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REPORT ON

BENCHMARKING IN PUBLIC PROCUREMENT OF PCs

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1 EXECUTIVE SUMMARY

The Government of India (GoI) has been steadfast in driving digital transformation through initiatives such as e-Governance, the Government e-Marketplace (GeM), and GST e-invoices. These efforts have significantly amplified the demand for robust IT infrastructure, making the efficiency of Personal Computers (PC) procurement a crucial factor in ensuring seamless digital operations.

This report delves into the existing public procurement landscape for PCs in India, analysing the prevailing specification-based evaluation systems set as a basis for procurement. It highlights potential avenues for reform and underscores the pressing need for a more performance-centric procurement framework.

Currently, the procurement framework aligns predominantly with the following:

- General Financial Rules 2017 (GFR) issued by the Ministry of Finance (MoF),
- Model Technical Specifications of PCs for Ministries/ Departments (Technical Specifications 2024) issued by the Ministry of Electronics and Information Technology (MeitY), and
- The standards being set by the Bureau of Indian Standards (BIS).

These guidelines emphasize hardware specifications such as Random Access Memory (RAM), processor, operating system, display size, and capacity. Furthermore, it also mandates certain tests, classified into four primary categories: Environmental Tests, Routine Tests, Acceptance Tests, and Type Tests, each of which is further subdivided into specific subcategories discussed in the report. However, this approach overlooks key operational factors such as user experience and system responsiveness, which are critical to assess real-world efficiency. For varied use cases, aspects of cybersecurity, support costs, operational efficiency, and suitability are different.

As technology evolves and government priorities shift towards innovation, sustainability, and efficiency, the limitations of a rigid specification-based procurement approach become even more pronounced. The increasing reliance on cloud computing, as well as emerging technologies like Artificial Intelligence (AI), and Machine Learning (ML) necessitates a procurement model that can also adapt to these emerging technological trends.

The inability to compare the performance of processors from different or same manufacturers solely based on specific technical characteristics, given their distinct internal architecture, has led to the creation of performance tests known as *benchmarks*. Benchmarks are specialized programs designed to evaluate computer systems. They execute standardized tests that replicate real-world workloads, generating performance scores that reflect system responsiveness and efficiency. It simplifies decision-making by eliminating the complexity of analyzing technical specifications, allowing procurement agencies to compare standardized performance scores quickly.

The report further highlights various benefits of benchmarking, including optimum utilization of public funds, future-proofing public procurement with technological advancements, objective performance analysis, alignment with real-world tasks, and simplifying decision-making.

Different types of benchmarks are also compared in this report, such as synthetic benchmarks, component level benchmarks, system level benchmarks, and application-based benchmarks, based on their levels of performance and their compositions.

Additionally, the report delves into understanding international practices and experiences, on public procurement of PCs, adopted by select jurisdictions. The report highlights the need for multi-stakeholder consultation, potentially through a Multi-Stakeholder Working Group, which may focus on exploring the feasibility/ implications of adopting a performance-based framework and the need for developing a national benchmark by learning from international experiences that focuses on end-user experience and performance.

CHAPTER 1:
INTRODUCTION

The 21st century is shaping into a digital age, with technology becoming deeply woven into daily life, supporting human endeavours in various fields[1]. Governments worldwide are leveraging digital tools and technology for governance through the computerization, and automation of government services and processes. India has also embraced digital transformation, which is proving to be the cornerstone of its economic growth. India's digital economy is projected to reach USD 1 trillion by 2028[2], thereby contributing one-fifth of the National Income by 2029-30[3].

1.1. Government's Focus on Digitization

The Indian government is prioritizing digitalization through e-governance initiatives, bridging the digital divide, promoting innovation and startups, among other measures.

E-governance benefits administration by streamlining internal government operations; enhances service delivery by making it easier for citizens to access public services; and strengthens society by improving interactions between public agencies, individuals, and other institutions[4]. Examples of e-governance efforts from the GoI include Unified Mobile Application for New-age Governance (UMANG), DigiLocker, digitalisation of land records[5], modernizing the postal department[6], the Goods and Services Tax (GST) e-invoice system, GeM, e-Courts, Centralised Public Grievance Redress and Monitoring System, etc[7].

The GoI has recognised digital inclusion as a key pillar to achieve inclusive growth by bridging the digital divide[8]. Notably, India is the third largest digitalised country in the world in terms of economy-wide digitalisation[9]. The *Digital India* initiative, which envisions India's transformation into a digitally empowered society and knowledge economy, was allocated INR 16,461 crore in the Union Budget 2025[10]. Computerisation initiatives are also being undertaken at the grassroots level for Primary Agricultural Credit Societies (PACS), Registrar Cooperative Society (RCS) Offices, Agricultural and Rural Development Banks (ARDBs), Gram Panchayats, among others. These aim to enhance efficiency, transparency, accountability, and improving digital inclusion.

1. How India is carving out its role in the Intelligent Age, World Economic Forum (2024), available at: https://www.weforum.org/stories/2024/09/india-role-in-the-intelligent-age/
2. Report on India's Trillion Dollar Digital Opportunity Released, Ministry of Electronics and IT, PIB Mumbai (2019), available at: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1565669
3. Future Ready: India's Digital Economy to Contribute One-Fifth of National Income by 2019-30, Ministry of Electronics & IT, PIB (2025), available at: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2097125#:~:text=India's%20digital%20economy%20is%20expected,or%20manufacturing%20in%20the%20country
4. Main contributions of E-governance, IEEE (2010), available at: https://ieeexplore.ieee.org/document/5541196
5. 95% of Land Records in Rural India Digitized, PIB (2024), available at: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2068408
6. Modernisation of Postal Department, PIB (2022), available at: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1881352
7. Digital India initiatives, MeitY, available at: https://www.digitalindia.gov.in/initiatives/; and E-governance, Press Information Bureau, available at: https://pib.gov.in/Pressreleaseshare.aspx?PRID=1847837
8. The emphasis on Digital Public Infrastructure, AI and data for governance is key to achieving inclusive growth and transforming lives globally: PM India (2024), available at: https://www.pmindia.gov.in/en/news_updates/the-emphasis-on-digital-public-infrastructure-ai-and-data-for-governance-is-key-to-achieving-inclusive-growth-and-transforming-lives-globally-pm/
9. State of India's Digital Economy (SIDE) Report, 2024, Indian Council for Research on International Economic Relations (ICRIER), (page no. 17), available at: https://icrier.org/pdf/State_of_India_Digital_Economy_Report_2024.pdf
10. Notes on Demand of Grants, Budget Allocation (2025-26), MeitY, available at: https://www.indiabudget.gov.in/doc/eb/sbe27.pdf

Use of digital technology in delivering public services like education and healthcare[11] is also increasing. For instance, the Union Budget 2025 provided for setting up 50,000 Atal Tinkering Labs, implementing the Bharatiya Bhasha Pustak Scheme and the Gyan Bharatam Mission[12].

With respect to fostering research, development, and innovation in private sector particularly in deep-tech sectors, the GoI has allocated INR 20,000 crore to implement the private sector driven Research and Development (R&D) and Innovation initiative, INR 500 crore for setting-up a Centre of Excellence (CoE) in Artificial Intelligence (AI) for incorporating AI into education system and propel startups through a Deep Tech Fund of Funds[13].

PCs are integral for successful outcomes of Government missions, and computerization has become a core component of digitalisation initiatives.

PCs are integral for successful outcomes of Government missions, and computerization has become a core component of digitalisation initiatives. Also, the rapid digital transformation creates a significant demand for computing resources across ministries and public institutions. The government routinely procures PCs and other Information Technology (IT) resources for use in various departments and as a part of its computerization initiatives.

1.2. Digitization Expenses

Estimates suggest India's PC market was at an all-time high in 2024, shipping 4.49 million units[14]. Much of this demand was being driven by government procurement. India's PC market saw a 2.6% Year-on-Year (YoY) growth in Quarter 1 of 2024, driven primarily by a 56.9% surge in government procurement[15], despite a decline in enterprise orders[16].

As India accelerates its digital transformation, there is likely to be a growing expenditure on public procurement of PCs and other IT hardware. Given the magnitude of exchequer money involved in public procurement, it becomes imperative to balance multiple factors, including cost efficiency, performance suitability, and compliance with evolving technical standards of PCs.

Standardized procurement frameworks aim to ensure consistency, interoperability, and quality assurance. However, they might struggle to accommodate the diverse functional requirements across different government departments and their different day to day requirements. Therefore, a dynamic and responsive approach to public procurement may benefit India, as it will align with India's ambitious digitalization goals while ensuring optimal value for investment.

11. From Data to Diagnosis Transforming Healthcare through Digitalization, PIB, available at: https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2094604
12. Highlights of Union Budget 2025-26, PIB, available at: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2098353
13. Union Budget 2025: Centre of excellence for AI to be set up with Rs 500 crore outlay, Economic Times, available at: https://economictimes.indiatimes.com/tech/technology/union-budget-2025-centre-of-excellence-for-ai-to-be-set-up-with-rs-500-crore-outlay/articleshow/117819492.cms?from=mdr
14. India's PC Market Shipped an All-Time High of 4.49 Million Units in 3Q24, IDC Global (2024), available at: https://www.idc.com/getdoc.jsp?containerId=prAP52757324
15. India PC Market Grew 2.6% YoY in 1Q2024 with 3.07 Million Units Shipped, IDC Global (2024), available at: https://www.idc.com/getdoc.jsp?containerId=prAP52140824
16. India's PC market sees 2.6% growth in Q1 2024, driven by govt. Procurement, Ministry of External Affairs, GoI (2024), available at: https://indbiz.gov.in/indias-pc-market-sees-2-6-growth-in-q1-2024-driven-by-govt-procurement/

1.3. About the Report

Given the ongoing initiatives of the GoI towards digital transformation and innovative technologies, there is a need to shift towards fit-for-purpose high-performance PCs. This calls for modernizing existing public procurement practices of PCs, to ensure that acquired PCs support India's digital transformation objectives.

Considering the above, the report explores the current public procurement policies to check their relevance and adequacy for procuring PCs for diverse use cases. It further delves into the challenges/ risks of relying on specification-based benchmarking in PC procurement and explores the importance of benchmarking in public procurement processes. It further examines different types of benchmarks and key considerations for choosing the right benchmark in public procurement of PCs, while also drawing from international practices on PC procurement from select jurisdictions. The report concludes with recommendations for India to ensure cost-effective, performance-driven, and future-ready public procurement of PCs.

CHAPTER 2:

CURRENT PUBLIC PROCUREMENT OF PERSONAL COMPUTERS IN INDIA

India's public procurement process for PCs follows a standardised approach, which comprises of those tabulated below:

Figure 1: Summary of Existing Public Procurement Approaches in India

Existing Practices	Details
Government e-Marketplace (GeM) Procurement Practices and the General Financial Rules 2017 Framework	GeM portal is India's national procurement platform for government entities. It promotes transparency and efficiency. GFR 2017 mandates GeM usage and ensures financial discipline, integrating digital tools.
MeitY's Model Technical Specifications of PCs for Procurement by Ministries/ Departments	The Technical Specifications issued by MeitY, outline hardware requirements for three categories of PCs—entry-level, mid-level, and high-end. Parameters such as processor type, RAM, storage capacity, and display size are being covered in this.
BIS Standards	BIS PC standards cover general requirements, performance requirements, safety requirements, and compatibility requirements. Furthermore, certain testing requirements have been prescribed by the BIS for multiple purposes.

These above-mentioned approaches have been further delved into the subsequent sections.

2.1. GeM Procurement Practices and the GFR 2017 Framework

The GeM portal, managed by the Directorate General of Supplies and Disposals (DGS&D) under the Ministry of Commerce and Industry, is India's national procurement platform for government entities. It facilitates the purchase of goods and services by central and state government departments, Public Sector Undertakings (PSUs), and other government organizations. GeM was launched in 2016 with the aim of enhancing transparency, efficiency, and inclusiveness in public procurement through a fully digital, paperless, and cashless system.

However, procurement practices on the GeM portal often rely on the technical specifications. For instance, given below are the excerpts of the Bid document dated 15 July 2025, published on GeM for procuring 46 high-end desktop computers[17].

17. Bid for procurement of Desktop Computers, UIDAI, available at: https://uidai.gov.in//images/GeM_Bid_for_procurement_of_Desktop_Computers.pdf

Figure 2: Government e-Marketplace Bid for the procurement of Desktop Computers[18].

Specification	Specification Name	Bid Requirement (Allowed Values)
Processor	Base processor Number	AMD Ryzen 7 7500G, Intel Core i7 12700, NA for Higher Processor or higher
	Higher Processor Name	NA for Base Processor, AMD Ryzen 7 PRO 5750G, AMD Ryzen 7 8700GE, AMD Ryzen 7 8700G, AMD Ryzen 7 PRO 8700G, AMD Ryzen 7 PRO 9700G, AMD Ryzen 9 PRO 7495, AMD Ryzen 9 7900X3D, AMD Ryzen 9 7950X3D, Intel Coire i7 - 13700, Intel Core i7 - 13700K, Intel Core i7 - 14700, Intel Core i7-14700K, Intel Core i9-12900, Intel Core i9-12900K, Intel Core i9-13900, Intel Core i9 - 13900K, Intel Core i9-14900, Intel Core i9-14900K or higher
Motherboard	Trusted Platform Module	Discrete TPM 2.0
Operating system	Factory Pre-loaded Operating System	Windows 11 Professional
Memory (RAM)	RAM Size (Memory Card/ Module) (in GB) (Capacity to be installed in the System)	16, 32, 64 or higher
Storage	Primary Storage Capacity (in GB)	1024, 2048 or Higher
	Availability of Secondary Storage	No Secondary Storage, HDD@5400RPM, HDD@7200RPM, NVME - SSD or Higher
	Secondary Storage Capacity (in GB)	0.0, 1024.0 Or higher
Monitor	Availability of Monitor	Yes as per IS 13252 (Part 1)
	Panel Type	Twisted Nematic (TN), In Plane Switching (IPS)
	Screen Size (in CMs)	53.1 - 58 (20.91" - 22.83")
Warranty	On Site OEM Warranty (in years)	3, 4, 5 Or higher

18. Bid for procurement of Desktop Computers, UIDAI, available at: https://uidai.gov.in//images/GeM_Bid_for_procurement_of_Desktop_Computers.pdf

In this example, the bid documents contain details of *documentary specifications* (e.g., eligibility criteria, submission formats) as well as *technical specifications* [e.g., hardware configurations like processor type, Random Access Memory (RAM) size[19], and storage capacity]. However, within the document, there is no explicit information regarding the intended use of the procured computers, nor do they establish benchmarks or criteria for assessing their operational performance. No performance-based requirements are specified, and the document fails to clarify the functional purpose or expected performance standards of the acquired systems.

The GFR, administered under the Department of Expenditure, MoF, manages public finances by providing a foundational framework applicable to all central government ministries, departments, and associated bodies. It covers various aspects of government finances, including procurement, inventory management, budget formulation, and accounting. The revised GFR of 2017 integrated contemporary financial mechanisms and e-governance platforms, including the Public Financial Management System (PFMS), Direct Benefit Transfer (DBT), and e-governance platforms such as the Central Public Procurement Portal (CPPP) and GeM. The objective of the GFR is to ensure financial discipline, administrative due diligence, and accountability in the management of public funds (taxpayers' money). Rule 149 of the GFR mandates that all government departments procure goods and services from the GeM portal.

In addition to the central framework provided by the GFR, some Indian States have also introduced regulations to modify specific rules to enhance transparency in public procurement. For instance, the states of Tamil Nadu and Karnataka have enacted specific legislations—the Tamil Nadu Transparency in Tenders (Public Private Partnership Procurement) Rules, 2012, and the Karnataka Transparency in Public Procurements Act, 1999—to ensure fair and transparent procurement practices. The ultimate objective of both state legislations is to ensure that the public funds are utilized efficiently and effectively.

2.2. Model Technical Specifications of PCs for Procurement by Ministries/ Departments

The Technical Specifications (2024) issued by MeitY, outline hardware requirements for three categories of PCs—entry-level, mid-level, and high-end[20]. The specifications primarily rely on parameters such as processor type, RAM, storage capacity, and display size, as shown in the table below. While these parameters establish a baseline for technical compliance, they do not account for the diverse performance needs across various public sector applications.

19. RAM is a common computing acronym that stands for random-access memory. Sometimes it's called PC memory or just memory. In essence, RAM is your computer or laptop's short-term memory. It's where the data is stored that your computer processor needs to run your applications and open your files. Available here: https://www.intel.com/content/www/us/en/tech-tips-and-tricks/computer-ram.html

20. Model Technical Specifications of Desktop PCs, Laptop PCs and Tablets for procurement to be made by Ministries/ Departments and their agencies, MeitY (2024), available at:
https://assets-bg.gem.gov.in/resources/upload/shared_doc/model-technical-specifications-meity_om-w_43_4_202_1740044574.pdf

Figure 3: MeitY's Model Specifications[21]

Parameters	Model Specifications		
	Entry-Level	Mid-Level	High-End
Processor	Advance Micro Device (AMD) Ryzen 3 5300G/ intel Core i3 12100	AMD Ryzen 5 5600G/ intel Core i5 12400	AMD Ryzen 7 5700G/ intel Core i7 12700 or Higher
RAM	Minimum 16GB DDR4, with support for suitable slots to expand memory up to 16GB or more	Minimum 16GB DDR4, with support for suitable slots to expand memory up to 32GB	Minimum 16GB DDR4 or latest, with support for suitable slots to expand memory up to 64 GB or Higher
Memory Size	Minimum 500 GB HDD or 500 GB SSD[22] (NVMe[23])	Minimum 500 GB HDD & 500 GB SSD (NVMe)	Minimum 1 TB SSD (NVMe)

The specifications allow for RAM expansion, but other crucial aspects, such as future-proofing and diverse use cases, are overlooked.

Furthermore, the guidelines also mandate compliance with specific certifications, such as Bureau of Energy Efficiency (BEE) certification and Restriction of Hazardous Substances (RoHS) certification, ensuring energy efficiency and environmental safety in public procurement. While energy efficiency and environmental compliance are critical, an emphasis on these certifications should complement, rather than replace, performance-driven evaluation criteria. A balance is needed to ensure that government procurement not only satisfies regulatory standards, but also delivers optimal performance, longevity, and adaptability for diverse applications.

2.3. BIS Standards

The BIS has adopted specific national standards for PCs and their components, drafted by the Computer Hardware Sectional Committee (CHSC) and approved by the Electronics and Telecommunication Division Council (ETDC)[24]. The scope of these standards covers general requirements, performance requirements, safety requirements, and compatibility requirements.

Various testing requirements have been prescribed by the BIS for multiple purposes, like checking the resistance of the PCs under different climate conditions, robustness of the PCs in case of a fall/ exposure to fire, safety etc. The testing requirements have been given in the figure below. Further, it also lists specific performance requirements.

21. Model Technical Specifications of Desktop PCs, Laptop PCs and Tablets for procurement to be made by Ministries/ Departments and their agencies, MeitY (2024), available at: https://assets-bg.gem.gov.in/resources/upload/shared_doc/model-technical-specifications-meity_om-w_43_4_202_1740044574.pdf

22. Solid state drives (SSD) and hard disk drives (HDD) are data storage devices. SSDs store data in flash memory, while HDDs store data in magnetic disks. SSDs are a newer technology that uses silicon's physical and chemical properties to offer more storage volume, speed, and efficiency. However, HDDs are a cost-efficient option if you require infrequent data access in blocks of 1 MB or more at a time. Available here: https://aws.amazon.com/compare/the-difference-between-ssd-hard-drive/

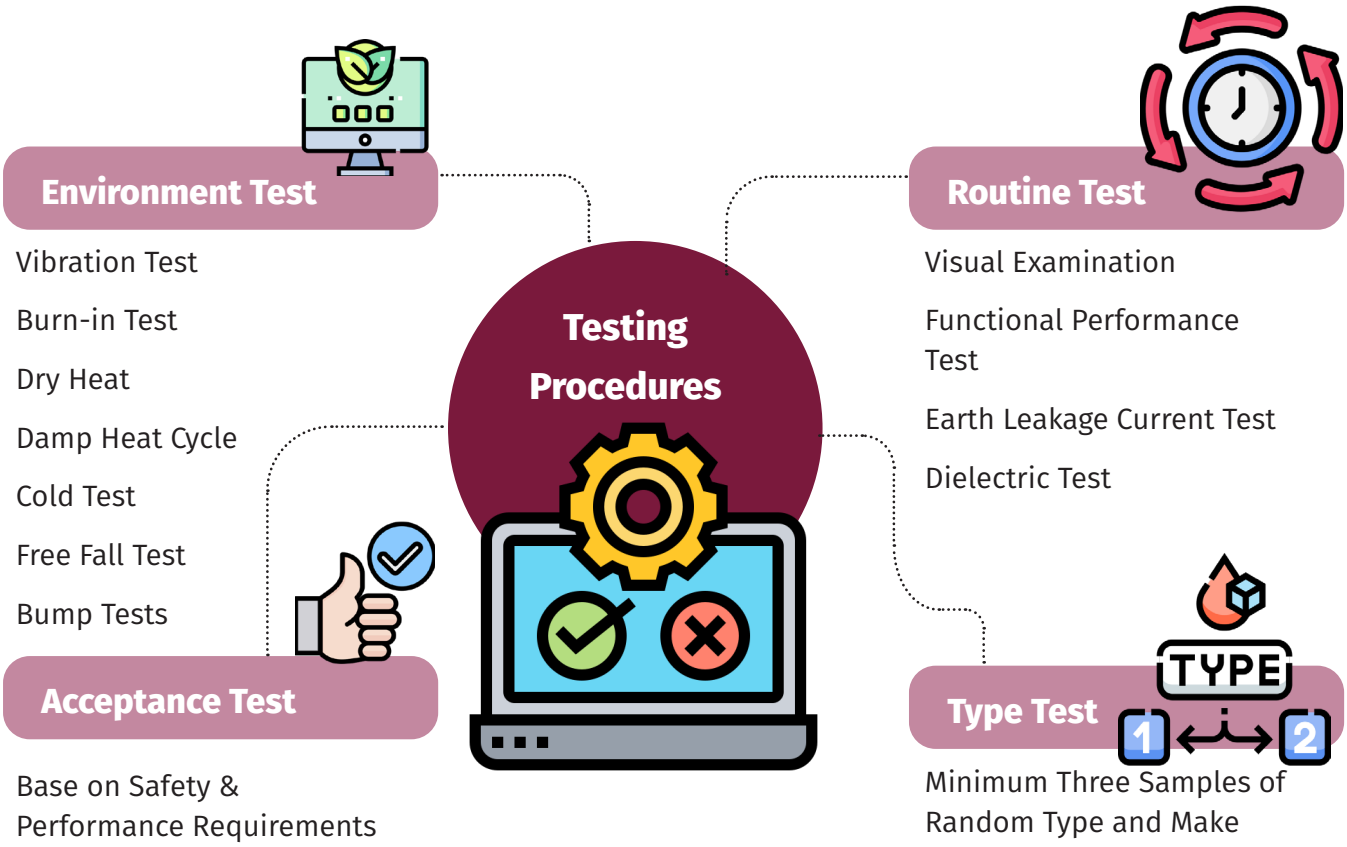
23. NVMe (Non-Volatile Memory Express) is a communications interface and driver that takes advantage of the increased bandwidth PCIe has to offer. It's designed to increase performance and efficiency while making a broad range of enterprise and client systems interoperable. NVMe was designed for SSDs and communicates between the storage interface and the system's CPU using high-speed PCIe sockets without the limitations of form factor. Available at: https://www.kingston.com/en/ssd/what-is-nvme-ssd-technology

24. BIS Indian Standard, Personal Computer: Specifications, BIS (2001), available at: https://ia600302.us.archive.org/9/items/gov.in.is.14896.2001/is.14896.2001.pdf

While the foreword of the BIS standard states that it aims to serve the public interest by assisting purchasers to obtain appropriate products best suited to their particular needs, the actual standard primarily focuses on generic performance parameters such as microprocessor type, RAM capacity, expansion potential, and clock rate. These hardware-centric criteria do not align with a usage-based procurement approach, where specifications should be tailored to the actual usage environment—for example, differentiating between PCs for basic administrative work, high-performance computing, or multimedia processing. Furthermore, these standards are dated (last reaffirmed in 2019) and yet to be updated for evolving use cases of PCs to reflect evolving use cases in digital governance, AI-driven applications, or cybersecurity needs.

Such specification-based procurement guidelines serve as a reference point for defining hardware specifications but may not always guarantee the best performance for every specific government use case. While these are aimed at streamlining the acquisition of PCs, there is a need to evolve the approach towards more performance-oriented benchmarks, tailored to the diverse requirements of different governmental functions. A one-size-fits-all strategy for computing hardware does not necessarily align with the specific requirements of every use case.

Figure 4: BIS Testing Requirements for PCs



CHAPTER 3:
NEED ASSESSMENT OF BENCHMARKING

3.1. Challenges with static specification-based public procurement

Public procurement of PCs is not merely a routine administrative process that can be undertaken without scrutiny; digital transformation needs to be responsive to evolving needs and preferences[25]. This remains amiss in the government's current technical specification-based public procurement modus operandi. The following section examines key shortcomings of the current approach and their potential implications.

Obsolescence

If newly procured PCs become obsolete prematurely, Governments will be forced to undertake the costly and time-consuming public procurement process again, wasting valuable public resources. Given that the BIS technical standards remain to be updated with the rapidly evolving use cases of PCs in the public sector, the risk of obsolescence remains a real threat in India's public procurement regime. The issue is further aggravated by the fast pace of technological upgrades in PCs/ IT hardware, necessitating agility in IT hardware procurement.

As a result, taxpayer-funded IT investments may become outdated before delivering their full value, leading to poor returns on public expenditure. *End-of-life (EOL) technology* further reduces productivity within government agencies, as outdated systems slow down operations and increase maintenance costs. Public sector employees may benefit from usage of advanced technologies, ultimately enhancing service delivery and productivity[26].

A responsive and aligned PC procurement improves the performance of the organisation[27]. Optimal upgradation of technology helps public agencies better achieve their outcomes by allowing for more efficient utilisation of limited resources[28].

25 How to create a robust digital transformation strategy, IBM (2024), available at: https://www.ibm.com/think/insights/digital-transformation-strategy

26 Unleashing productivity in government; available at, Deloitte (2024): https://www.deloitte.com/us/en/insights/industry/government-public-sector-services/government-trends/2024/releasing-untapped-government-efficiency-and-productivity.html

27 IT Alignment: What Have We Learned?, Yolande E. Chan (2007), available at: https://www.researchgate.net/publication/220220710_IT_Alignment_What_Have_We_Learned

28 Government in the digital age: Exploring the impact of digital transformation on governmental efficiency, Cunyi Yang, Mingrui Gu, Khaldoon Albitar (2024), available at: https://www.sciencedirect.com/science/article/pii/S0040162524005201

Disconnect with Diverse Use Cases

IT procurement should be aligned with the particular needs of the government department and the users[29]. 'Alignment' in this context means the degree to which the IT supports the strategic goals of the public agency[30]. Public procurement can become complex due to the federal structure of the public delivery system. Also, different government departments have different needs. Even within a department, use cases can differ between employees, as illustrated in the box below.

Figure 5: Examples of diverse use cases within Government employees

Field workers involved in data collection, like for the Census, frequently travel to remote areas and need to upload collected data to central databases. Therefore, the computing device of such field workers must be portable and have strong connectivity[31].

On the other hand, a data analyst responsible for interpreting the data and generating insights from the data collected would likely work from an office and use statistical tools and software to process large amounts of data. Thus, an analyst's computer must focus on performance and storage instead[32].

Accordingly, the procurement process must consider such differing needs, so that government employees have appropriate technology to support their work. Categorizing needs into performance classes or use cases can correspond to common usage in public administration.

Lack of flexibility in adapting to technological advancements

Computer system performance ought to be juxtaposed with rapid technological advancements and the need for differential governance. Accordingly, it becomes crucial to look beyond baseline technical metrics and consider broader capabilities of a system, including high-performance computing[33], process cores, and multi-threaded tasks. Notably, technical specifications may not always represent a PC's performance capabilities. An example has been given in the box below.

29 Organisational Agility and IT Alignment in Public Organisations, Gideon Mekonnen Jonathan, Josue Kuika Watat (2020), available at: https://www.researchgate.net/publication/343311299_Organisational_Agility_and_IT_Alignment_in_Public_Organisations

30. IT Governance Mechanisms and Administration/IT Alignment in the Public Sector: A Conceptual Model and Case Validation, Till J Winkler (2013), available at: https://www.researchgate.net/publication/261528222_IT_Governance_Mechanisms_and_AdministrationIT_Alignment_in_the_Public_Sector_A_Conceptual_Model_and_Case_Validation

31. United Nations Guidelines on the use of electronic data collection technologies in population and housing censuses, Department of Economic and Social Affairs, Statistics Division (2019), available at: https://unstats.un.org/unsd/demographic/standmeth/handbooks/data-collection-census-201901.pdf

32. US Census Bureau, Data Scientist, US Census, available at: https://www.census.gov/about/census-careers/jobs/headquarters/data-scientist.html

33. What is high-performance computing, IBM 2024, available at: https://www.ibm.com/think/topics/hpc

Figure 6: Mismatch of technical specifications with technological advancement

Clock speed, measured in gigahertz (GHz), indicates the number of cycles a processor can execute per second. While a higher clock speed can improve performance for tasks that rely on a single processing thread, it is not the sole determinant of a processor's overall efficiency[34]. Other factors such as the number of processors, cache size, and operating system, amongst others, play crucial roles in real-world performance. Moreover, higher clock speed also increases power, which adversely impacts battery life of the system, a parameter which is crucial in portable devices such as laptops. Meanwhile, a lower-clocked, multi-core processor with better efficiency can sustain high performance without excessive power consumption for extended periods.

Similarly, TOPS (Tera Operations Per Second) serve as a benchmark for AI processing capabilities, particularly in AI PCs and neural processing units. Like GHz for traditional processors, TOPS represents a theoretical maximum throughput that may not accurately reflect real-world AI performance. The actual effectiveness of AI workloads depends on factors such as memory bandwidth, data precision (INT8 vs. FP16)[35] , software optimization, and the specific neural network architectures being executed. An AI processor advertising high TOPS ratings might underperform in practical applications if it lacks efficient data pathways or encounters bottlenecks in memory access, demonstrating once again *how raw specifications can be misleading indicators of true performance capabilities.*

This highlights the lack of agility in the current public procurement metrics for PCs and questions the long-term validity of model technical specifications.

Missing parameters for comparing the performance of PCs

Agencies procuring hardware compare PCs on easily accessible specifications, such as Central Processing Unit (CPU)[36] frequency and core count, cache size, RAM type and amount, and Hard Disk Drive (HDD)/ Solid State Drive (SSD) type and capacity. While these specifications provide a framework for comparison, when put together, they do not fully capture important performance aspects which, among others, broadly include:

i. User Experience: Efficiency in user experience is particularly important in public sectors with high-pressure environments. A computer system with higher technical specifications could still deliver a poor user experience. Evaluating user experience rather than solely relying on standard technical specifications is helpful.

ii. System Responsiveness: Technical responsiveness includes boot time, application launch speed, handling multitasking etc. Such parameters become especially useful for diverse or high-end use cases, which are not duly accounted for in the current MeitY and BIS model specifications and tests.

34. What Is Clock Speed?, Intel, available at: https://www.intel.com/content/www/us/en/gaming/resources/cpu-clock-speed.html
35. What is the difference between FP16 and INT8 precision in deep learning?, Available at: https://massedcompute.com/faq-answers/?question=What%20is%20the%20difference%20between%20FP16%20and%20INT8%20precision%20in%20deep%20learning
36. A CPU, or central processing unit, is a hardware component that is the core computational unit in a server. It handles all types of computing tasks required for the operating system and applications to run. Available here: https://aws.amazon.com/compare/the-difference-between-gpus-cpus/

Cybersecurity gaps

The National Information Centre (NIC) has deployed centralised cybersecurity endpoint management tools in PCs/ laptops/ tablets across ministries/ departments to enable centralised command and control of cybersecurity. It has also prescribed certain minimum specifications for PCs, as shown in the figure below[37].

However, these specifications remain basic and reactive, leaving significant cybersecurity gaps unaddressed, such as lifecycle vulnerability management, and supply chain risk assurance amongst others. Furthermore, it is imperative to underscore that ageing systems become increasingly susceptible to cyber-attacks, which, over time, become a risk that governments cannot afford. Such cyberattacks jeopardize the confidentiality, availability, and integrity of the data processed and stored on the devices and the functionality of the devices themselves.

As technology advances, outdated hardware and software often lack the tools to counter modern cyber threats, creating significant vulnerabilities within public infrastructure. Ensuring airtight security must therefore be a non-negotiable priority. Notably, aspects of PC cybersecurity have not been touched upon in the BIS and MeitY technical specifications or tests. Adopting a zero-trust framework, conducting regular security assessments and audits, and selecting infrastructure with end-to-end encryption features are necessary to safeguard against attacks[38].

On 09 July 2025, the Indian Computer Emergency Response Team (CERT-In), under MeitY, issued a formal technical guideline pertaining to the Hardware Bill of Materials (HBOM). The introduction of the HBOM marks a shift from static, one-time specifications toward a dynamic, lifecycle-oriented approach to cybersecurity assurance, ensuring not only that devices meet minimum requirements at procurement but also that their integrity and security can be validated throughout their operational lifespan.

Figure 7: Minimum requirements for cybersecurity

Minimum specifications for PCs as an endpoint	OS: Windows Professional Edition or Linux versions
	CPU: x86 Processor i.e. Intel i5/ AMD Ryzen 5 or equivalent
	RAM: Minimum 16 GB
	Storage: SSD (no IIDD) - At least 500 GB
	Trusted Platform Module (TPM)[39] Chip required for BitLocker disk encryption

In the context of cybersecurity and supply chain risk management, the HBOM is an instrument for ensuring traceability, verifying component integrity, and maintaining compliance with relevant security, regulatory, and procurement frameworks. The technical guidelines recommend that all government bodies, PSUs, organizations providing essential services, as well as entities engaged in the manufacturing, deployment, or integration of hardware systems, institutionalize HBOM requirements as a mandatory clause within all hardware procurement and supply chain agreements.

37. Minimum specifications for the procurement of desktop/ laptop/ tablet by Ministries/ Department of the Government of India to ensure Cyber Security, available at: https://icar.gov.in/sites/default/files/Circulars/cybersecurity.pdf
38. AMD EPYC Processors Excel in Addressing Performance, Sustainability Goals, and Cybersecurity for Public Sector (2024); available at: https://www.amd.com/content/dam/amd/en/documents/epyc-technical-docs/white-papers/performance-sustainability-cybersecurity-for-public-sector.pdf
39. The Trusted Platform Module (TPM) technology is designed to provide hardware-based, security-related functions. A TPM chip is a secure crypto-processor that is designed to carry out cryptographic operations. The chip includes multiple physical security mechanisms to make it tamper-resistant, and malicious software is unable to tamper with the security functions of the TPM. Available here: https://learn.microsoft.com/en-us/windows/security/hardware-security/tpm/trusted-platform-module-overview

3.2. Need assessment and formulation of technical specifications

For diverse use cases, aspects of cybersecurity, support costs, operational efficiency, and suitability, differ. These aspects determine the PC's user productivity, return on investment, and long-term value. Notably, such aspects are touched upon in the Manual for Procurement of Goods, 2024, by the Department of Expenditure (DoE), as good principles for a procurement agency. These aspects have been discussed in the box below:

Figure 8: Good principles in DoE's Manual for Procurement of Goods

Need Assessment
■ The Manual prescribes that the Government agency procuring products first determines the need for the subject matter of the procurement.
Formulation of Technical Specifications
■ Apart from the technical specifications, it also calls for considering the qualitative and performance characteristics required to meet the bare essential specific needs of the procuring entity without including superfluous and nonessential features, which may result in unwarranted expenditure. ■ It suggests avoiding the procurement of obsolete goods and requires that all goods and materials be the most recent or current models and incorporate all recent improvements in design and materials. ■ It also emphasizes considering the efficiency of the product being procured. ■ Tender documents are required to mention the end-use of the goods required to be procured, along with the qualitative, functional, and performance characteristics/ requirements.

Such aspects have not been adequately incorporated in the MeitY and BIS public procurement requirements. Furthermore, the Manual recognises that new procurement approaches have started to evolve, especially for IT procurement.

3.3. What are Benchmarks and their Benefits

In line with the above, the inability to compare the performance of processors from different manufacturers solely based on specific technical characteristics, given their distinct internal architecture, has led to the creation of performance tests known as benchmarks.

Figure 9: What are benchmarks?[40]

Benchmarks are specialized computer programs that run on the systems under evaluation. The benchmarking program executes a series of standard tests and trials simulating particular workloads on the system and then generates a final performance score. The performance score provides a snapshot of system performance on the measured workloads, enabling an objective, data-driven comparison.

40. Circular regarding system performance benchmarks for PCs Desktop, PCs Notebook, and PCs Tablet platforms based on O.S. Microsoft Windows, Italian Digital Agency (2017), available at: https://www.agid.gov.it/sites/default/files/repository_files/documentazione/circular_regarding_the_cpu_benchmarks.pdf

Once benchmarks for specific hardware are set, comparing and reviewing them becomes easier.[41] Notably, using benchmarks is not limited to PCs but extends to various IT hardware components. Also, performance is a multi-dimensional metric, and defining benchmarks solely based on generic specifications overlooks real-world use cases.

Benefits of benchmarking

Benchmarking can unlock many benefits while choosing the right PC for public procurement. These include the following:

- **Achieving value for public funds:** Government purchases should ensure the best balance of price, performance, and energy efficiency, accounting for total cost of ownership (including maintenance and upgrades) minimizing total cost of ownership while maximizing long-term value. Such a holistic approach helps agencies better understand the long-term financial implications of t4heir purchases, guiding them to invest in technology that remains viable over time[42]. Such an approach underscores the importance of benchmarking, as standardized performance evaluations enable governments to objectively compare options and ensure optimal value, efficiency, and longevity in public technology investments.

- **Future-proofing and technological advancements:** Benchmarking encourages innovation by ensuring that the government procures up-to-date and efficient PCs that meet evolving needs. It allows agencies and vendors to supply IT hardware with the latest technological advancements, fostering innovation.

- **Objective performance evaluation:** Benchmark tests provide quantifiable data on PC performance, allowing procuring agencies to make informed decisions based on standardized metrics. Furthermore, PC performance requirements are clear, unbiased, and manufacturer-neutral, promoting fair competition among suppliers. This neutrality also supports fair competition among suppliers and encourages decisions based on performance rather than brand loyalty or marketing.

- **Alignment with real-world tasks:** Benchmarks simulate typical work environments and activities, ensuring that procured PCs meet the actual needs of end-users. Furthermore, by identifying PCs that meet performance requirements without unnecessary features, benchmarking help optimize procurement budgets, thus enabling cost-effectiveness.

- **Simplifies decision making:** Benchmarking test results enable procurement agencies to quickly compare benchmark scores instead of analyzing complex technical specifications. The clarity provided by benchmark results allows procurement teams to focus on what matters the most – performance, rather than technical specifications.[43]

Examples of benchmark tests

Below are a few common types of benchmark tests for PCs, for different purposes:

41. How to read and understand CPU Benchmarks, Intel, available at: https://www.intel.com/content/www/us/en/gaming/resources/read-cpu-benchmarks.html#articleparagraph_1327504493
42. Whitepaper on Guidelines of AI Procurement, World Economic Forum (2019), available at: https://www.nist.gov/system/files/documents/2021/08/23/ai-rmf-rfi-0039-3.pdf
43. Improving project system performance through benchmarking, PMI Global Congress 2006—EMEA Madrid, Spain, PA: Project Management Institute (2006), available at: https://www.pmi.org/learning/library/improving-project-system-performance-benchmarking-8160

Figure 10: Examples of benchmark tests

Test	Details
Business Applications Performance Corporation (BAPCo)	SYSmark and CrossMark are benchmarking tools developed by BAPCo, but they are distinct products with different purposes, methodologies, and supported platforms. SYSmark measures PC performance using real-world commercial applications. It is used for deep PC performance analysis for business[44]. CrossMark measures system performance using open-source and proprietary workloads, designed for cross-platform comparisons. It is used for quick, cross-device/system performance comparison.[45]
Procyon (UL Solutions)	Procyon (UL), a benchmark developed for various industry standards, evaluates system performance by running tasks within actual applications.[46] The Procyon suite encompasses multiple specialized benchmarks designed to assess different aspects of system performance in real-world scenarios. One key component of this suite is Procyon Office Productivity, which specifically measures how well a system handles common workplace applications and tasks. This benchmark tests performance across typical office workflows, including document processing, spreadsheet calculations, and presentation creation, providing insights into how a system would perform during everyday business operations rather than relying solely on synthetic testing scenarios.
3Dmark (UL Solutions)	Designed to assess graphics and gaming performance, 3DMark evaluates the capabilities of the Graphics Processing Unit (GPU)[47] while measuring metrics on the combined and overall performance of the system[48].
Geekbench 6 (Primate Labs)	Evaluates CPU performance using a comprehensive benchmark suite that reflects modern real-world workloads, including tasks such as augmented reality, machine learning, image processing, and web browsing. It provides separate single-core and multi-core scores, allowing users to assess the efficiency of individual CPU cores and the processor's ability to handle heavily threaded, multitasking scenarios.[49]

44. Are you getting the real picture when evaluating PCs for business use?; available at: https://www.intel.com/content/dam/www/central-libraries/us/en/documents/2023-05/are-you-getting-real-picture-evaluating-pcs-business-use-sb.pdf
45. BAPCo introduces Linux and Chrome support to CrossMark, a cross architecture performance benchmark; available at: https://bapco.com/bapco-introduces-linux-and-chrome-support-to-crossmark-a-cross-architecture-performance-benchmark/
46. Procyon benchmark suite; available at: https://benchmarks.ul.com/procyon
47. The graphics processing unit, or GPU, has become one of the most important types of computing technology, both for personal and business computing. Designed for parallel processing, the GPU is used in a wide range of applications, including graphics and video rendering. Although they're best known for their capabilities in gaming, GPUs are becoming more popular for use in creative production and artificial intelligence (AI). Available here: https://www.intel.com/content/www/us/en/products/docs/processors/what-is-a-gpu.html
48. 3DMark user Guide; available at: https://support.benchmarks.ul.com/support/solutions/articles/44002146295-3dmark-user-guide
49. Introducing Geekbench 6; available at: https://www.geekbench.com/

CHAPTER 4:
CHOOSING THE BENCHMARK

Choosing an appropriate benchmark is a crucial step in procuring relevant PCs. There are different types of benchmarks, including system-based, application-based, component-based, and synthetic benchmarks. Furthermore, standardizing the appropriate benchmark requires adhering to certain principles to ensure effective and efficient procurement.

4.1. Types of Benchmarks

Different benchmarks are categorized based on 'levels of performance' and 'composition', as described below:

4.1.1. Based on the levels of performance

Based on the levels of performance being measured, the following are the two levels:

Component-level Benchmarks

Component-level benchmarks measure the performance of specific parts, subsystems, or individual components of the computer, rather than the whole system. They test the performance of CPU, memory, graphics card, web server, disk etc[50].

Component-level benchmarks are best applicable in procurements when the objective is to optimise a particular component, such as a CPU suited for high-performance computing workload, without the variability in other components of the PCs. An example of component-level benchmarks is the "SPEC CPU® 2017" benchmark. This is a CPU-focused benchmark measuring and comparing compute-intensive performance and stressing a system's processor.[51]

System Level Benchmarks

System-level benchmarks evaluate a complete system's overall performance (response time) under predefined workloads. These benchmarks focus on understanding the interactions between different components of the PC, such as CPU, RAM, storage, GPU, and operating system.[52] This benchmark aims to simulate the experience of a real user while using the PCs. Such benchmarks take into consideration the end-user experience. An example of a system-level benchmark is PCMark 10, which measures a complete system performance for modern office requirements, such as battery life in various common scenarios.[53]

50. Different Types of Benchmarks, University of Maryland (Department of Computer Science), available at: https://www.cs.umd.edu/~meesh/411/website/projects/morebenchmarks/types.html
51. SPEC CPU® 2017 benchmark, available at: https://www.spec.org/cpu2017/
52. Different Types of Benchmarks, University of Maryland (Department of Computer Science), available at: https://www.cs.umd.edu/~meesh/411/website/projects/morebenchmarks/types.html
53. PCMark 10 — The Complete Benchmark, available at: https://benchmarks.ul.com/pcmark10

4.1.2. Based on their composition

Based on their composition, the following are the two types:

Synthetic Benchmarks

Synthetic benchmarks are created by combining basic computer functions in proportions that developers feel will yield an indicative measure of the machine's performance capabilities under test[54]. These benchmarks are best suited for initial screening or where real-world application benchmarking is not feasible.

Application Benchmarks

Application-based benchmarks reflect real-world usage scenarios and provide a reliable framework for evaluating and comparing computing devices[55]. These benchmarks reflect how a system performs for actual users.

4.2. Comparison of Benchmarks

Below is a tabular comparison of the scope, relevance, use cases, and testing approach of the two benchmarks mentioned above.

Figure 11: Comparing Synthetic Benchmarks and Application-based Benchmarks

Criteria	Synthetic Benchmarks	Application-based benchmarks
Definition	Synthetic benchmarks are designed with artificial, controlled workloads to stress specific system functions.	Application based benchmarks are based on actual applications or realistic usage scenarios that simulate typical user workloads.
Scope	Narrow and component-specific (e.g., CPU, memory, disk I/O).	Broad and system-wide, capturing real-world interactions among components.
Use Cases	Useful for testing hardware limits and comparing component performance in isolation.	Suitable for evaluating performance in practical contexts such as office productivity, media editing, or coding.
Testing Approach	It uses synthetic tasks crafted by developers and is not tied to specific applications.	Runs actual software or closely simulates usage patterns of real users across tasks.
Performance Metrics	Reports synthetic scores, often single-component scores.	Provides holistic metrics like responsiveness, multitasking efficiency, and application throughput.
Procurement Relevance	Limited—may not reflect real usage scenarios of government employees or administrative staff.	High—aligns with expected tasks in public sector environments (e.g., document processing, browsing, collaboration).

54. Different Types of Benchmarks, University of Maryland (Department of Computer Science), available at: https://www.cs.umd.edu/~meesh/411/website/projects/morebenchmarks/types.html
55. Different Types of Benchmarks, University of Maryland (Department of Computer Science), available at: https://www.cs.umd.edu/~meesh/411/website/projects/morebenchmarks/types.html

Criteria	Synthetic Benchmarks	Application-based benchmarks
Decision-making Impact	May lead to over- or under-estimation of performance in practical settings if used in isolation.	Offers a more reliable basis for procurement decisions based on fit-for-purpose evaluation.

Another important consideration when choosing a benchmark is whether it is open or closed. The difference between the two, along with their pros and cons, has been tabulated below.

Figure 12: Open versus Closed architecture of benchmarks

Criteria	Open	Closed
Definition	An open-source Instruction Set Architecture (ISA) is a freely available, publicly defined set of instructions that a computer processor can understand and execute, allowing anyone to implement and customize processors without licensing fees or restrictions.	A closed-source ISA is a proprietary, vendor-controlled blueprint that defines how a processor executes instructions, with the source code and future roadmap tightly controlled by a specific company, limiting customization and potentially vendor lock-in.
Pros	■ Increased innovation and customization ■ Lower barriers to entry for chip design ■ Potential for greater flexibility ■ Enhance technological sovereignty ■ Encourages domestic manufacturing and design ■ Benefits from economies of scale in global production	■ Established ecosystems and mature technology ■ Strong performance and software support ■ Vendor provided support ■ Robust and globally accepted ■ Proven performance in enterprise, education, and public sector workloads ■ Seamless integration with existing digital infrastructure
Cons	■ The ecosystem is still developing ■ Fragmentation can occur ■ Possible compatibility issues with mainstream software like MS Office, video conferencing, etc.	■ Limited customization ■ Higher costs ■ Vendor lock-in ■ Could be subject to geopolitical constraints and Intellectual Property (IP) restrictions
Examples	RISC-V	ARM and x86

Choosing between open and closed architecture depends on technical priorities and operational goals for specific cases or organizational structures. Open architecture suits environments requiring interoperability, scalability, and vendor independence—ideal for integrating heterogeneous systems, adopting best-of-breed solutions, or supporting hybrid and multi-cloud deployments. It enables greater customization but demands strong integration and governance capabilities. Conversely, closed architecture fits organizations prioritizing simplicity, performance consistency, and tighter security within a fully managed, vendor-provided ecosystem. While it reduces integration overhead and ensures compatibility, it may limit flexibility and increase dependence on a single vendor.[56]

4.3. Choosing the Right Benchmark

Not all benchmarks are equally effective; their relevance depends on user responsiveness and use case. The following principles must be followed while choosing the proper benchmark for public procurement of PCs.

- **Relevant and representative:** Government procurement agencies should choose a benchmark that measures performance using tests representative of the actual everyday use for which the system is intended.[57]
- **Up to date:** The most recent version of any given benchmark should be used. Good performance benchmarks are continuously updated, and new benchmarks are regularly introduced to keep pace with development and innovation in the IT industry.
- **Use of future technologies:** New IT purchases usually aim for better performance, newer technology, and forward compatibility. Accordingly, government IT purchases should prioritise state-of-the-art technologies, which are agile enough to accommodate emerging technologies.
- **Recognised and built with stakeholder input:** Procurement agencies should choose performance benchmarks openly developed and maintained by well-recognised industry consortia and/ or standardisation bodies.[58]
- **Device security and system performance:** These should form the foundational considerations. Benchmarks should assess security measures alongside system performance, ensuring that procurement decisions align with operational requirements and risk management strategies.[59]
- **Fair and open competition:** Vendor-neutral benchmarks and transparent scoring methodologies prevent biases, fostering healthy competition among suppliers and ensuring optimal value for public funds.
- **Open vs. Closed Hardware Architectures:** The choice of hardware architecture significantly impacts system performance, scalability, and procurement flexibility. When establishing benchmarks, it is essential to recognize that different architectures cannot be effectively compared based solely on select technical specifications due to their distinct operational characteristics and ecosystem maturity. For instance, x86 processors dominate the PC market with extensive software compatibility and optimization, while ARM architectures are increasingly prevalent in mobile devices and emerging in laptop computing with different power efficiency profiles. These architectural differences necessitate tailored benchmarking approaches

56. Open Architecture Defined: Advantages & When to Consider; available at: https://www.netsuite.com/portal/resource/articles/data-warehouse/open-architecture.shtml
57. The role of benchmarking in the public procurement of computer, Whitepaper, INTEL, available at: https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/role-of-benchmarks-white-paper.pdf
58. IT benchmarks: better integration of IT and business, Metrics 2024, available at: https://www.metrics.biz/en/blog-post/it-benchmarks-better-integration-of-it-and-business.html
59. IT benchmarks: better integration of IT and business, Metrics 2024, available at: https://www.metrics.biz/en/blog-post/it-benchmarks-better-integration-of-it-and-business.html

that account for varying instruction sets, memory management systems, and software optimization levels. A benchmark suite designed for x86 systems may not accurately reflect ARM performance capabilities, as each architecture excels in different computational scenarios. Therefore, organizations must select benchmarks that are either architecture-agnostic or specifically validated for their target hardware platform to ensure meaningful performance comparisons and avoid procurement decisions based on incomparable metrics across different architectural foundations.

AI Performance Benchmarking: Emerging Needs and Challenges

AI capabilities are now integral to modern computing systems, driving new performance requirements and procurement considerations.

Measuring PC AI performance introduces complex benchmarking challenges that differ from traditional CPU and GPU assessments because AI workloads span diverse tasks, each with unique requirements and evaluation criteria.

Key Differences from Traditional Benchmarks

AI performance measurement must account for much more than raw computational power or graphics throughput. Unlike CPU/ GPU benchmarks that focus on metrics like floating-point operations per second (FLOPS)[60] and frame rates, AI benchmarks need to assess:

- Model accuracy across tasks such as speech recognition or image classification.
- Latency[61] at various data precisions (FP32, FP16, INT8), which affects real-time inference speed.
- Power efficiency during sustained AI workloads, which is crucial for battery-powered personal devices.
- Support and optimization for different neural network architectures and frameworks (e.g., TensorFlow, PyTorch).

The Role of MLPerf, Procyon AI and Other AI Benchmarks

Emerging AI-specific benchmarks like MLPerf provide standardized ways to test hardware and software across a variety of AI frameworks. MLPerf tests real-world tasks including natural language processing, image recognition, and recommender systems:

- MLPerf evaluates throughput, latency, and accuracy under multiple precision levels and model architectures.
- Procyon AI is a standardized benchmarking suite developed by UL Solutions to assess the AI inference performance of CPUs, GPUs, and dedicated accelerators across Windows and Mac devices to evaluate real-world AI tasks such as image classification, object detection, and text/ image generation using multiple popular AI models and inference engines. The key focus of Procyon AI is to provide actionable metrics—like

60. FLOPS is a unit of measurement used to quantify the computing power of a computer or a processor. It measures the number of floating-point calculations that can be performed in one second. FLOPS is important in technology because it helps determine a system's computational performance. It allows us to compare the speed and efficiency of different computers and processors when it comes to handling complex mathematical calculations, simulations, graphics rendering, and machine learning algorithms. Available here: https://www.lenovo.com/in/en/glossary/flops/?orgRef=https%253A%252F%252Fwww.google.com%252F&srsltid=AfmBOoq21R328l9yBU3EKC755jd-MOU26MJtRcQ3-KsSU_7KN7GorxgZX

61. Latency refers to the delay that happens between when a user takes an action on a network or web application and when it reaches its destination, which is measured in milliseconds. This can be caused by a variety of factors and components within the network itself. Adding elements to a network can therefore increase latency. Available here: https://www.fortinet.com/resources/cyberglossary/latency

inference speed, latency, and efficiency—ensuring repeatable, comparative insights on both hardware and software AI implementations.

■ Application-centric benchmarks are also used to measure practical performance in everyday tasks such as voice assistants, photo categorization, and predictive analytics.

Challenges in Universal AI Benchmarking

AI technology is evolving rapidly, with new model architectures (such as Transformers and diffusion models) and use cases constantly emerging. This makes it difficult to establish universal metrics:

■ Benchmarks must be regularly updated to remain relevant, incorporating recent models and workloads.

■ Performance can vary dramatically depending on the specific AI task, hardware optimizations, and software stack.

■ User experiences rely not just on speed, but accuracy and energy efficiency, which are harder to quantify in a single metric.

Measuring What Matters in AI

To accurately assess AI performance in personal computing, benchmarks must focus on real-world scenarios and balance multiple metrics:

■ Use a mix of standardized and application-specific tests for diverse evaluation.

■ Consider precision, efficiency, adaptability, and practical utility as key benchmarking parameters.

■ Benchmarking should track ongoing developments in hardware (e.g., integrated AI accelerators) and software optimizations.

AI benchmarking is inherently multidimensional, requiring continuous updates and adaptable frameworks like MLPerf to remain relevant. For public procurement, integrating such benchmarks ensures that technology acquisitions keep pace with evolving workloads, deliver value for money, and support long-term innovation goals.

CHAPTER 5:

LEARNINGS FROM INTERNATIONAL PRACTICES

Benchmarking in public procurement is beginning to gain global acceptance to prioritize performance measurement, standardization, and continuous improvement in procurement efficiency. Several international practices offer valuable models for efficient, transparent, and competitive procurement. Discussed in this chapter are good international practices in this regard.

5.1. International Practices

European Union

The EU incorporates Green Public Procurement principles into procuring PCs to promote sustainability and environmental responsibility. The procurement process includes rigorous benchmarks, particularly in energy efficiency, hazardous substances, product lifetime extension, and end-of-life management.[62]

Germany

Germany's procurement policies mandate objective technical benchmarks to ensure that PCs and laptops meet the required performance standards. Germany's procurement agencies require suppliers to provide benchmark scores from industry-recognized tests. These include:[63]

- **SYSmark:** This measures PC performance based on real-world application usage.
- **PCMark 10:** A widely recognized benchmark that evaluates overall system performance.
- **PassMark CPU scores:** Used to compare processor performance across different manufacturers.

The German government also encourages segmenting procurement into different categories, ensuring that agencies procure devices based on specific needs.[64] For example:

- General-use laptops for administration must meet baseline productivity benchmarks.
- High-performance workstations for specialized tasks (e.g., data analysis, engineering) require higher computing power.

62. Revision of the EU Green Public Procurement (GPP) Criteria for Computers and Monitors (and extension to Smartphones), EU-JRC Science for Policy Report (2020), available at: https://susproc.jrc.ec.europa.eu/product-bureau/sites/default/files/2020-07/200616_Technical_Report_GPP_Computers_v2.pdf
63. Product-Neutral Tendering of Desktop PCs Guideline for Public IT Procurement, Bitkom (2022), available at: https://www.bitkom.org/sites/main/files/2023-09/ICT-Procurement-Product-Neutral-Tendering-of-Desktop-PCs-2022.pdf
64. Public Procurement in Germany: Strategic Dimensions for Well-being and Growth, OECD Public Governance Reviews (2019), available at: https://doi.org/10.1787/1db30826-en

Australia

Australia's Digital Transformation Agency promotes an outcome-based procurement model for Information and Communication technology (ICT), where agencies focus on the results they want to achieve, rather than prescribing specific hardware configurations. This encourages innovation, allowing vendors to propose cutting-edge solutions tailored to user needs.[65] Key elements of Australia's procurement strategy include:

- Prioritizing functionality over brand preferences.
- Avoiding overly prescriptive technical specifications.

Chile

Chile has adopted a coordinated procurement approach, particularly through ChileCompra, its central procurement agency. The country utilizes framework agreements to streamline the purchase of ICT equipment, ensuring a fair and competitive procurement environment. These agreements standardize equipment, categorize purchases into different performance levels, and require the inclusion of 'or equivalent' when mentioning specific brands to maintain neutrality. This approach helps prevent vendor lock-in and ensures value for money.[66] Chile has also implemented PCMark10 CPU benchmarks for processor classification, providing a neutral and transparent evaluation method that prevents reliance on subjective brand preferences.[67]

Colombia

Colombia has implemented framework agreements that involve consultation with industry stakeholders to define benchmark thresholds and technical specifications. This ensures that procurement decisions are based on objective, industry-validated performance measures such as PCMark 10, a widely used benchmarking tool for evaluating computing performance.[68]

Figure 13: Governments Using Benchmarks in Procurement

Tests	Governments Using Benchmarks in Procurement
PCMark 10 (UL Benchmarks) 3Dmark (UL Benchmarks)	France, Germany, Chile, Northern Ireland, Brazil, and the European Union are major tenders for tens of thousands of PC systems.[69]
PassMark Performance Test (PassMark Software)	Germany
SPECworkstation	European Union[70], Japan[71], United States[72]

65. Report of the ICT Procurement Taskforce, Digital Transformation Agency, Australian Government (2017), available at: https://www.dta.gov.au/sites/default/files/files/taskforce-report/ICT-procurement-taskforce-report_WCAG.pdf
66. Redesigning Framework Agreements in Chile Reduces Government Spending, available at: https://web.stanford.edu/~dsaban/chilecompra.pdf-
67. Good Practices for Procuring Computers and Laptops in Latin America- Fostering neutrality and market engagement, available at: https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/06/good-practices-for-procuring-computers-and-laptops-in-latin-america_fd40f69d/cdf11f4d-en.pdf
68. Good Practices for Procuring Computers and Laptops in Latin America: Fostering Neutrality and Market Engagement, OCED 2024, available at: https://doi.org/10.1787/cdf11f4d-en
69. Benchmarks for public sector procurement, UL Solutions, available at: http://benchmarks.ul.com/services/public-sector-procurement#:~:text=Benchmarking%20for%20procurement,of%20thousands%20of%20PC%20systems.
70. SERT® Suite, Standard Performance Evaluation Corporation, available at: https://www.spec.org/sert/
71. SPECpower® Committee, Standard Performance Evaluation Corporation, available at: https://www.spec.org/power/
72. Energy Star Program Requirements for Computer Servers, Energy Star, available at: https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%203.0%20Computer%20Servers%20Program%20Requirements.pdf

Tests	Governments Using Benchmarks in Procurement
APPmark 2018 [Business Applications Performance Corporation (BAPCo)] MobileMark 2018 (BAPCo) SYSmark	BAPCo products are used in government IT tenders in over 50 countries[73]. This includes: Argentina, Armenia, Australia, Austria, Azerbaijan, Belgium, Brazil, Canada, Chile, China, Columbia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Latvia, Lithuania, Macedonia, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Serbia, Singapore, Slovakia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Tajikistan, Thailand, Turkey, United Arab Emirates, United Kingdom and United States of America.
WebXPRT 3 [Principled Technologies (PT)]	Poland[74].

5.2. Key Learnings for India from International Good Practices

India can enhance its public procurement of PCs by shifting from rigid specification-based procurement to performance-based benchmarks. Notable principles/ good practices from the above have been given in the figure below.

Figure 14: Learnings for India

Prioritize system functionality, instead of hardware specifications

Categorize procurement requirements requirements based on specific needs

Require suppliers to **submit benchmark test reports** measuring the PC's overall performance based on real-world application usage

Incorporate benchmarks for measuring **energy efficiency, hazardous substances, product lifetime extension, and end-of-life management**

Periodic review and updating benchmarks to adapt to technological advancements

Involve industry stakeholdlers while choosing a benchmark

73. Products used in Government Tenders, BAPCo, available at: https://bapco.com/bapco-products-used-in-government-tenders/
74. Benchmark XPRT Community, Principled Technologies, available at: https://www.principledtechnologies.com/benchmarkxprt/blog/

As technology evolves, traditional specification-based procurement models risk inefficiencies, and outdated infrastructure. Benchmarking, a globally recognized tool for evaluating performance, offers a structured approach to procurement. By adopting some of these good practices that align with the needs of India's digital growth journey, India can modernize its public procurement framework for PCs, enhance efficiency, drive innovation, and ensure long-term cost-effectiveness and sustainability (i.e., promote environmentally responsible procurement).

5.3. Developing an Indian Benchmarking Framework

While international procurement benchmarks provide valuable insights, India should consider developing its context-specific benchmarking framework for public procurement of PCs. This requires balancing performance, cost-effectiveness, sustainability, and domestic industry support.

This requires a structured approach—one that integrates international practices while accounting for local market dynamics and institutional capacities. Many of these benchmarks are developed for Western markets, often prioritizing high-end hardware that may not align with India's procurement needs, particularly regarding affordability and scalability.

Developing a benchmarking standard for India's public procurement of PCs requires a structured and adaptable approach. To ensure efficiency, transparency, and alignment with India's technological and economic landscape, the following approach can be adopted:

i. Defining Benchmarking Objectives: The first step is establishing clear procurement objectives, ensuring that the benchmark aligns with India's digital priorities. This includes identifying key performance parameters such as energy efficiency, processing power, longevity, and cost-effectiveness. The framework should prioritize flexibility, allowing for procurement decisions that cater to diverse government needs, from basic administrative tasks to high-performance computing.[75]

ii. Selecting and Customizing Benchmarking Tools: A practical approach would be to adopt select internationally recognized benchmarks as the foundation and then build additional India-specific requirements on top of then. To strike the right balance between relevance and feasibility, India can adopt a layered benchmarking strategy—using widely accepted international tools for core evaluation (e.g., Procyon for regular usage, Cinebench for high-performance needs) and overlaying them with India-specific criteria such as affordability, energy consumption in Indian environments, after-sales service support, and lifecycle costs. Such an approach of leveraging established international benchmarks reduces both the time and cost of operationalizing a performance-based procurement framework, while ensuring flexibility to accommodate India's specific use cases.

iii. Institutionalizing Governance and Implementation: A dedicated government working group under the MeitY or BIS should oversee the benchmarking process. This working group must ensure neutrality, conduct periodic reviews, and update the benchmarks to reflect technological advancements. Engaging industry stakeholders, academia, and procurement agencies in this process will help maintain transparency and prevent vendor lock-in.

75. Best Practice in Benchmarking Reporting to Cabinet Office and HM Treasury Government Project Delivery Framework, Infrastructure and Project Authority, (Pg 24), available at: https://assets.publishing.service.gov.uk/media/60f02c5ee90e0764d0ab7d37/1176-APS-CCS0421465542-001_Best_Practice_in_Benchmarking_Web.pdf

iv. **Testing, Validation, and Iteration:** The benchmarking framework should undergo pilot testing in select government agencies before full-scale implementation. This phase will help evaluate its effectiveness, identify gaps, and allow iterative refinements. Feedback from procurement officers, IT professionals, and independent auditors should be integrated to improve the framework before wider adoption.

v. **Longevity and future-readiness:** AI and ML have become integral to business operations across a wide range of industries. These technologies are increasingly leveraged to extract patterns and insights that may not be readily apparent to human analysts. In particular, AI and Deep Learning (DL) models demonstrate higher accuracy when trained on large, diverse datasets. This dependence on data drives demand for high-capacity storage systems, low-latency networking infrastructure, and high-performance PCs to maximize the value extracted from data assets. As technologies evolve, benchmarking methodologies must also adapt, focusing on metrics, scalability and workloads, most representative of AI and ML environments. Maintaining alignment with emerging architectural trends and data growth patterns is essential for future-ready infrastructure planning.

CHAPTER 6:
WAY FORWARD

As India aims to become *Viksit Bharat*, optimizing public procurement through international good practices can play a key role in building a digitally empowered nation. Various jurisdictions have successfully implemented benchmarking tools to enhance procurement efficiency. India can adapt to some of these approaches to best suit its governance framework, ensuring a more dynamic, performance-driven procurement model that aligns with its aspirations of transitioning towards a digital economy. To achieve this, it is recommended that a structured mechanism for implementing benchmarking-based procurement be established.

6.1. Considerations for benchmarking-based procurement of PCs

Measures that can foster a digitally empowered society with efficient, sustainable and highly performing public sector IT infrastructure may include the following:

i. Updating Public Procurement Standards: Regularly updating procurement standards for PCs to reflect technological advancements, in parallel with emerging trends in AI, cloud integration, and high-speed solutions. Incorporating security benchmarks and compliance checks into PC procurements is necessary to ensure devices meet cybersecurity standards.

ii. Establishing Clear Use-Cases: Defining entry-level, mid-level, and high-end PC categories based on government use cases shall help narrow down the requirements and needs of the procurement. Alignment of procurement guidelines with specific workload and performance needs is better than relying on hardware specifications.[76]

iii. Sustainable and Energy-Efficient IT Infrastructure: Multinational organizations and nations worldwide are realizing the pressing need to conserve at every step of business. Mandating compliance with BEE certifications and RoHS standards will aid energy efficiency and sustainability in government IT purchases[77]. Adopting low-power and high-efficiency computing solutions shall reduce government energy consumption and operational costs, while supporting environmental goals.

iv. Transparency in Government IT Procurement Process: The government has already streamlined its e-marketplace procurement process on the GeM platform. The platform promotes transparency within the procurement process through e-tendering, reverse auctions, and real-time evaluations. Real-time benchmarking assessments can be added to the selection process. This should also improve the clarity of procurement guidelines by having well-defined selection criteria based on performance, use cases, and long-term value.[78]

76. Working Paper on Public Procurement in India: Assessment of Institutional Mechanism, Challenges, and Reforms, NIPFP (2017), available at: https://www.nipfp.org.in/media/medialibrary/2017/07/WP_2017_204.pdf
77. Working Paper on Public Procurement in India: Assessment of Institutional Mechanism, Challenges, and Reforms, NIPFP (2017), available at: https://www.nipfp.org.in/media/medialibrary/2017/07/WP_2017_204.pdf
78. Advance Procurement (Policy & Procedures based on GFR, GeM & E-Procurement), Strategic Sourcing, Cost Reduction Techniques & Contract Management: Navigating Solutions to Present & Future Challenges, IICAF(2020), available at: https://iica.nic.in/images/Fothcoming_Program-24/Detailed_Program_17-20_Feb_2025.pdf

v. Future-Ready Procurement and AI Integration: As organizations embrace AI to enhance their operations, improve decision making and innovate, AI is emerging as a cornerstone of forward-thinking organizations[79]. Given the growing integration of AI capabilities into mainstream systems, benchmarking tools shall also evolve to include performance measurement for AI-specific use cases such as on-device inference, automated data processing, and AI-augmented productivity tools. This is essential to ensure that procured systems remain relevant and capable as AI becomes integral to governance and service delivery. Structured procurement processes will accommodate future technological advancements to remain relevant and upgradable.

6.2. Multi-stakeholder Working Group

For studying the aspects mentioned above, it becomes imperative for the Government to initiate a dialogue among key stakeholders that can contribute to defining standardized benchmarking criteria and procurement frameworks. Forming a multi-stakeholder working group would be helpful in this regard. The following contours may be specified for such a working group.

- **Central benchmarking working group:** The Government should constitute a central benchmarking working group under the MeitY, in coordination with the BIS.

- **Composition:** The working group should comprise representatives from:

  - **Government:** Procurement teams (including PSUs), NIC, Center for Development and Advanced Computing (C-DAC), DoE, DPIIT, BIS, MeitY and GeM.

  - **Industry:** Manufacturers of PCs, chipset manufacturers and other IT hardware (domestic and foreign), as well as industry associations.

  - **Academia and research institutions:** Two categories may primarily be explored. One with technical expertise in benchmarking IT hardware, and the other with a forte in working on public procurement.

- **Objectives:** The working group may be tasked with assessing the need for updating existing procurement standards and deliberating on the need to develop national technical benchmarks for the public procurement of PCs.

- **Scope:** The following aspects should be considered while choosing the right benchmarking process for India.

  - **Undertake a needs assessment:** Basis analysis of public procurement of PCs in the past few years, for various purposes, by different Government agencies, the working group should develop an assessment grid of the common needs of procurement, procurement trends, pricing, models, and user feedback, which will help assess the efficacy of the current procurement modus operandi.

  - **Assess good international practices:** The holistic assessment of international public procurement practices of IT hardware, and the adoption of benchmarking therein needs to be studied, especially from the lens of adaptability and suitability to the Indian context.

  - **Choose between system level versus component level benchmarks:** This would require an assessment of the scope of procurement and the intended use, i.e., general or special purpose PCs, application and workload of the PCs for the intended use cases etc.

79. Accelerate Your Organization's AI Strategy by Deploying High-Performance AI PCs (2025), available at: https://www.amd.com/content/dam/amd/en/documents/products/processors/business-systems/accelerate-your-orgs-ai-strategy-by-deploying-high-performance-ai-pcs.pdf

- **Choose between open and closed architecture:** This may be evaluated based on end-use, i.e., to be used in mainstream public service PCs or in pilot programs, R&D, and strategic domains; level of sovereignty and strategic autonomy required; performance; compatibility with existing ecosystem; cost; level of security requirements; among others.

- **Evaluate existing benchmarks:** The many different types of benchmarks discussed in the previous chapter remain to be assessed for the Indian context. Given that each has their own merits and demerits, a careful examination and use-case based testing needs to be undertaken to check their adaptability with the objectives of public procurement of PCs.

- **Harmonization with international benchmarking practices:** While India develops its benchmarking standard, there is a need to enhance and harmonize the IT and hardware product procurement practices with the international benchmarking standards.

- **Wider public consultation:** The findings of the working group should be captured in a report/ discussion paper, which is open to public consultation.

6.3. Conclusion

The current procurement model relies on rigid technical specifications, and fails to keep pace with rapid technological advancements, diverse operational needs, and evolving cybersecurity challenges. This leads to inefficiencies, premature obsolescence, and procurements that do not fully align with the strategic objectives of government agencies. By embedding performance-oriented benchmarking in procurement strategies, India can ensure its IT infrastructure is future-ready, aligned with digital governance objectives, and capable of enhancing public service delivery while strengthening the nation's technological resilience.

APPENDIX

A.1 List of Figures

A.2 List of Abbreviations

Abbreviation	Full Form
CPU	Central Processing Unit
DBT	Direct Benefit Transfer
DEA	Department of Economic Affairs
DGS&D	Directorate of General Supplies and Disposals
DoE	Department of Expenditure
EoDB	Ease of Doing Business
EOL	End of Life
ETDC	Electronics and Telecommunication Division Council
EU	European Union
FY	Financial Year
GB	Gigabyte
GeM	Government e-Marketplace
GFR	General Financial Rules
GHz	Gigahertz
GOI	Government of India
GPU	Graphics Processing Unit
GST	Goods & Services Tax
HDD	Hard Disk Drive
ICT	Information and Communication Technology
INR	Indian Rupee
IP	Intellectual Property
IT	Information Technology
ISA	Instruction Set Architecture
MeitY	Ministry of Electronics and Information Technology
MoF	Ministry of Finance
NIC	National Information Center
OS	Operating System
PACS	Primary Agricultural Credit Societies
PC	Personal Computer
PFMS	Public Financial Management System
PSU	Public Sector Unit
RAM	Random Access Memory
RCS	Register Cooperative Society
R&D	Research and Development
RoHS	Restriction of Hazardous Substance
SPV	Special Purpose Vehicle
SSD	Solid State Drive
TPM	Trusted Platform Module
UMANG	Unified Mobile Application for New-age Governance
UNOPS	United Nations Office for Projected Services
USD	United States Dollar
YoY	Year over Year

Abbreviation	Full Form
RCS	Register Cooperative Society
R&D	Research and Development
RoHS	Restriction of Hazardous Substance
SPV	Special Purpose Vehicle
SSD	Solid State Drive
TPM	Trusted Platform Module
UMANG	Unified Mobile Application for New-age Governance
UNOPS	United Nations Office for Projected Services
USD	United States Dollar
YoY	Year over Year

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