The Machine: The future of technology

HP Labs

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

What are the questions you can't ask today?

Magnitude of the data

+

Flash flooding of legacy data bases

+

Unable to secure

+

Time consuming data integration

+

Real-time insight needed

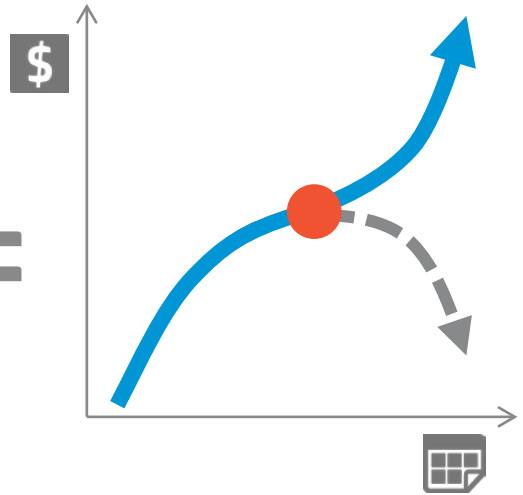
+

Insufficient resources

+

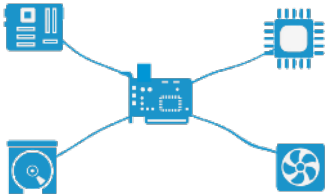
The end of cheap hardware

=



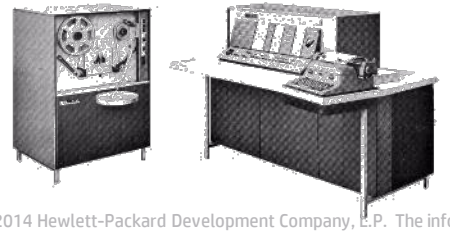
© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

The Past 60 Years



1950s

1960s



1970s

1980s

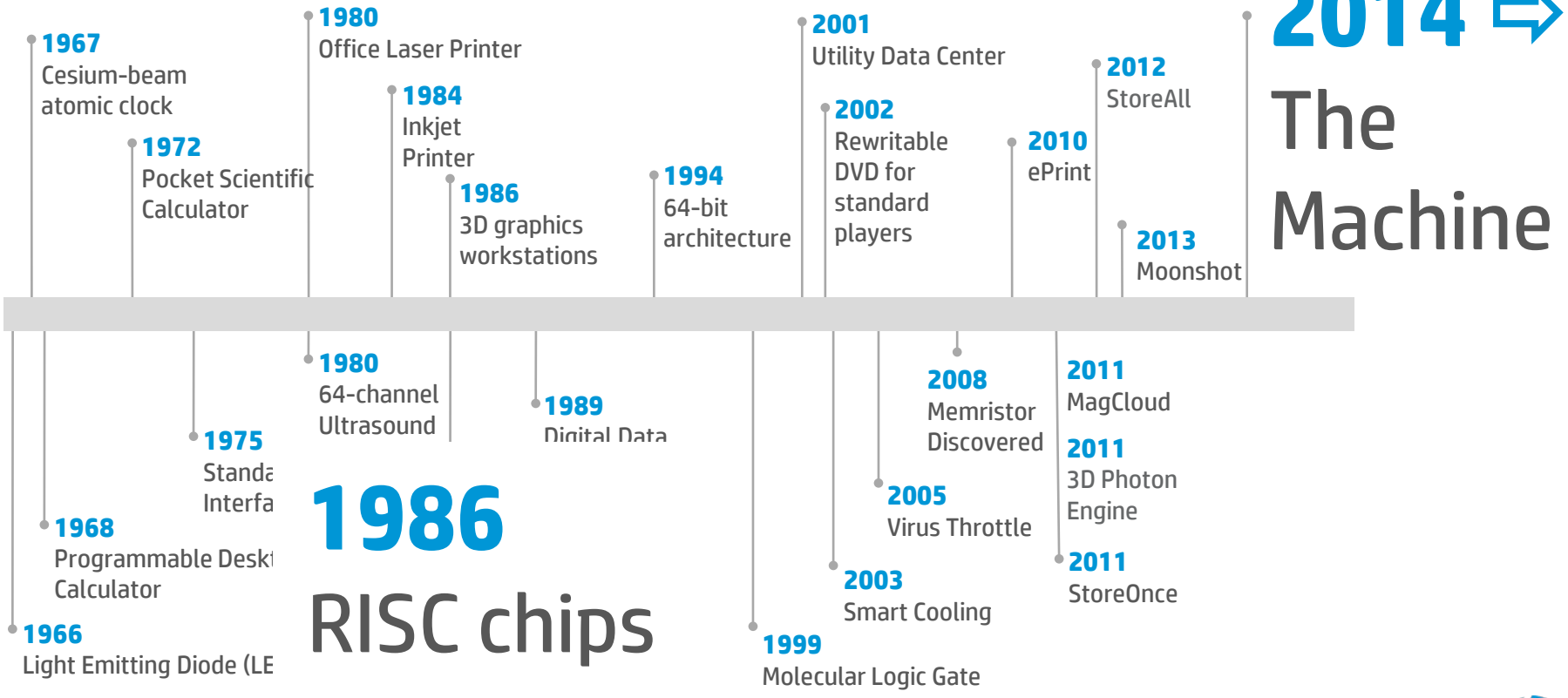
1990s

2000s

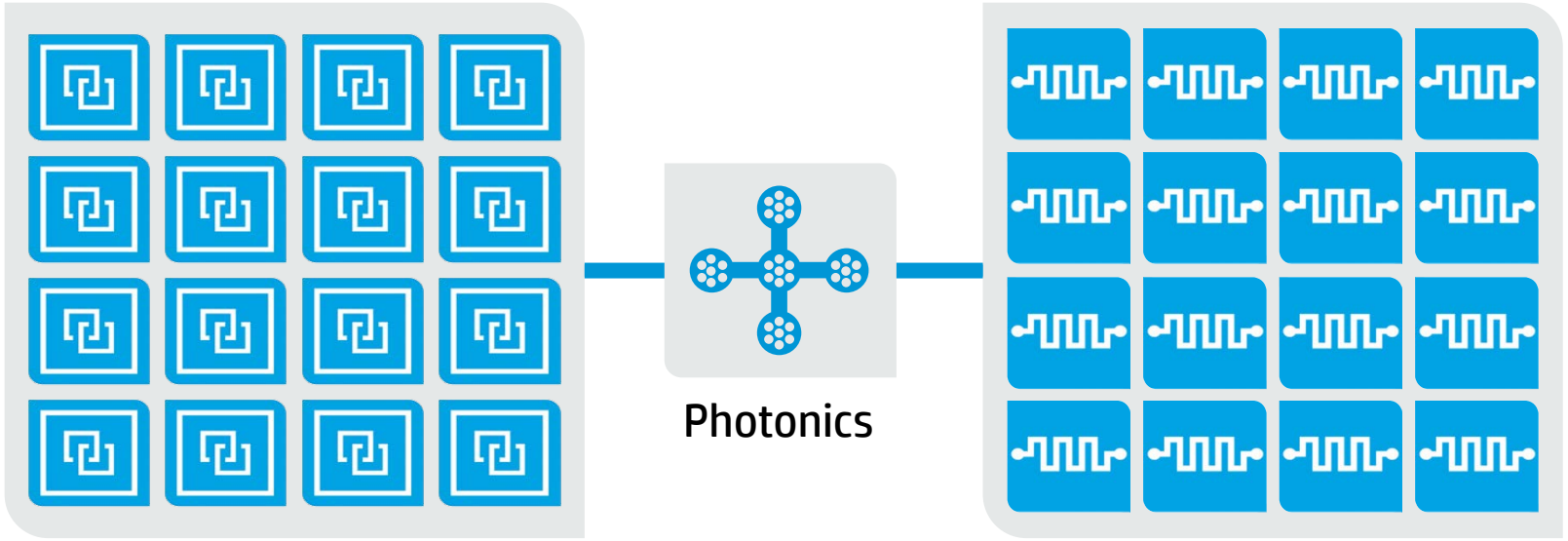
Today

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

HP Labs: engine of innovation

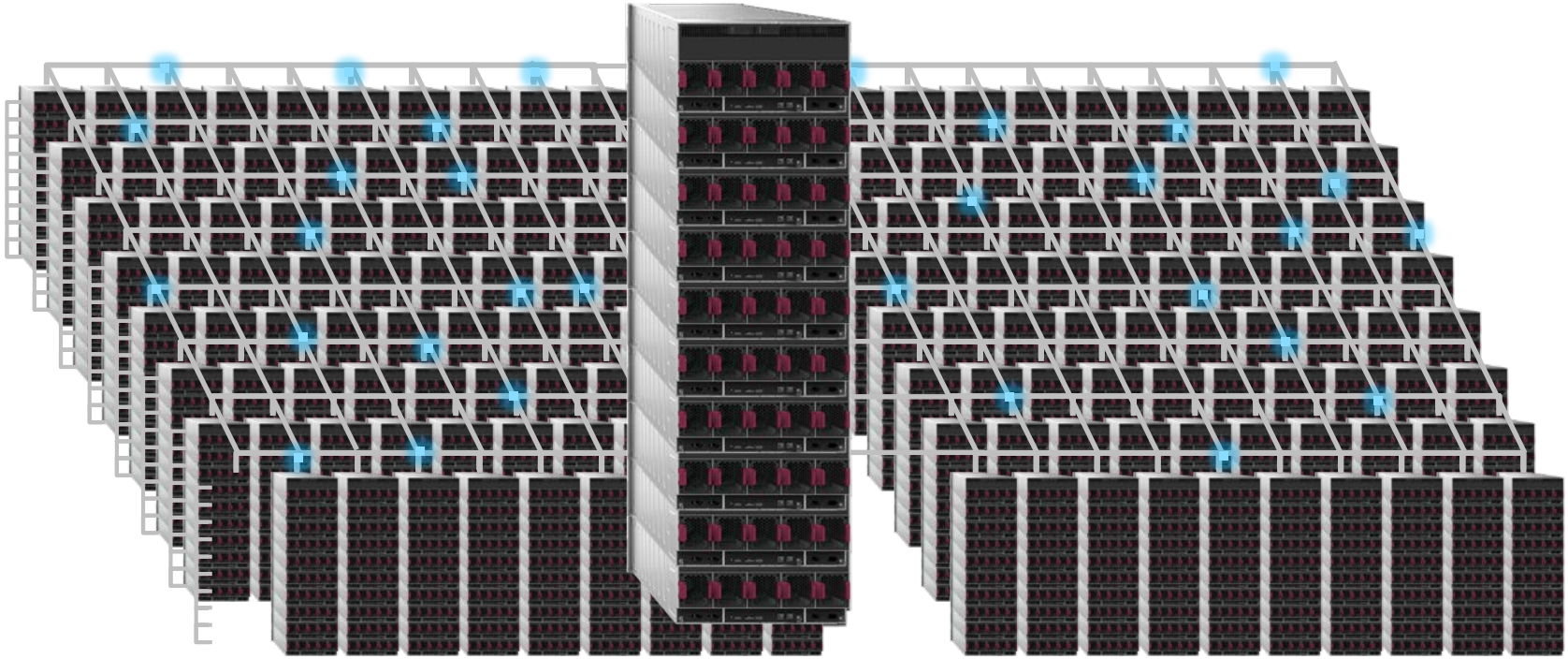


© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

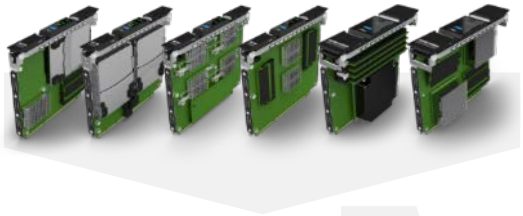


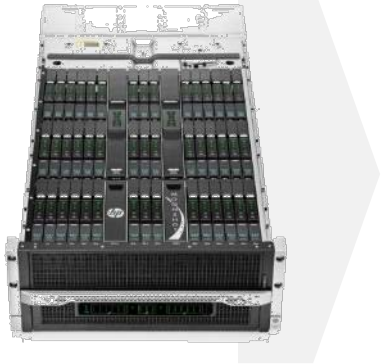
The Machine

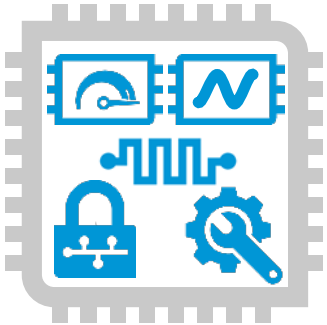
© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

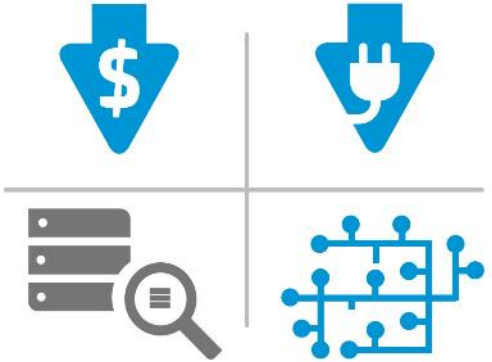


© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.







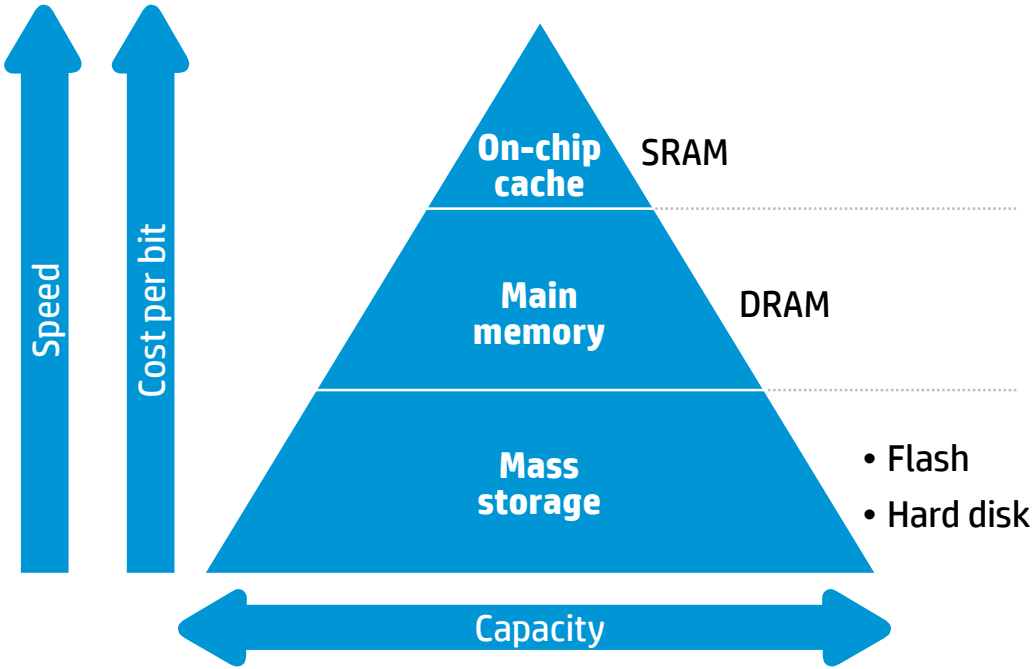


Customize the hardware to the workload

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

Photonics destroys distance

Massive memory pool



Universal memory obsoletes this hierarchy

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

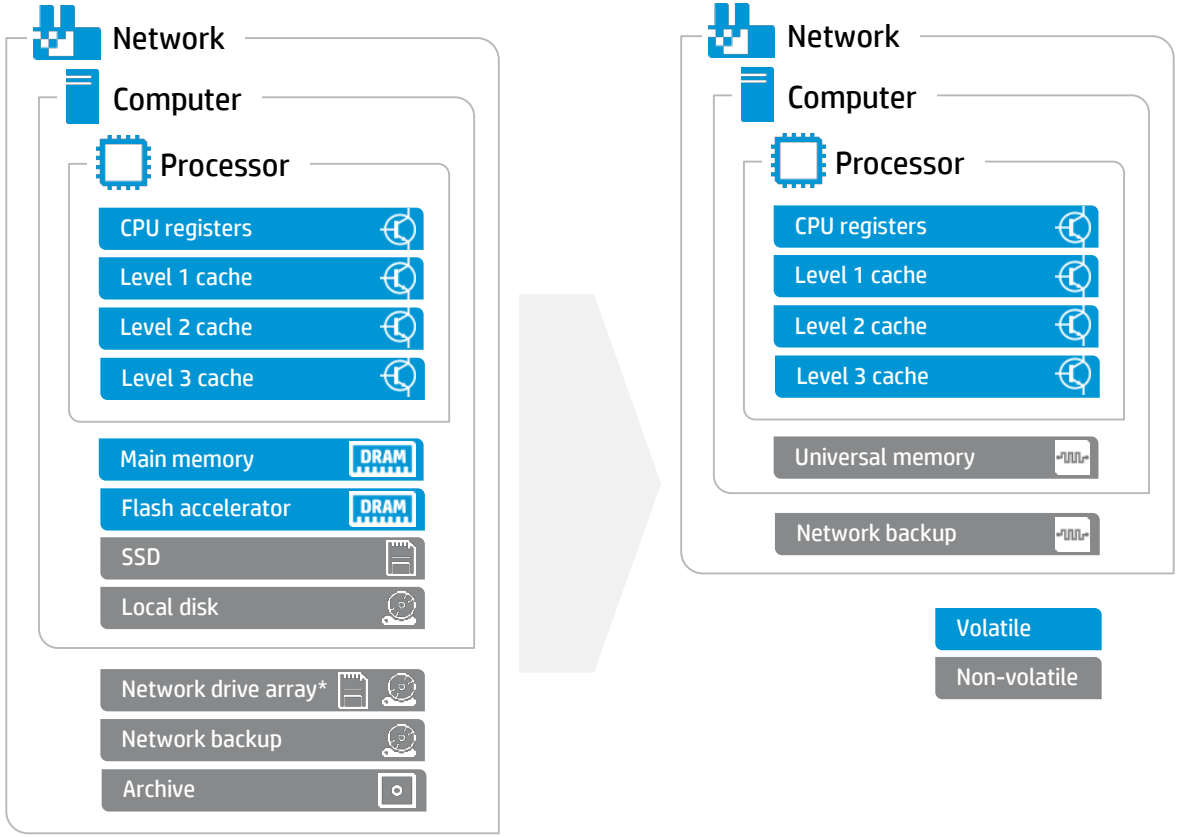
Imagine if a computer ran at human speed ...

Processor cycle	1 second

Time to retrieve a byte from ...

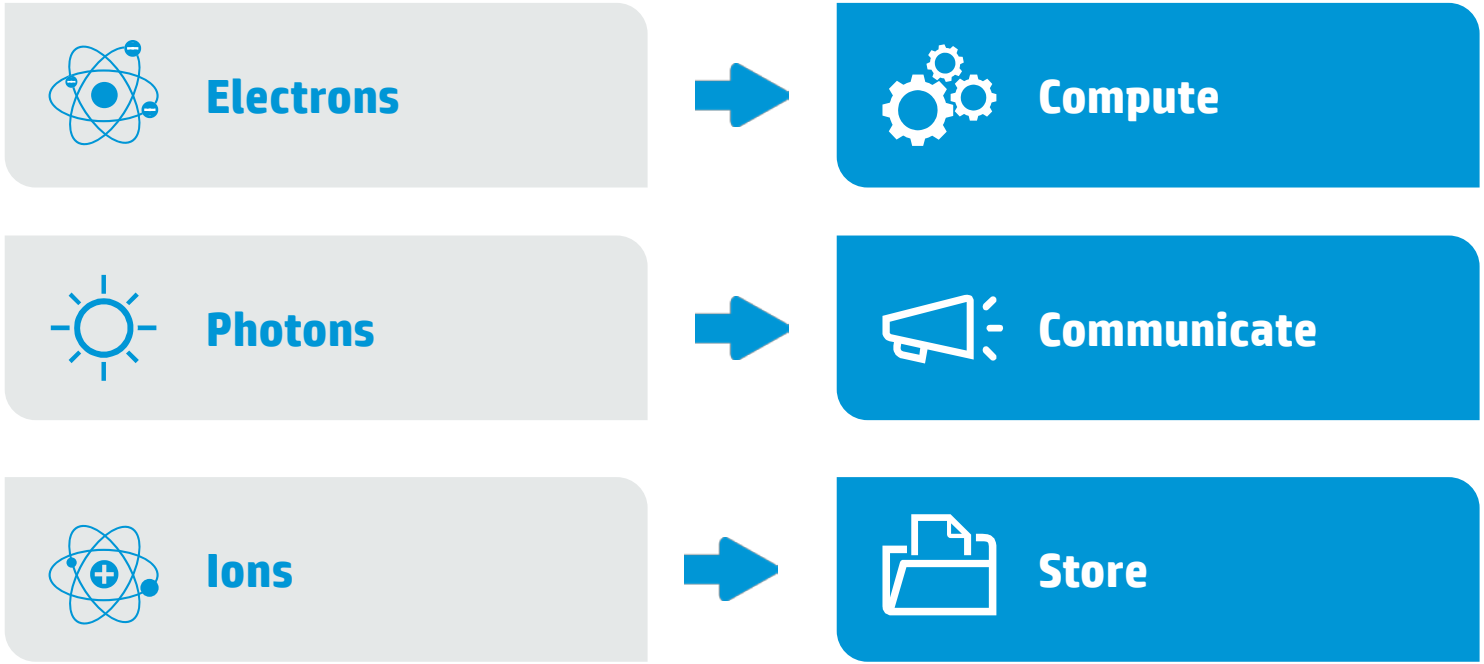
SRAM	5 seconds
DRAM	2 minutes
Flash	1 day
Hard drive	2 months
Tape	1,000 years!

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

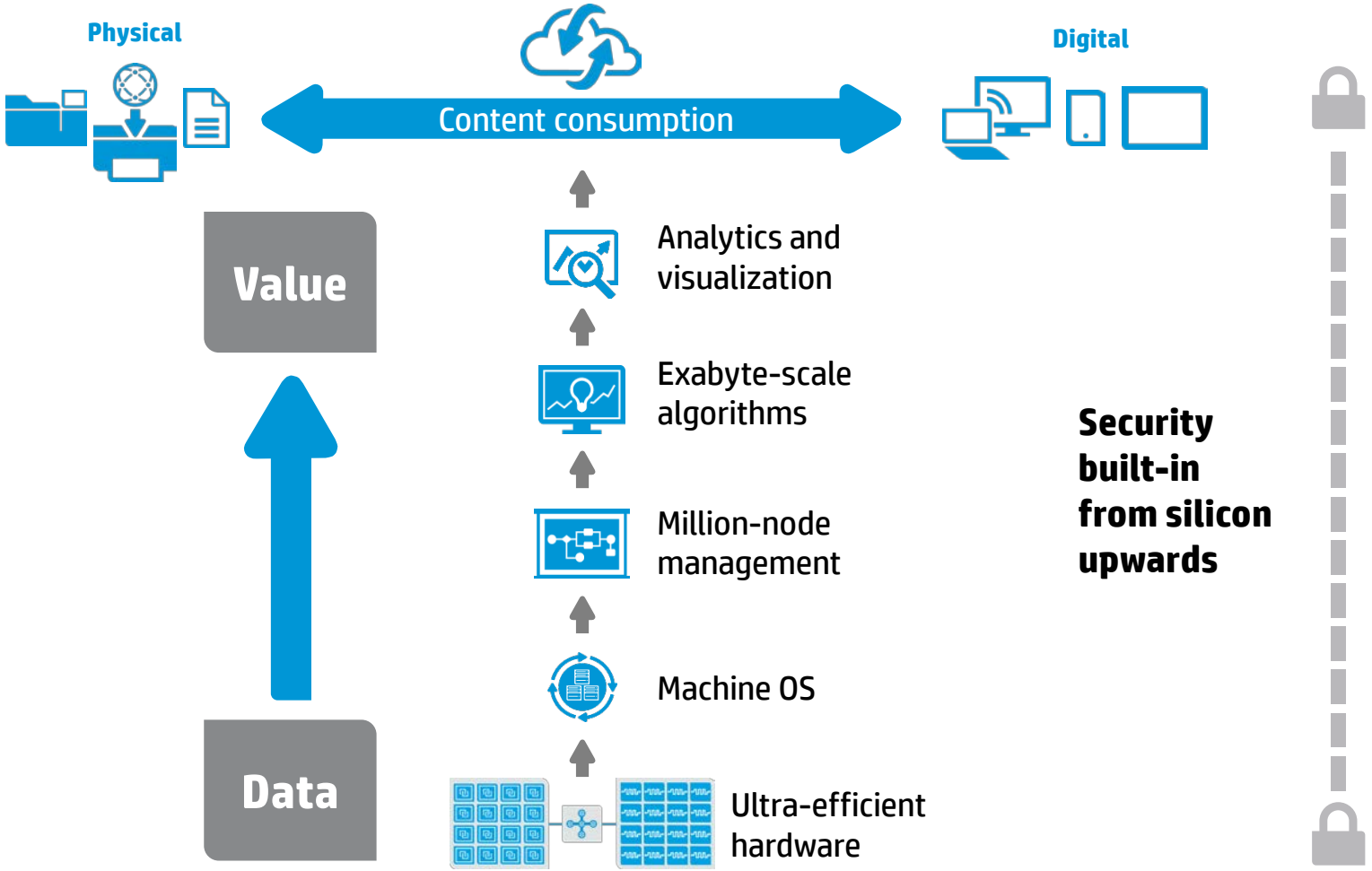


* actually an entire computer system with its own hierarchy

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

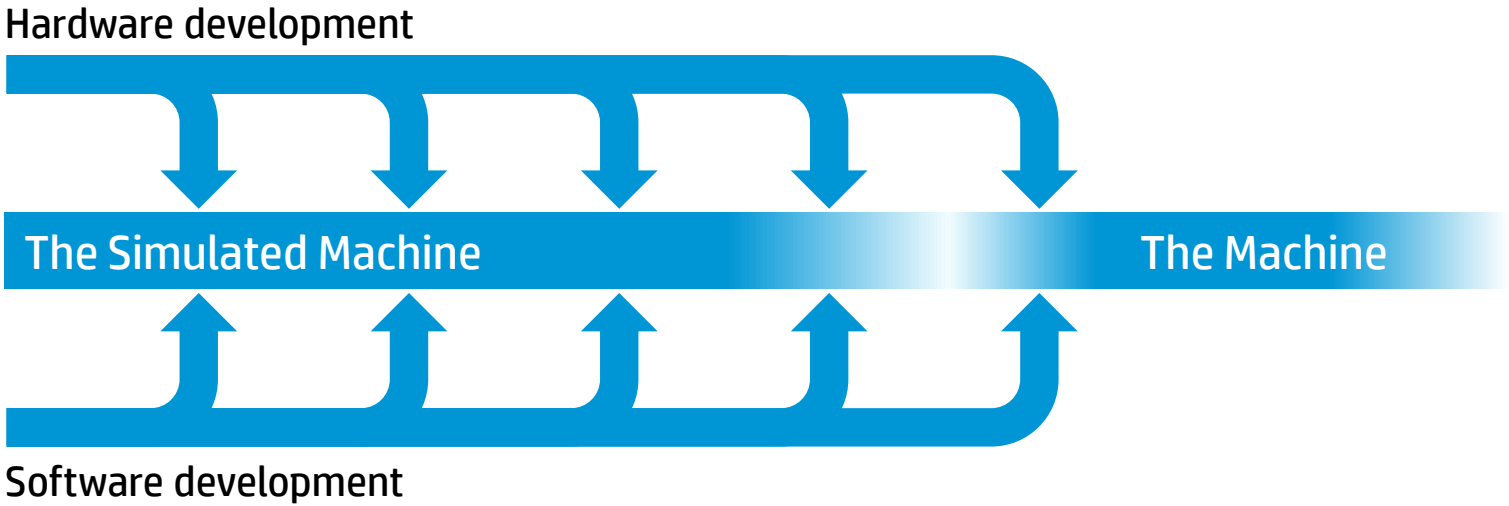


 © Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

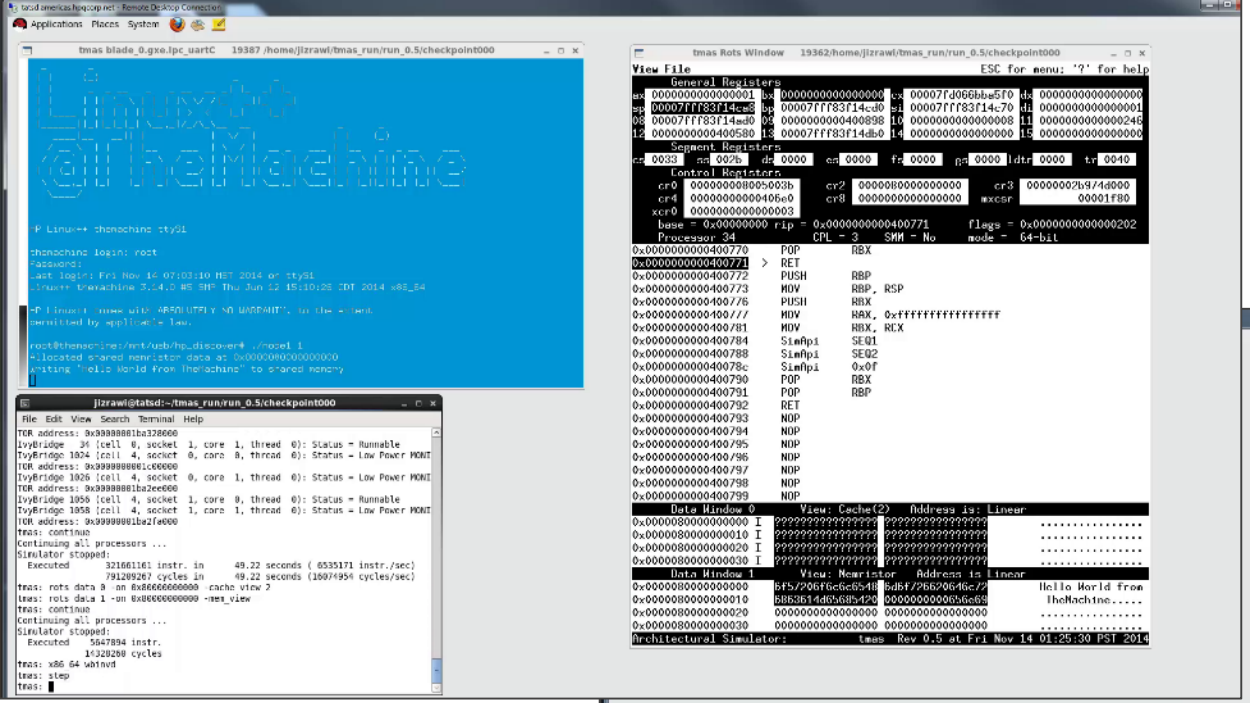


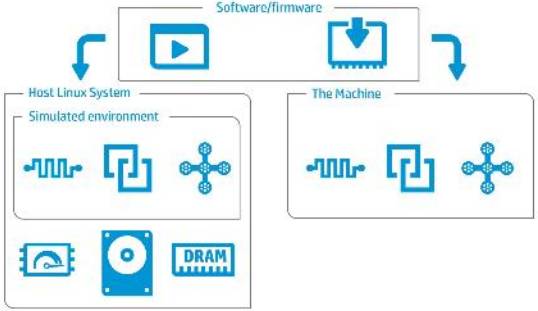
© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

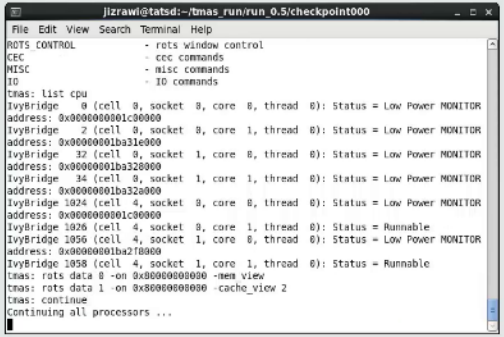
Hardware/software co-development

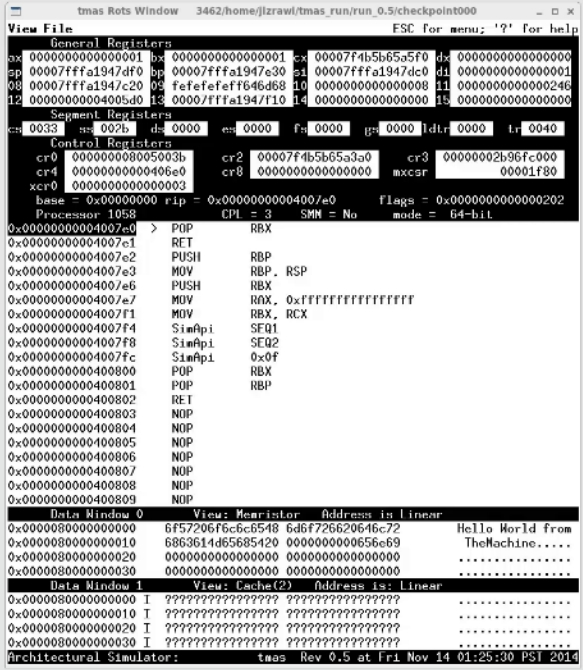


© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.


tasd.americas.hpqcorp.net - Remote Desktop Connection
Applications Places System
tmas blade_0.gxe.lpc_uartC 19387 /home/jizrawl/tmas_run/run_0.5/checkpoint000
Linux++ thenachine tty91
thenachine login: root
Password:
Last login: Fri Nov 14 07:03:10 MST 2014 on tty91
Linux++ thenachine 3.14.0 #8 SMP Thu Jun 12 15:10:28 EDT 2014 x86_64
Linux++ comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
root@thenachine:/mnt/usb/hp_discover# ./nosel 1
Allocated shared memristor data at 0x0000080000000000
writing "Hello World from TheMachine" to shared memory
jizrawl@tatsd:~/tmas_run/run_0.5/checkpoint000
File Edit View Search Terminal Help
IvyBridge 26 (cell 0, socket 1, core 1, thread 0): Status = Runnable
IvyBridge 1024 (cell 4, socket 0, core 8, thread 0): Status = Low Power MONI
IvyBridge 1026 (cell 4, socket 0, core 1, thread 0): Status = Low Power MONI
IvyBridge 1056 (cell 4, socket 1, core 0, thread 0): Status = Runnable
IvyBridge 1058 (cell 4, socket 1, core 1, thread 0): Status = Low Power MONI
tmas: continue
Continuing all processors ...
Simulator stopped:
Executed 321661161 instr. in 49.22 seconds (6535171 instr./sec)
79120267 cycles in 49.22 seconds (1607495 cycles/sec)
tmas: rots data 0 -on 0x0000000000000 -cache_view 2
tmas: rots data 1 -on 0x0000000000000 -mem_view
tmas: continue
Continuing all processors ...
Simulator stopped:
Executed 5047894 instr.
14320280 cycles
tmas: x86_64 wbinvd
tmas: step
tmas:
tmas Rots Window 19362/home/jizrawl/tmas_run/run_0.5/checkpoint000
View File ESC for menu: '?' for help
General Registers
Segment Registers
Control Registers
Processor 34 CPL = 3 SMM = No mode = 64-bit
0x0000000000400770 POP RBX
0x0000000000400771 RET
0x0000000000400772 PUSH RBP
0x0000000000400773 MOV RBP, RSP
0x0000000000400776 PUSH RBX
0x0000000000400777 MOV RAX, 0xffffffffffffffff
0x0000000000400781 MOV RBX, RCX
0x0000000000400784 SimApi SEQ1
0x0000000000400788 SimApi SEQ2
0x000000000040078c SimApi 0x0f
0x0000000000400790 POP RBX
0x0000000000400791 POP RBP
0x0000000000400792 RET
0x0000000000400793 NOP
0x0000000000400794 NOP
0x0000000000400795 NOP
0x0000000000400796 NOP
0x0000000000400797 NOP
0x0000000000400798 NOP
0x0000000000400799 NOP
Data Window 0 View: Cache(2) Address is: Linear
0x0000080000000000 I ???????????????? ????????????????
0x0000080000000010 I ???????????????? ????????????????
0x0000080000000020 I ???????????????? ????????????????
0x0000080000000030 I ???????????????? ????????????????
Data Window 1 View: Memristor Address is: Linear
0x0000080000000000 6f57206f6c6c6548 6d6f726620646c72 Hello World from
0x0000080000000010 6863614d65685420 0000000000656e69 TheMachine.....
0x0000080000000020 0000000000000000 0000000000000000 ....
0x0000080000000030 0000000000000000 0000000000000000 ....
Architectural Simulator: tmas Rev 0.5 at Fri Nov 14 01:25:30 PST 2014

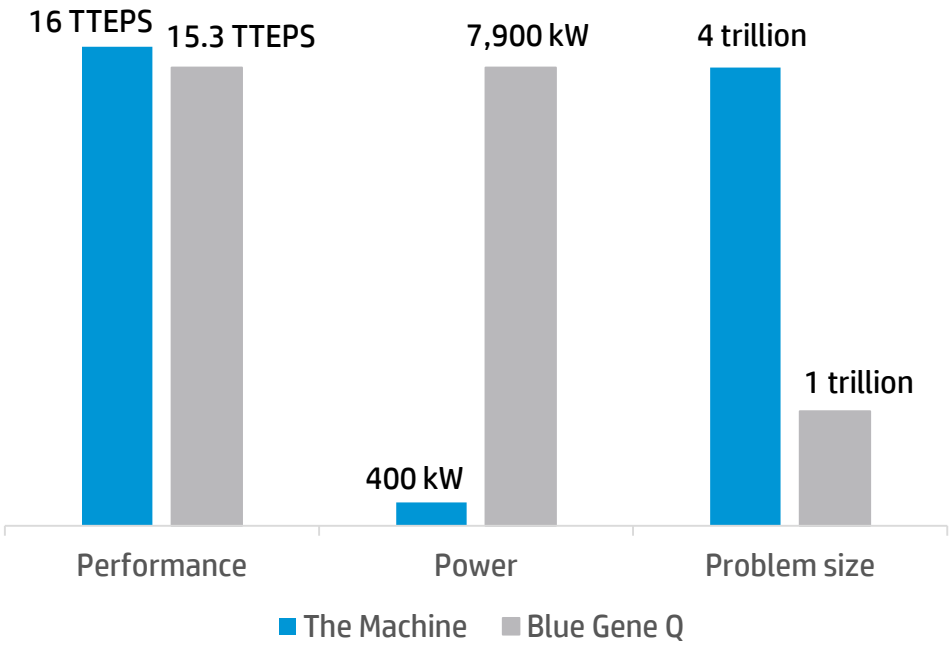

Software/firmware
Host Linux System
Simulated environment
The Machine
DRAM


jizrawl@tatsd:~/tmas_run/run_0.5/checkpoint000
File Edit View Search Terminal Help
ROTS CONTROL - rots window control
CEC - cec commands
MISC - misc commands
IO - IO commands
tmas: list cpu
IvyBridge 0 (cell 0, socket 0, core 0, thread 0): Status = Low Power MONITOR address: 0x000000001c00000
IvyBridge 2 (cell 0, socket 0, core 1, thread 0): Status = Low Power MONITOR address: 0x00000001ba31e000
IvyBridge 32 (cell 0, socket 1, core 0, thread 0): Status = Low Power MONITOR address: 0x00000001ba328000
IvyBridge 34 (cell 0, socket 1, core 1, thread 0): Status = Low Power MONITOR address: 0x00000001ba32a000
IvyBridge 1024 (cell 4, socket 0, core 0, thread 0): Status = Low Power MONITOR address: 0x000000001c00000
IvyBridge 1026 (cell 4, socket 0, core 1, thread 0): Status = Runnable
IvyBridge 1056 (cell 4, socket 1, core 0, thread 0): Status = Low Power MONITOR address: 0x00000001ba2f8000
IvyBridge 1058 (cell 4, socket 1, core 1, thread 0): Status = Runnable
tmas: rots data 0 -on 0x80000000000 -mem view
tmas: rots data 1 -on 0x80000000000 -cache_view 2
tmas: continue
Continuing all processors ...


tmas Rots Window 3462/home/jizrawl/tmas_run/run_0.5/checkpoint000
View File ESC for menu: '?' for help
General Registers
Segment Registers
Control Registers
Processor 1058 CPL = 3 SMM = No mode = 64-bit
0x00000000004007e0 POP RBX
0x00000000004007e1 RET
0x00000000004007e2 PUSH RBP
0x00000000004007e3 MOV RBP, RSP
0x00000000004007e6 PUSH RBX
0x00000000004007e7 MOV RAX, 0xffffffffffffffff
0x00000000004007f1 MOV RBX, RCX
0x00000000004007f4 SimApi SEQ1
0x00000000004007f8 SimApi SEQ2
0x00000000004007fc SimApi 0x0f
0x0000000000400800 POP RBX
0x0000000000400801 POP RBP
0x0000000000400802 RET
0x0000000000400803 NOP
0x0000000000400804 NOP
0x0000000000400805 NOP
0x0000000000400806 NOP
0x0000000000400807 NOP
0x0000000000400808 NOP
0x0000000000400809 NOP
Data Window 0 View: Memristor Address is: Linear
0x0000080000000000 6f57206f6c6c6548 6d6f726620646c72 Hello World from
0x0000080000000010 6863614d65685420 0000000000656e69 TheMachine.....
0x0000080000000020 0000000000000000 0000000000000000 ....
0x0000080000000030 0000000000000000 0000000000000000 ....
Data Window 1 View: Cache(2) Address is: Linear
0x0000080000000000 I ???????????????? ????????????????
0x0000080000000010 I ???????????????? ????????????????
0x0000080000000020 I ???????????????? ????????????????
0x0000080000000030 I ???????????????? ????????????????
Architectural Simulator: tmas Rev 0.5 at Fri Nov 14 01:25:30 PST 2014

Performance estimates – graph traversal

What could you do if you could traverse 16 trillion graph edges per second?



Graph 500-like workload

Sequoia, Blue Gene Q at Livermore

64,000 nodes, > 1M cores total

HP – The Machine

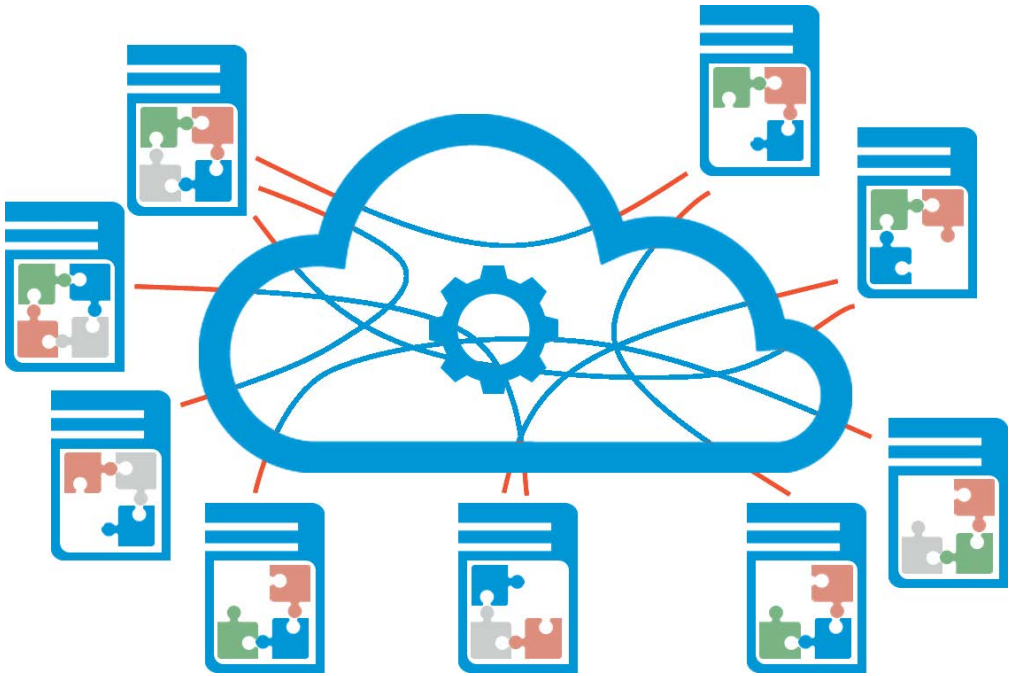
20 racks, 256 SoCs / rack, 122k cores total

256 GB NVM per SoC, 1.3 PB total

256 NICs per rack, 2*100 Gbps links / NIC

Utilization < 70%

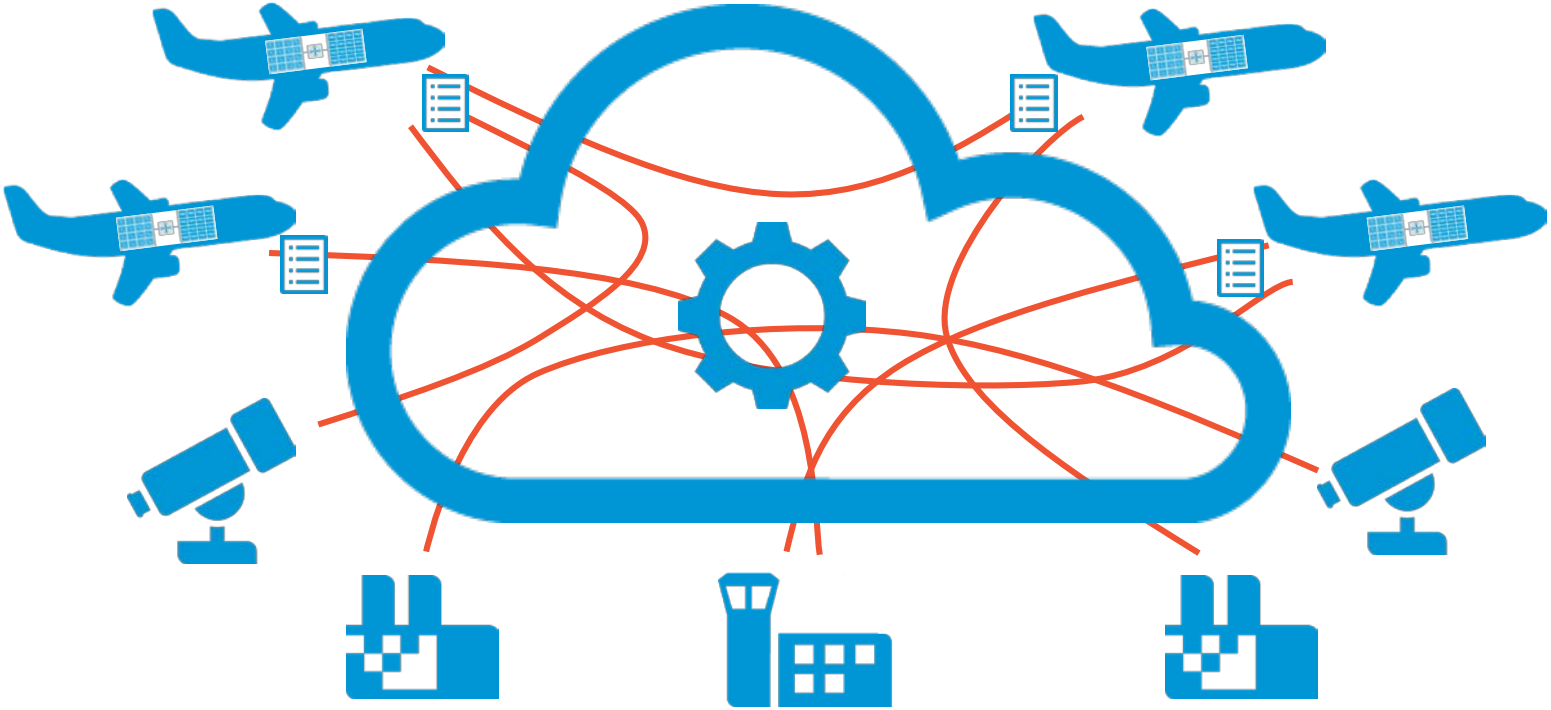
© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.



Translator
Coordinator
Orchestrator
Arbitrator
Aggregator
Replicator
Anonymizer
Border guard
Learning engine

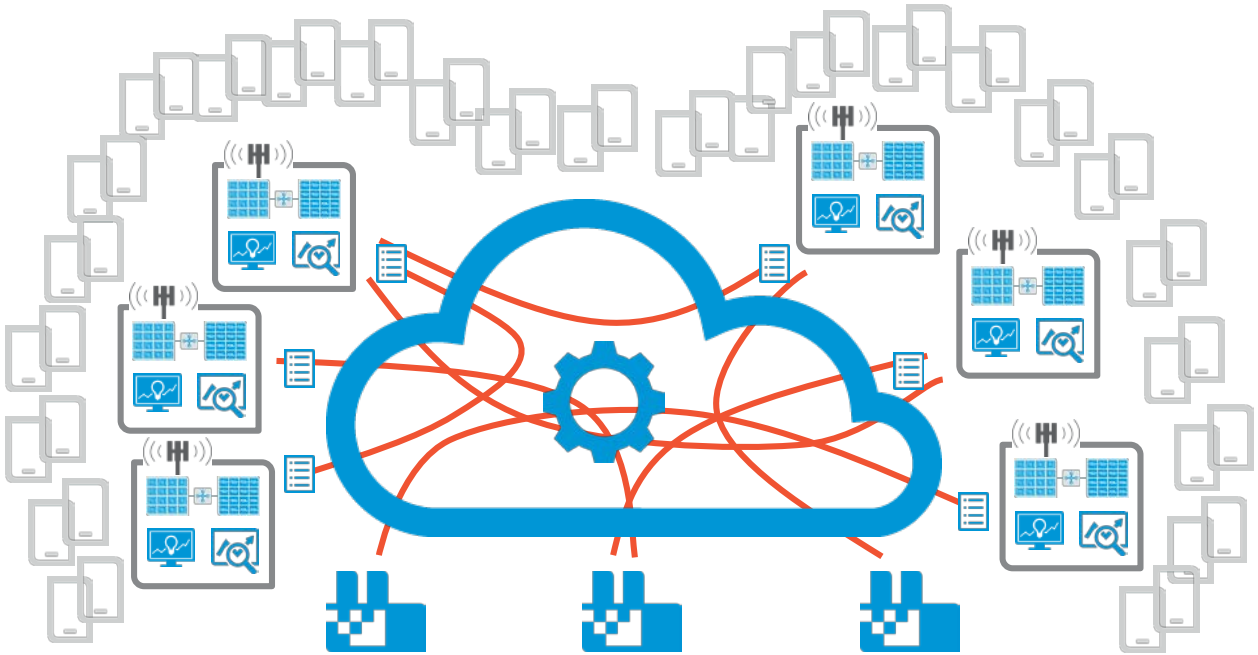
© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

A mesh of connected aircraft …



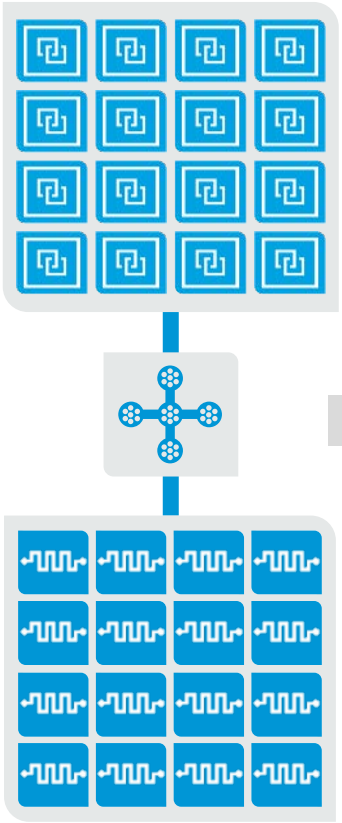
© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

Use case: the smart cell tower



© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

Future History



2014

- Memristor media controller, protocols and standards established
- SoC Partners selected for co-development
- Machine OS development begins

2015

- Memristors begin sampling
- Physical infrastructure of Core prototypes established
- Open Source Machine OS SDK and emulators released
- ISV Partner collaborations begin

2016

- Memristor DIMMs launched
- Integrated core technologies demonstrated

2017

- Edge devices begin sampling
- Machine OS enters public beta

2018

- Edge devices ship in volume
- Core Machines running real-world workloads at scale
- Machine OS released

2019

- Core devices at volume
- Machine available as product, service, and as a business process transformation

2020

- Distributed mesh cloud goes mainstream

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

This changes everything

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice.

The Machine

Resources to share with customers

The Machine External Webpage

The Machine (German) 3 min video

The Machine classic 3 min video

Memristor Lab Tour

Photonics Lab Tour

HP Analytics Lab

HP Security and Cloud Lab