HPC Applications Update

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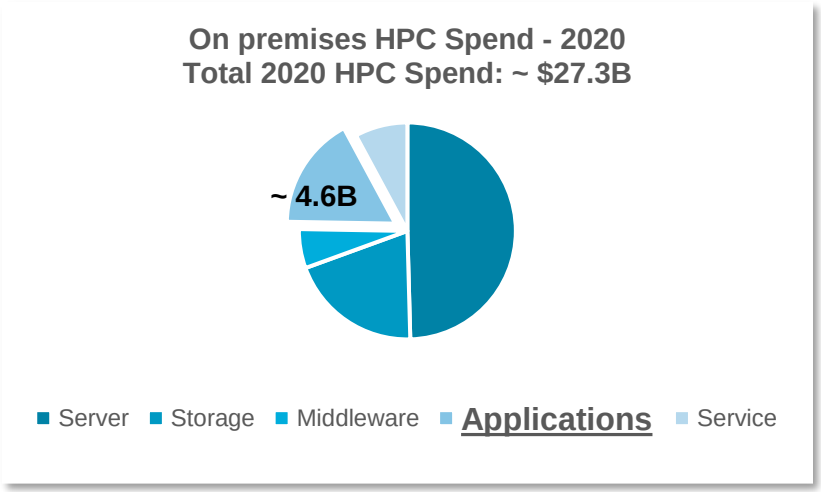
www.HyperionResearch.com
www.hpcuserforum.com

Melissa Riddle

HPC Applications Market View

Applications form sizeable broader market area



Source: Hyperion Research, 2021

- **Applications are 17% of overall broader market view spend**
- **For every $ spent on servers, an additional 34% is spent on applications**

Area ($M)	2020	2021	2022	2023	2024	2025	CAGR 20-25
Server	$13,523	$14,550	$16,947	$18,565	$19,947	$19,901	8.0%
Add-on Storage	$5,423	$5,931	$6,981	$7,835	$8,479	$8,454	9.3%
Middleware	$1,590	$1,736	$2,035	$2,244	$2,426	$2,420	8.8%
Applications	**$4,600**	**$4,913**	**$5,626**	**$6,060**	**$6,396**	**$6,353**	**6.7%**
Service	$2,146	$2,254	$2,531	$2,674	$2,767	$2,738	5.0%
Total Revenue	$27,283	$29,383	$34,121	$37,378	$40,015	$39,867	7.9%

Source: Hyperion Research, 2021

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ISV Application Growth

Modest application software budget increases are expected

- **On average, users expect application spending to increase 4% in the next year**
- **About half of MCS respondents (52%) expect application spending to stay flat**
- **In addition, ISV license revenues expected to increase due to cloud growth**
- **Most MCS respondents (77%) use ISV software for at least part of their HPC workload**
- **On average, an HPC workload consists of:**
  - 22% ISV software applications
  - 44% in-house applications
  - 34% open-source (free) applications

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Motivators for ISV Application Spending Growth

Expanding HPC resources are increasing ISV licenses

- **Demand for more differentiated resources (e.g., accelerators or specialized AI processors) is driving up the average number of HPC systems per site**
- **HPC sites are using the cloud to address expanding workloads**
  - Many HPC users value continuity between their on-prem and cloud applications but licenses in the cloud (when available) come with additional premiums
  - Code may need to be refactored to run in the cloud vs. on-prem
- **Many HPC users perceive ISV software as producing faster, more accurate results when compared to open-source applications**

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Study: Top Applications by Vertical

Many applications are critical across multiple verticals

- **HPC users were asked to list their top 3 critical applications only**
- **Large breadth of ISV applications in some verticals**
  - Government Lab, Academic/University, Other
- **Some verticals esp. favored in-house/open-source**
  - DCC & Distribution, Economics/Financial, Weather
- **Many ISVs represented across multiple verticals**
  - Ansys, FLUENT, GAMESS, Gaussian, Hadoop, LS-DYNA, MATLAB, NAMD, SAP, Spark, VASP
- **Many open-source apps also span verticals**
  - Gromacs, LAMMPS, OpenFOAM, Quantum ESPRESSO, TensorFlow, WRF
- **Programming languages frequently in top 3**
  - MATLAB, R, Python

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AI and Big Data Applications

Software used to support AI/big data spans many verticals

- **In 2021 MCS, HPC users were asked to list their top 2 successful AI/big data applications (if any)**
- **Several applications cited across multiple verticals**
  - Hadoop (CAE, EDA/IT/ISV)
  - MATLAB (Academic, EDA/IT/ISV, CAE)
  - R (Academic, CAE)
  - Python (Bio-Sciences, EDA/IT/ISV)
  - PyTorch (Academic, Government Lab)
  - TensorFlow (Academic, Defense, Government Lab)
- **Consistent with top choices for data-intensive middleware (Hadoop) and AI/ML frameworks (PyTorch, TensorFlow), and also ranked as top HPC applications overall**

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Applications in the Cloud

Applications are a notable barrier to increasing cloud use

- **In 2021 MCS, HPC users were asked to list their top 2 successful cloud applications (if any)**
- **Wide variety of responses, but a couple were commonly cited**
  - Abaqus (CAE)
  - Python (Bio-Sciences, EDA/IT/ISV, CAE)
- **Interestingly, a large number of sites stated their top cloud application was AI/ML/DL**
- **Respondents were asked to give their top 3 barriers to expanding HPC cloud use**
  - 18% cited 3rd party application costs
  - 13% cited availability of desired applications
  - 8% of respondents ranked an application issue as their #1 top barrier to increasing cloud use

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Applications as Decision Criteria

Application performance essential for on-premises purchasing decisions

- **Respondents were also asked to give their top 3 barriers to explaining HPC on-premises**
  - 16% cited 3rd party application costs
  - 13% cited availability of desired applications
- **Application performance is the top selection criterion for HPC server purchase**
  - 28% of users consider this #1 most important attribute
  - 45% of users rank in their top 3 criteria

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ISV Applications Database

Database recently updated from new survey data

- **Hyperion Research maintains ISV application/tool/software database**
  - Leaders/major/minor players by vertical
  - Leading ISV vendors
- **Recently updated from newest survey data. Ex:**
  - VASP added to university and government
  - MATLAB added to university and EDA/IT/ISV
  - Converge added to CAE

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Conclusion

Applications continue to be key to HPC decisions

- **Application performance, cost, and availability are critical for HPC decisions both on-premises and in the cloud**
- **Increasing ISV availability and accessibility in the cloud could encourage further cloud growth**
- **The definition of an HPC application is evolving**
  - ISVs, open source, in-house
  - Packaged software, middleware, programming languages
  - AI/ML/DL considered applications in their own right, and changing utilization of ISVs

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QUESTIONS?

info@hyperionres.com
mriddle@hyperionres.com

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