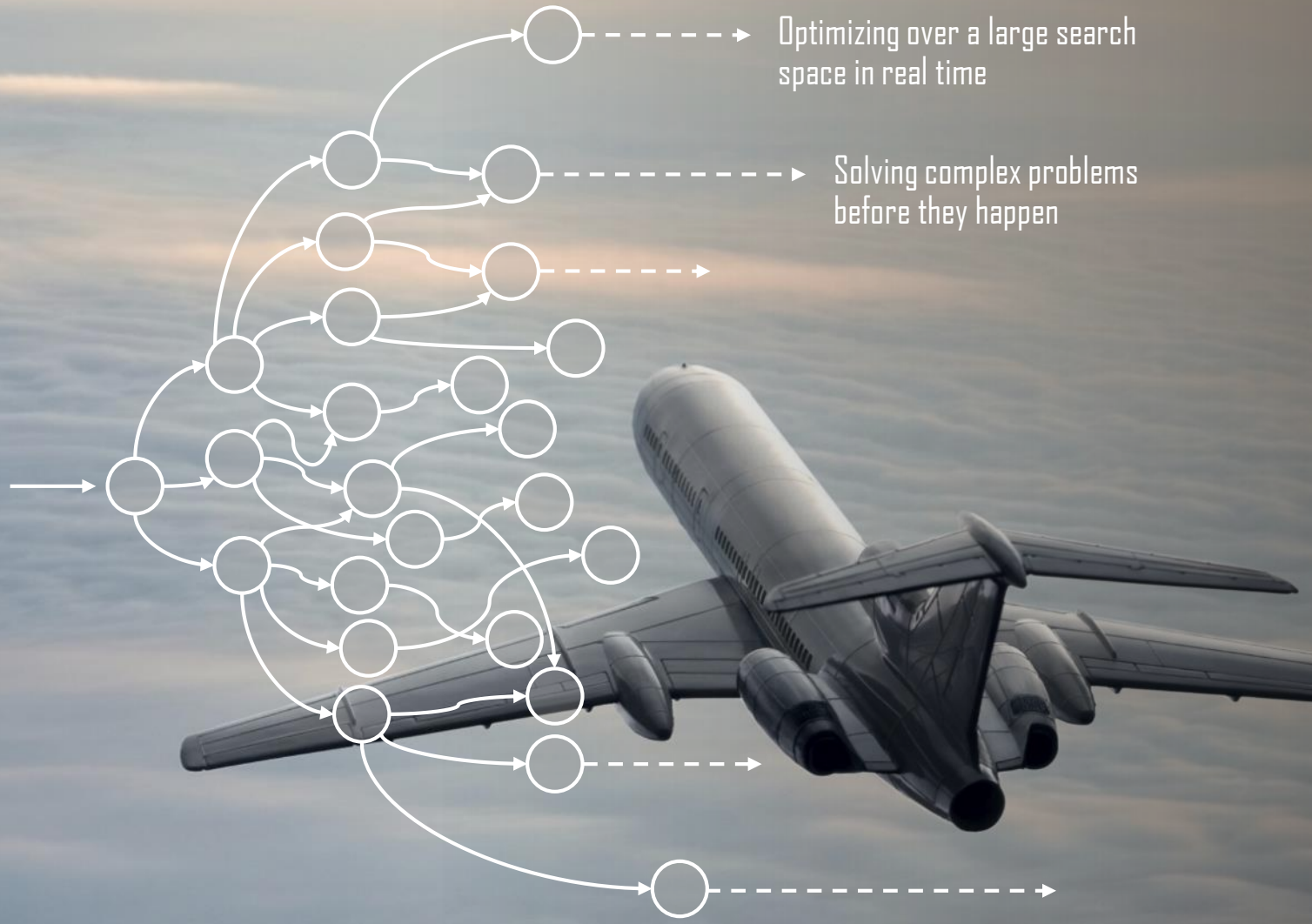
The Machine will allow you to optimize everything to maximize on-time flights

by having control of every state of the plane, and the operations associated with it, avoiding delays.

Simulate likely disruptions and store an almost infinite series of "what-ifs" so you can easily look up the scenario and immediately know what to do.



Smart Medecine

1. Smartphones, apps, and wearables are empowering patients, doctors, and caregivers.
2. Big Data will uncover patterns, problems, and opportunities in healthcare.
3. Cloud computing will unlock the valuable insights that live in healthcare data.
4. Security risks must be taken seriously.
5. Computing power and energy efficiency will be star players behind the scenes of healthcare.
6. 3D Printing will spur a new wave of growth and innovation in healthcare.
7. Telemedicine will expand healthcare into our homes and beyond.
8. Global health will improve with the expansion of technology to developing countries.
9. Technology will help us understand the brain..
10. Innovation will unlock business opportunities.

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https://www.hpematter.com/content/10-big-technology-trends-healthcare

AI

Memory-Driven Computing an enabler for AI

Analytics Everywhere
Memory-Driven Computing simplifies big-data and interactive analytics

Distributed Mesh Computing
Intelligent IOT in all environments

The Machine – the future of computing
Today, 10X bigger, better, faster analytics on large memory systems and fit to workload SOC

Hewlett Packard
Enterprise

Thank you

More resources on The Machine

Industry articles, blogs, and social media outlets:

The Machine on Hewlett Packard Labs Webpage (http://labs.hpe.com/research/themachine/)
Videos: Story on The Machine (https://www.youtube.com/watch?v=NwWF1LSmBJY) and
The Machine: Future of Computing (https://www.youtube.com/watch?list=PL0_ubpZ6vGcAm1sLOSyQWYx_WTJ_u9zNr&v=NZ_rbeBy-ms)

IEEE

- Adapting to Thrive in a New Economy of Memory Abundance – Computer Magazine special article
  http://www.labs.hpe.com/pdf/IEEE_Adapting_to_Thrive_in_a_New_Economy_of_Memory_Abundance.pdf
- At IEEE's Rebooting the Computer Conference, A New Economy of Memory Abundance
  http://community.hpe.com/t5/Behind-the-scenes-Labs/At-IEEE-s-Rebooting-the-Computer-Conference-A-New-Economy-of/ba-p/6818400
- Blah, blah, technology, blah: Sharing the MDC Vision with the IEEE Conference
  http://community.hpe.com/t5/Behind-the-scenes-Labs/Blah-blah-technology-blah-Sharing-the-MDC-Vision-with-the-IEEE/ba-p/6875502
- Memory-Driven Computing – how will it impact the world?
  http://community.hpe.com/t5/Behind-the-scenes-Labs/Memory-Driven-Computing-How-will-it-impact-the-world/ba-p/6796925

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