The Machine
The future of technology
What can’t you ask today?
Magnitude of the data
Velocity of data
Unable to secure
Time-consuming data integration
Real-time insight needed
Insufficient resources
Growing power consumption of DC
The Past 60 Years

It’s time to rethink how computers are built
Innovation is our legacy and our future

1968
Programmable Desktop Calculator

1967
Cesium-beam atomic clock

1972
Pocket Scientific Calculator

1966
Light-Emitting Diode (LED)

1975
Standard for Interface Bus

1980
Office Laser Printer

1980
64-channel Ultrasound

1984
Inkjet Printer

1989
Digital Data Storage Drive

1986
3D graphics workstations

1999
Molecular Logic Gate

2002
Rewritable DVD for standard players

2001
Utility Data Center

2003
Smart Cooling

2008
Memristor discovered

2009
3D Photon Engine

2011
StoreOnc e

2010
ePrint

2011
3D Printing Technology

2012
OpenFlow switches

2012
Memristor

2012
StoreAll

2013
Threat Central

2013
SureStart

2014
DNS Logging Traffodion Location Awareness

2015
Distributed R

2015
HP Moonshot

1986
Commercialized RISC chips

1994
64-bit architecture

1994
Molecular Logic Gate

2001
Utility Data Center

2002
Rewritable DVD for standard players
Innovation is our legacy and our future

The Machine
From processor-centric computing... 

...to Memory-Driven Computing
The Machine

What is it?  How does it work?  Practical use cases
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!
Making the memory hierarchy obsolete

**Today**

Constant balance between cost and performance

- On-chip cache
- Main memory
- Mass storage

**The Machine**

Enabling massive data sets

- Faster
- More cost per bit

**Massive Memory Pool**

- Mass storage
  - Flash
  - Hard disk

- Main memory
  - DRAM

- On-chip cache
  - SRAM

**Universal memory**

- Faster
- Capacity
Simplicity: Fewer data layers

Database System

- Cache
- Main Memory
- Network
- Database Cache
- Filesystem Cache
- Disk

Managed Data Structures

- Cache
- Non-volatile Memory
Open Hardware + software stack

Data

- Ultra-efficient hardware
- Operating systems and programming models
- Million-node management
- Exabyte-scale algorithms
- Analytics and visualization

Insight

Security built-in from silicon upwards
How The Machine Works
The Machine in context

Shared nothing

- SoC
  - Local DRAM
  - Local NVM

- SoC
  - Local DRAM
  - Local NVM

- SoC
  - Local DRAM
  - Local NVM

Shared everything

- Physical Server
  - Coherent Interconnect
    - SoC
      - Local DRAM
      - Local NVM
    - SoC
      - Local DRAM
      - Local NVM
The Machine in context

- **Shared nothing**
  - SoC
    - Local DRAM
    - Local NVM

- **Shared something**
  - SoC
    - Local DRAM
    - Local DRAM

- **Shared everything**
  - SoC
    - Local DRAM
    - Local DRAM
    - Local NVM
    - Local NVM

Communications and memory fabric

- Network
  - Physical Server
    - Coherent Interconnect

Memory Pool

- NVM
- NVM
Fabric-Attached Memory access

Accessing Memory Across the Fabric

SoC  Bridge

256 GB DRAM

256 GB DRAM

256 GB DRAM

2-4 TB

Fabric-Attached Memory

A “Node” of The Machine
Thanks! That was way faster than conventional networking or storage. Now I can access everything in nanoseconds!
What kind of world becomes possible?
This is what we are dealing with...

<table>
<thead>
<tr>
<th><strong>HPE IT supports</strong></th>
<th><strong>300K+</strong></th>
<th><strong>6</strong></th>
<th><strong>88</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Infrastructure</strong></td>
<td><strong>Employees and contractors</strong></td>
<td><strong>Next generation data centers</strong></td>
<td><strong>Mission Critical Services</strong></td>
</tr>
<tr>
<td>41K+ servers owned by HPE IT</td>
<td>39M IP Addresses including 2 contiguous Class A’s</td>
<td>450K mailboxes managed</td>
<td>2.5B security events logged per day with HPE ArcSight</td>
</tr>
<tr>
<td>440K+ PCs deployed</td>
<td>11.5M+ Internet mails per day sent/received</td>
<td>1.2M connected devices</td>
<td>450K end points protected with anti-virus</td>
</tr>
<tr>
<td>140+ Windows Domain Controllers</td>
<td>15K+ HPN switches</td>
<td>150K+ mobile devices</td>
<td>2K+ HPE IT-managed firewalls</td>
</tr>
<tr>
<td>1,500+ enterprise HPN Routers</td>
<td>39M IP Addresses including 2 contiguous Class A’s</td>
<td>450K mailboxes managed</td>
<td>597 HPE TippingPoint IPS sensors deployed</td>
</tr>
</tbody>
</table>

- **970K+** devices scanned for vulnerabilities
Graph analytics time machine
Massive memory and fast fabrics to ingest all data

“Are there any emerging new behaviors in my network?”

Fast graph databases and the ability to look at things that change over time
### The evolution of the IoT

<table>
<thead>
<tr>
<th>Generation</th>
<th>Description</th>
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<td><strong>Gen 0</strong></td>
<td>Yesteryears</td>
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<tr>
<td><strong>Gen 1</strong></td>
<td>Today</td>
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<tr>
<td><strong>Gen 2</strong></td>
<td>Tomorrow</td>
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<tr>
<td><strong>Gen 3</strong></td>
<td>The future</td>
</tr>
</tbody>
</table>

#### Gen 0: Yesteryears
- **Things on a network**
- Still works well for small, local, custom systems with strict performance needs

#### Gen 1: Today
- **The Cloud-centric IoT**
- Good choice for low-cost “things” where data is easily moved, with few ramifications

#### Gen 2: Tomorrow
- **Edge analytics**
- Ideal for “things” producing large volumes of data that are difficult, costly or sensitive to move

#### Gen 3: The future
- **Distributed Mesh Computing**
- Multiple “things” autonomously collaborate with privacy intact
IoT: Beyond the edge

Application
Data lake

Local Hub
Gateway
Aggregator

Application
Application
Application

Network
Network
Network

Gen 2 IoT (Edge analytics)

Gen 3 IoT (Distributed mesh computing)

Trusted or untrusted cloud mediator (optional)

Hewlett Packard Enterprise
Distributed Mesh Computing

Translator
Coordinator
Orchestrator
Arbitrator
Aggregator

Replicator
Anonymizer
Border guard
Learning engine
Scale up and out simultaneously

Memory + Fabric
The Machine

1. on a Very fast fabric
 Massive Memory/Storage Pool

2. Special Purpose Cores can operate on *any* of the memory or storage on the fabric *without having to go through another core*
Fabric-Attached Memory Emulation
Code for memory-driven architecture of The Machine on a laptop

Provides a programmer’s view of fabric attached memory
– QEMU virtual machines with Linux for The Machine mimic compute nodes
– Shared memory on the host emulates Fabric-Attached Memory
– New APIs for programming Fabric-Attached Memory are included as part of Linux

Performant environment allows rapid development of prototype code for The Machine
– Allows developers to
  – Create code for The Machine architecture
  – Modify legacy code to take advantage of The Machine architecture

Find out more from http://www.labs.hpe.com/research/themachine
The Machine Architecture Simulator
Get a head start on software before hardware is available

- Instruction-level simulator that simulates The Machine hardware on standard x86 machines
- Use for developing firmware or software. Supports both x86 and ARM 64.
- To be available either as a stand-alone simulator, or as a cloud-based service
- Get started on your code to prepare for The Machine
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”
This changes everything