Server technologies in the light of accelerated computing

Dr. Roland Kunz
7.11.2023
Top strategic technology themes through 2025

**SYSTEM OPTIMIZING TECHNOLOGIES**
New processors, persistent media, fabrics and data center architectures

**CLOUD STACK EVOLUTION**
Technologies that enable intelligent workload placement across different clouds, the development of cloud native apps and disparate clouds to work as an aggregated system

**EDGE & DECENTRALIZED IT**
Technologies, system designs, frameworks and security and management tools that drive the creation of edge-centric architectures and software

**DATA MANAGEMENT**
Tools and technologies that enable a holistic approach to the data lifecycle; e.g. metadata lifecycle management, automated data catalog and data-as-a-service

**DATA SCIENCE (AI & ANALYTICS)**
Analytics and AI/ML technologies that address the growing needs of data scientists and the ecosystems they leverage

**INTRINSIC TRUST & SECURITY**
Technologies and use cases enabling security to be built into all the components and layers of a solution in an increasingly automated way for foolproof, scalable and end-to-end protection of modern, distributed architectures

**NEXT GENERATION COMMUNICATIONS**
New high-performance wireless, wired and virtualized technologies to connect Things at the Edge and Apps across the multi-cloud

**INTELLIGENT AUTOMATION & ORCHESTRATION**
Machine learning and analytics embedded into systems combined with Automation/Orchestration systems to enable self-driving, self-optimizing and auto configuring infrastructures and systems

**CITIZEN DEVELOPERS & DEVOPS**
Technologies, frameworks and toolchains that democratize and automate application development and drive innovation from across an enterprise

**AUGMENTATION**
Comprises Augmented Perceptions, Interactions and Cognition and the underlying systems that enable them

**SUSTAINABILITY**
Emerging technologies and strategies that embrace and enable sustainable products, circular economy, energy efficiency and waste reduction
Partnering on the path to a green data center

ENERGY EFFICIENT HARDWARE
Dell’s data center solutions are designed to deliver high performance per watt

PLATFORM POWER MANAGEMENT
Dell servers have built-in BIOS and iDRAC settings to help reduce energy waste

WORKLOAD MIGRATION
Dell solutions can help customers manage workloads on premise and in the cloud

RESPONSIBLE RETIREMENT
With Dell recovery and recycling services, customers can retire equipment responsibly

DC POWER MANAGEMENT
OME power manager delivers telemetry to help lower customers' carbon footprint

OPTIMIZED THERMALS
Dell designs hardware with optimized cooling and power capabilities
Reducing the carbon footprint of your IT hardware

Maximizing energy efficiency is critical to lowering Product Carbon Footprint in the data center

Key focus areas for reduction are:

1. **Energy** (Use)
2. **Materials** (Manufacturing)
3. **Packaging** (Transportation)
4. **Repairability & Upgradability** (Manufacturing & End-of-Life)
5. **Reuse & Recycling** (Manufacturing & End-of-Life)

*Results may vary based on region and energy mix*
PowerEdge portfolio 2023

Core

- Acceleration-Optimized
  - XE9680
  - XE9640
  - XE8640

- Mainstream
  - R760xa
  - R760
  - R660
  - R960
  - R860

- Modular
  - Storage Dense
    - R760xd2
  - R7625
  - R625
  - T560

- Mainstream Optimized
  - R7625
  - R6625
  - T560

Edge

- XR8000
- XR5610
- XR7620
- XR4000
- XR4000

Scale

- C6620

- MX760

- Cloud Service Providers
  - HS5620
  - HS5610

- XE9640
- XE9680
- R660
- R6615
- R760
- R760xa
- R7625
- R860
- R960
- XR7620
- XR4000
- HS5620
- HS5610

Copyright © Dell Inc. All Rights Reserved.
Industry Enabled Technologies Overview

Next Generation Intel & AMD Processors

- Intel 4th Gen Xeon (Sapphire Rapids)
  - Up to 60 cores/CPU*
  - 50% performance increase over Ice Lake
- AMD 4th Gen EPYC (Genoa)
  - Latest 5nm technology with up to 96 high-performance “Zen 4” cores
  - 1.5X & 1.25X the density and power over Milan

Memory: DDR5
- DDR5 (4800MT/s)
  - Latest DRAM technology with higher speed & bandwidth
  - Greater efficiency with 2 channels per DIMM
  - Improved RAS features with on-die ECC
  - Lower power
  - Enhanced telemetry for temperature reporting and systems management

PCIe Gen5 Capability
- Doubles throughput compared to PCIe Gen4
  - Benefits NVMe drives, GPUs, and some networking cards

EDSFF E3.S NVMe Gen5
- E3.S form factor will be introduced with PCIe Gen5 NVMe drives
  - Benefits density, thermals, and improved packaging in space constrained servers
- Double the performance over NVMe Gen4

*Max 60 cores for 4S CPUs, max 56 cores for 2S CPUs
### Dell enabled Technologies Overview

#### Next Gen HWRAID (PERC12)
- New gen controller with 2X better performance over PERC11 and 4X better than PERC10
  - Supports all drive interfaces: SAS4, SATA & NVME
  - x16 connectivity to devices to take full advantage of PCIe Gen5 throughput

#### BOSS-N1
- Segregated RAID controller for OS with secure UEFI boot that is rear facing and hot-pluggable
  - Enterprise-class 2 x M.2 NVMe devices with strong endurance and high quality that provide increased performance over BOSS-S1 with SATA drives

#### System Cooling & Efficiency
- Power Manager & Smart Cooling
- High Power Optimized Airflow chassis design to maximize air cooling capabilities
  - Support for XCC/HBM in air-cooled chassis
- Optional CPU direct liquid cooling (DLC) solutions

#### Data Processing Unit (DPU)
- SmartNIC with hardware accelerated networking and storage that enables customers to save CPU cycles
  - Improved security, running workloads and security software on different CPUs (“air gap”)
  - Offload hypervisor, networking stack, and storage stack to the DPU making them OS independent

#### System Management
- Seamless integration of new 16G servers into your existing processes and tool set
- Complete iDRAC9 support for all components
  - PERC12, BOSS N-1, PCIe Gen5 devices, UEFI Secure Boot, Smart Cooling, DPU’s, and more

#### Security
- TLS 1.3 with FIPS certification, SEKM 2.0 with support for NVMe drives and VxFrail
- End-to-end threat management with Zero Trust approach
  - Silicon-based platform root of trust, multi-factor authentication (MFA), inventory and platform component tracking during delivery, tamper protection during shipping
Future technology disjunction

Power consumption of current CPU and GPU gen increases massively (>350 / 500 Watt TDP)
Cooling will increase and need new technology (non-air cooled)
New AI and ML applications will eat up those resources

Power and Cooling of existing Datacenters almost stays the same and is often limited to ~10-15 kw/rack*
Density is not longer possible with legacy environments

Compute power required is not increasing massively for existing workloads
New methods of power management might mitigate some of the requirements
DPUs can perform some tasks at lower power consumption
Cooling

Our world class engineers designed PowerEdge servers for ultimate thermal performance.

With a new layout and high-performance fans, hot air exits the system quickly and efficiently.

- Latest Intelligent thermal algorithms minimize fan and system power consumption while maintaining component reliability
- Enables custom cooling options that can be managed via iDRAC GUI

3rd generation DLC solutions enable dense configs with high TDP CPUs

- expanding to cover more platforms, with solutions backed by Dell Services
- New 2U 4-way DLC-cooled GPU system in CY23

PowerEdge Smart Cooling Solutions

Overview

- Next generation technologies are driving power and heat higher and higher
- PowerEdge ensures no-compromise system performance through innovative cooling solutions, while also offering customers options that fit their facility or usage model needs (one size does not fit all!)

Air Cooling

- 16G delivers innovations that extend the range of air-cooled configurations
- Advanced designs - airflow pathways are streamlined within the server, directing the right amount of air to where it’s needed
- Latest generation fan and heat sinks – to manage the latest high-TDP CPUs and other key components
- Intelligent thermal controls – automatically adjusts airflow during workload or environmental changes, seamless support for channel add-in cards, plus enhanced customer control options for temp/power/acoustics

Direct Liquid Cooling (DLC)

- For high performance CPU & GPU options in dense configurations, Dell DLC effectively manages heat while improving overall system efficiency
- DLC options available for C-series, select R-series, 4S and MX platforms
- New: purpose-built liquid-cooled 2U 4-way GPU accelerator system

Edge Cooling

- New XR edge platforms deliver performance with extended temperature range support from -5°C to 55°C
### Cooling Technology Comparisons

<table>
<thead>
<tr>
<th>Cooling Solution Options</th>
<th>Air cooling</th>
<th>Air + Supplemental</th>
<th>Direct Liquid Cooling (DLC)</th>
<th>Immersion</th>
</tr>
</thead>
</table>
| **Products**             | • Traditional air-cooling & air-handling equipment  
  • Containment          | • In-row coolers  
  • Rear Door Heat Exchangers (RDHx)  
  • Containment (hot & cold aisle) | • CPU/GPU Cold-plate loops  
  • Rack/facility level DLC products required | Single-phase (1P) and Two-phase (2P) Immersion tank solutions |
| **Environments**         | Traditional data centers | Traditional data centers, with facility water | Traditional data centers, with facility water | • Non-traditional spaces, no conditioned air required (ex. - warehouse)  
  • Note: facility water required |
| **Main usage model**     | • Low to Mid-density racks  
  • Up to ~15kW/rack | • Mid to High-density racks  
  • Up to ~30kW/rack | • Systems with high TDP parts  
  • High-density racks, up to ~80kW/rack | • Limited/no air cooling available  
  • High-density racks, or high TDP parts |
| **Typical Cost Adder**   | NA | + | + + | Single phase (1P): + +  
  Two-phase (2P): + + + |
| **Availability**         | Standard cooling | Standard server cooling + 3rd party supplemental cooling solutions | Dell factory supported configurations | Dell OEM project engagement |
**Data Processing Unit**

* (DPU aka SmartNIC)

- Save CPU cycles with hardware accelerated networking and storage
- Improve security by running workloads and security software on different CPUs (“air gap”)
- Offload hypervisor, networking stack, and storage stack to the DPU making them OS independent
- Enable landlord/tenant models by isolating tenants not just with software, but also through hardware

**DPU Definition**

- DPU is a combination of ARM Cores and a NIC ASIC
  - ARM cores run an OS and applications
  - NIC ASIC has hardware accelerate networking and storage
- PCIe form factor only

**VMware ESXi 8.0 Distributed Services Engine on DPUs**

* (formerly VMware’s Project Monterey)

- PowerEdge servers will support VMware ESXi running on a DPU
- These DPUs will be fully integrated into PowerEdge systems management - DRAC, OMIVV, and OME
- This solution will be supported with VxRail
- This solution has special hardware integrations
  - A cable that provides a serial connection as well as a high-speed connection to the iDRAC (same type of connection that a LOM has)
  - In 16G support for "Always On" where the DPU can be powered on and off independently from the server. This is necessary for the DPU "landlord-tenant" model

**NVIDIA Channel DPUs**

- PowerEdge supports NVIDIA channel DPUs that will run Linux
- Channel DPUs will have limited systems management integration (i.e., the server cools the DPU)
- Channel DPUs will not support VMware ESXi
Accelerated portfolio
Gartner Hype Cycle

Hype Cycle for Artificial Intelligence, 2023

- Smart Robots
- Responsible AI
- Neuromorphic Computing
- Prompt Engineering
- Artificial General Intelligence
- Decision Intelligence
- AI/ISR
- Operational AI Systems
- Composite AI
- Data-Centric AI
- AI Engineering
- AI Simulation
- Causal AI
- Neuro-Symbolic AI
- Multiagent Systems
- First Principles AI
- Autonomic Systems

- Generating AI
- Synthetic Data
- ModelOps
- Edge AI
- Knowledge Graphs
- Cloud AI Services
- Data Labeling and Annotation
- Intelligent Applications
- Autonomous Vehicles

As of July 2023

TIME

- Innovation Trigger
- Peak of Inflated Expectations
- Trough of Disillusionment
- Slope of Enlightenment
- Plateau of Productivity
## PowerEdge.Next GPU Acceleration Server Portfolio

### PCIe Optimized

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R760XA</td>
<td>2U monolithic&lt;br&gt;2-socket Sapphire Rapids CPU&lt;br&gt;Up to 4 x double-wide GPUs&lt;br&gt;Up to 12 x single-wide GPUs&lt;br&gt;Full PCIe GPU portfolio supported&lt;br&gt;Air cooled with optional liquid cooling for CPU</td>
</tr>
</tbody>
</table>

High performance 2U server purpose built for dense PCIe GPU acceleration.

Maximize AI, HPC, VDI and performance graphics supporting multiple GPU choices.

Use cases:
- AI/ML Inferencing
- AI/ML Training
- Rendering/Perf. Gfx
- VDI

### 4-way SXM

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XE8640</td>
<td>2U monolithic&lt;br&gt;2-socket Sapphire Rapids CPU&lt;br&gt;4 x Nvidia H100 SXM NVLink GPUs (Q3 availability);&lt;br&gt;Direct liquid cooled CPUs and GPUs</td>
</tr>
</tbody>
</table>

Accelerate and automate analysis into insights.

Maximize AI initiatives performance in a 4-way GPU, 4U server.

Use cases:
- AI/ML Training
- HPC Modeling & Simulation

### 4-way Dense

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XE9640</td>
<td>6U monolithic&lt;br&gt;2-socket Sapphire Rapids CPU&lt;br&gt;8 x Nvidia H100 SXM NVLink GPUs (Q2 availability)</td>
</tr>
</tbody>
</table>

Push performance boundaries with a dense form-factor, liquid cooled approach to AI initiatives.

Smallest form factor 4-way GPU, dense 2U AI/ML/DL & HPC server.

Use cases:
- AI/ML Training
- HPC Modeling & Simulation

### 8-way SXM

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XE9680</td>
<td>8 x Nvidia A100 SXM NVLink GPUs</td>
</tr>
</tbody>
</table>

Modernize operations and infrastructure to drive new AI initiatives.

Optimized for demanding AI/Machine Learning & Deep Learning applications.

Use cases:
- Large AI/ML/DL Training
## NVIDIA GPU Portfolio

<table>
<thead>
<tr>
<th>Design</th>
<th>H100</th>
<th>A100</th>
<th>A30</th>
<th>L4</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Factor</td>
<td>SXMS</td>
<td>SXMS</td>
<td>SXMS</td>
<td>SXMS</td>
<td>SXMS</td>
</tr>
<tr>
<td>Max Power</td>
<td>700W</td>
<td>350W</td>
<td>500W</td>
<td>165W</td>
<td>72W</td>
</tr>
<tr>
<td>FP64 TC</td>
<td>67</td>
<td>51</td>
<td>134</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>TF32 TC</td>
<td>980</td>
<td>756</td>
<td>165</td>
<td>120</td>
<td>18</td>
</tr>
<tr>
<td>FP8 TC</td>
<td>3598</td>
<td>3020</td>
<td>485</td>
<td>614</td>
<td>18</td>
</tr>
<tr>
<td>GPU Memory</td>
<td>80GB HBM3 3350 GB/s</td>
<td>80GB HBM2 2000 GB/s</td>
<td>48GB GDDR6 864 GB/s</td>
<td>24GB GDDR6 300GB/s</td>
<td>16GB GDDR6 200 GB/s</td>
</tr>
<tr>
<td>Multi-Instance GPU (MIG)</td>
<td>Up to 7</td>
<td>Up to 7</td>
<td>Up to 7</td>
<td>Up to 7</td>
<td>Up to 4</td>
</tr>
<tr>
<td>Media Acceleration</td>
<td>7-JPEG Decoder, 7 Video Decoder</td>
<td>14-JPEG Decoder, 14 Video Decoder</td>
<td>1-JPEG Decoder, 5 Video Decoder</td>
<td>1-JPEG Decoder, 4 Video Decoder</td>
<td>2 Video Encoder, 2 Video Decoder</td>
</tr>
<tr>
<td>Ray Tracing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transformer Engine</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DPX Instructions</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Graphics</td>
<td>For in situ visualization (no NVIDIA vPC or RTX VWS)</td>
<td>For in situ visualization (no NVIDIA vPC or RTX VWS)</td>
<td>Better</td>
<td>Good</td>
<td>Top-of-Line</td>
</tr>
<tr>
<td>vGPU</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hardware Root of Trust</td>
<td>Internal and External</td>
<td>Internal with Option for External</td>
<td>Internal with Option for External</td>
<td>Internal with Option for External</td>
<td>Internal with Option for External</td>
</tr>
<tr>
<td>Confidential Computing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>NVIDIA AI Enterprise</td>
<td>Add-on</td>
<td>Add-in</td>
<td>Add-on</td>
<td>Add-on</td>
<td>Add-on</td>
</tr>
</tbody>
</table>

### Notes:
1. Supported on Azure NVIDIA A100 with reduced performance compared to A100 without Confidential Computing or H100 with Confidential Computing.
2. All Tensor Core numbers with sparsity. Without sparsity is 1/2 the value.
3. Includes AV1 in addition to H.265, H.264, VP9, VP8, MPEG4
## GPU Accelerators

- Accelerate demanding AI/ML, HPC, data analytics workloads for faster value extraction and collaboration for VDI
- Drive enhanced workload outcomes with greater insights, inferencing and visualization

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Memory</th>
<th>Max Power</th>
<th>Form-Factor</th>
<th>2-way Bridge Capable</th>
<th>Recommended Workloads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nvidia</td>
<td>A2</td>
<td>16 GB GDDR6</td>
<td>60W</td>
<td>SW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nvidia</td>
<td>A16</td>
<td>64 GB GDDR6</td>
<td>250W</td>
<td>DW</td>
<td></td>
<td>VDI</td>
</tr>
<tr>
<td>Nvidia</td>
<td>A40, L40</td>
<td>48 GB GDDR6</td>
<td>300W</td>
<td>DW</td>
<td>✔</td>
<td>Performance Graphics, Multi-Workload</td>
</tr>
<tr>
<td>Nvidia</td>
<td>A30</td>
<td>24 GB HBM2e</td>
<td>165W</td>
<td>DW</td>
<td>✔</td>
<td>AI Inferencing, AI Training</td>
</tr>
<tr>
<td>Nvidia</td>
<td>A100, A800*</td>
<td>80 GB HBM2e</td>
<td>300W</td>
<td>DW</td>
<td>✔</td>
<td>AI Training, HPC, AI Inferencing</td>
</tr>
<tr>
<td>Nvidia</td>
<td>H100</td>
<td>80 GB HBM2e</td>
<td>300W - 350W</td>
<td>DW</td>
<td>✔</td>
<td>AI Training, HPC, AI Inferencing</td>
</tr>
<tr>
<td>AMD</td>
<td>MI210</td>
<td>64 GB HBM2e</td>
<td>300W</td>
<td>DW - FHHL</td>
<td></td>
<td>HPC, AI Training</td>
</tr>
<tr>
<td>Intel</td>
<td>Max 1100*</td>
<td>48 GB HBM2e</td>
<td>300W</td>
<td>DW - FHHL</td>
<td>✔</td>
<td>HPC, AI Training</td>
</tr>
<tr>
<td>Intel</td>
<td>Flex 140*</td>
<td>12 GB GDDR6</td>
<td>75W</td>
<td>SW - HHHL</td>
<td>✔</td>
<td>AI Training</td>
</tr>
<tr>
<td>Intel</td>
<td>Max 1550*</td>
<td>80 GB HBM2e</td>
<td>600W</td>
<td>OAM with XeLink</td>
<td></td>
<td>AI Training</td>
</tr>
</tbody>
</table>

Not supported on R760xa
To the edge
## Accelerate anywhere

- Dell’s ‘built-for-the-edge’ server portfolio
- Short-depth to fit in field cabinets & racks (<483mm/<19”)
- Front-facing I/O to make servicing in tight spaces easier for field engineers
- Shock, vibration, dust, and thermally rated for harsh and unpredictable edge environments (MIL/NEBS)
- Dell ecosystem-enabled with iDRAC

### Monolithic

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR7620</td>
<td>• 472mm chassis 2U, 2S Intel® Xeon® Scalable Processors</td>
</tr>
<tr>
<td></td>
<td>• Supports 2 x 300W GPUs for AI at Edge</td>
</tr>
<tr>
<td></td>
<td>• GPU and CPU-optimized configurations to handle multitude of edge-use cases</td>
</tr>
<tr>
<td></td>
<td>• -5C to 55C operating temperature</td>
</tr>
</tbody>
</table>

### XR5610

- 463mm chassis 1U, 1S Intel® Xeon® Scalable Processor
- Right-sized for on-site dedicated workloads
- Telco-optimized configuration with time & sync card available
- -5C to 55C operating temperature

### XR4000

- 2U multi-node with Intel® Xeon® D
- Dell shortest-depth server at 350mm
- Nano witness-node allows for VM-cluster in single box
- Rackable, stackable, and wall-mountable for ultimate deployment flexibility
- -5C to 55C operating temperature

### XR8000

- 2U multi-node with 1S Intel® Xeon® Scalable with optional vRAN boost up to 4 nodes per chassis
- -20C to 65C operating temperature for select configurations
- Telco-optimized for DU and CU RAN deployments
- Extensible to multitude of enterprise edge use cases
Dell Edge Gateway 3200

Rich Storage
- M.2 SSD

Intel Elkhart Lake – Quad Core
- Intel Atom (x6425RE)
- Up to 32GB DDR4 memory

Optional Expansion
- CANbus
- PoE out
- 2 x Isolated Serial COM
- 2 x Isolated GbE
- DIO
- PoE in
- Sensors T, P, RH, GYRO

Front accessible I/O and Adaptive uFM module
- RS-232/422/485
- CANbus
- 2 x GbE
- 4 x USB 3
- 2 x DP++
- 2 x Serial COM
- 6-ch DI
- 6-ch DO

Security
- TPM 2.0

TARGET WORKLOADS

Manufacturing
Simplify and automate data collection at every stage of the production cycle

Telecom
Accelerate innovation and revenue growth with new services

Retail
Personalize customer experience with data insights

Smart Cities
Improve quality of life by increasing the city’s efficiency

-20°C to 60°C operating temperature
- Compact, Fan-less and Rugged Design
- WiFi-6E, Bluetooth 5.2 and Certified Dual Nano SIM 4G & 5G options
- OEM ready options
Summary & Conclusion
Accelerate Intelligent Outcomes Everywhere

- Align business and IT to a data-first culture
- Put any data to work anywhere in any way
- Achieve success at any scale as you grow
Thank You