Translation

The following document is a Chinese government industrial policy for the near-term development of computing power. The plan urges the expansion of compute in China, particularly of supercomputing and "intelligent compute" optimized for AI applications. But the policy also emphasizes improving the energy efficiency and lowering the carbon footprint of computing power infrastructure such as data centers. An appendix includes various compute-related metrics for China to strive for in 2023, 2024, and 2025.

Title
Action Plan for the High-Quality Development of Computing Power Infrastructure
算力基础设施高质量发展行动计划

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Action Plan for the High-Quality Development of Computing Power Infrastructure

Computing power ("compute") is a new productive force (新型生产力) that integrates information computing power, network carrying capacity (网络运载力), and data storage capacity. It mainly provides services to society through compute

[1] Translator's note: The Office of the Central Cyberspace Affairs Commission is effectively the same organization as the Cyberspace Administration of China (CAC; 国家互联网信息办公室; 国家网信办), as they share the same personnel and the same offices.

infrastructure. Compute infrastructure is an important part of the new information infrastructure. It is diverse, ubiquitous, intelligent, agile, secure, reliable, green, and low-carbon. It is of great significance for promoting industrial transformation and upgrading, empowering scientific and technological (S&T) innovation and progress, meeting the needs of the people for the good life (美好生活), and achieving high-efficiency governance of society. This action plan has been formulated to strengthen collaborative innovation in computing, networks, storage, and applications, promote the high-quality development of compute infrastructure, and give full play to the role of compute as a driver of the digital economy.

I. Overall Requirements

(i) Guiding Ideology

Taking Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era as the guide, we must fully implement the spirit of the 20th Party Congress, take the new stage of development (新发展阶段) as our basis, completely, accurately, and comprehensively implement the new concept of development (新发展理念), accelerate the construction of the new pattern of development (新发展格局), and strive to promote high-quality development. With the goal of building a modernized infrastructure system and facing up to the needs of economic and social development and major national strategies, we will steadily improve the comprehensive supply capacity of compute, strive to strengthen the efficient support of its carrying capacity, continuously improve flexible assurance of storage capacity (存力), continue to enhance the effectiveness of compute empowerment (算力赋能), comprehensively promote the green and secure development of compute, and inject new momentum into the high-quality development of the digital economy.

(ii) Basic Principles

Diversify supply and optimize layout. We must adhere to the path of diversified development, mobilize the enthusiasm of various market entities, build a supply system for the coordinated development of general purpose compute, intelligent compute, and supercomputing, continue to optimize the geographical layout of compute resources, strengthen intensive construction, strengthen the coordinated development of compute, networks, storage, and applications, promote the integrated application of the new generation information technology (IT) and compute facilities, and guide the intelligentized (智能化) upgrading of compute operations.

Be demand-driven and strengthen empowerment. We must adhere to a market demand orientation, give full play to regional comparative advantages, further unleash the potential demand for compute applications in key sectors such as industry and finance, stimulate the innovative vitality of all-scenario applications such as intelligent compute and edge compute, and promote the integrated development of compute and the real economy.

Use innovation as a driver and gather forces together. We must adhere to the innovation-driven approach, follow the law of gradual introduction of technology, standards, industries, and applications, and promote breakthroughs in core technologies. We must give full play to the innovative main role of scientific research institutes, universities, and enterprises in technological breakthroughs and in the conversion of S&T achievements into practical applications (成果转化), and form a consolidated force for the development of the technology industry.

Green, low-carbon, secure, and reliable. We must adhere to green and low-carbon development and comprehensively improve the energy utilization efficiency of compute facilities and the level of carbon efficiency of compute.[2] Coordinate development and security, further strengthen network, application, and production chain security management and capacity building, and build a complete security assurance system.

(iii) Main Objectives

By 2025, **In terms of compute,** our compute scale will exceed 300 EFLOPS, the proportion of this that is intelligent compute (智能算力) will reach 35%, and compute will develop in a balanced and coordinated manner between the eastern and western regions.

In terms of carrying capacity (运载力), the data center clusters at national hub nodes will have basically achieved direct network transmission with a latency no higher than 1.5x the theoretical latency, the optical transport network (OTN) coverage rate in key application sites will reach 80%, and the proportion of backbone networks and metropolitan area networks that comprehensively support the use of innovative technologies such as IPv6 and SRv6 will reach 40%.

In terms of storage capacity, total storage capacity will exceed 1800 EB, the proportion of this that is advanced storage capacity will exceed 30%, and the disaster recovery coverage rate of core data and important data in key industries will reach 100%.

[2] Translator's note: The Chinese source text supplies the English acronym "CEPS" following the Chinese term 算力碳效 "carbon efficiency of compute." The translator is unable to identify the expansion of the acronym CEPS and has therefore omitted it from the translation.

In terms of application empowerment, we will have created a number of new compute businesses, new models, and new business formats (新业态), the penetration rate of compute in industry, finance, and other fields will significantly increase, applications in healthcare, transportation, and other fields will be replicated and promoted on a large scale, and the scope of applications in energy, education, and other fields will be further expanded. We will establish more than 30 application benchmarks in each key area.

II. Key Tasks

(i) Improve the Comprehensive Supply System for Compute

1. Optimize the construction layout of compute facilities. According to the layout of national hub nodes in the national integrated compute network, for the nodes of Beijing-Tianjin-Hebei, the Yangtze River Delta, the Guangdong-Hong Kong-Macao Greater Bay Area, and Chengdu-Chongqing, we must build compute facilities in an orderly manner for the implementation of major regional development strategies. For the nodes in Guizhou, Inner Mongolia, Gansu, and Ningxia, while promoting the construction of data center clusters, we must strive to improve the utilization efficiency of compute facilities and promote efficient complementarity and collaborative linkage between the east and west. We must strengthen the monitoring of indicators such as data center availability rates (上架率) and strengthen the demonstration of planned new projects in areas where the overall availability rate is less than 50%. We must support Chinese enterprises in “going global” (“走出去”), deploy overseas computing facilities focusing on “Belt and Road Initiative”[3] countries, and enhance globalized service capabilities.

2. Promote a diverse configuration in compute structure. Taking the development of the artificial intelligence (AI) industry and its business needs into consideration, we must focus on intensively developing intelligent computing (智算) centers in western compute hubs and areas with a solid foundation for AI development and increase the proportion of intelligent compute in a gradual and reasonable manner. We must promote the coordinated development of intelligent compute and general purpose compute of different computing architectures and satisfy the compute needs of various businesses such as balanced, compute-intensive, or storage-intensive.

3. Promote the collaborative deployment of edge compute. We must accelerate the construction of edge compute to support low-latency business applications, such as industrial manufacturing, financial transactions, smart grids, and

[3] Translator's note: The "Belt and Road Initiative" (“一带一路”), abbreviated BRI, refers to the Silk Road Economic Belt (丝绸之路经济带) and the 21st Century Maritime Silk Road (21世纪海上丝绸之路).

cloud-based games, and promote the ubiquitous distribution and coordinated development of "cloud-edge-terminal" compute. We must strengthen the layout of industry compute construction to meet the application needs of the industrial Internet, education, transportation, healthcare, finance, energy, and other industries and support the digital transformation of traditional industries.

4. Promote the construction of the compute standards system. We must accelerate the formulation of basic and general purpose standards for computing facilities, IT equipment, intelligent operations, and other areas that are oriented to business needs, improve relevant technical requirements and testing methods, and give full play to the leading and promoting role of standards in industry development. We must simultaneously explore the construction of standards for compute measurement, sensing, scheduling, interoperability, and transactions and support the development of computing-network fusion (算网融合) and industrialization.

Box 1 Compute supply improvement initiatives
First, we must continue to carry out the selection of archetypal examples of national computing center and encourage all parties to innovate and explore the construction and operation of models of intelligent computing centers and multi-party collaborative cooperation mechanisms. **Second**, we must hold the China Computing Power Conference, build consensus in the industry, carry out propaganda and promotion for compute technology, products, and applications, and create a good atmosphere for the development of compute. **Third,** we must continue to publish the *China Composite Computing Power Index* (中国综合算力指数) and conduct a comprehensive evaluation of China's compute, network, and storage capabilities.

(ii) Improve the Efficient Carrying Capacity for Compute

1. Optimize the quality of efficient compute carrying capacity. We must explore and build an Internet of computing power (算力互联网) featuring a reasonable layout, ubiquitous connectivity, agility, and efficiency. We must enhance the integration capabilities of heterogeneous compute and networks, respond to various application needs in a timely manner through network application awareness and resource allocation mechanisms, and achieve the efficient utilization of computing and storage. For scenarios such as intelligent computing, supercomputing, and edge computing, we must carry out technological upgrades and pilot applications such as data processing units (DPUs) and lossless networks and achieve high-performance transmission over compute center networks.

2. Strengthen the integration of compute with network capabilities. We must promote the deployment of optical transmission equipment to comprehensive access nodes and the user side in cities, accelerate the realization of wide coverage of access to large-bandwidth, low-latency, all-optical networks, and ensure that the latency between important compute infrastructure in urban areas is no higher than 1 ms. We must improve the flexible and efficient compute capabilities of edge nodes and meet the needs of enterprises for fast, nearby, flexible, and efficient connection to compute.

3. Improve the hub network transmission efficiency. We must promote the direct connection of national hub nodes of the compute network to backbone network nodes and gradually build single-hop direct links between clusters. The latency between important compute infrastructure in national hub nodes shall not exceed 5 ms. We must promote the deployment of ultra-low-loss optical fiber and optimize optical fiber cable routing. We must accelerate the R&D and deployment of 400G/800G high-speed optical transmission networks and the application of optical cross-connect, SRv6, network slicing, Flexible Ethernet, optical service units, and other technologies and achieve intelligent, efficient, flexible, agile, on-demand, and selectable network transmission.

4. Explore the collaborative scheduling mechanisms for compute. We must promote the integration of compute resources through cloud services and give full play to the advantages of the elastic scheduling of cloud computing resources. We must encourage all parties to explore the creation of a multi-level compute scheduling architecture system and build a platform environment that can meet the needs of various agents of innovation as they carry out scheduling, application, R&D, and verification on diverse and heterogeneous compute resources. We must leverage the national new-type internet exchange points (国家新型互联网交换中心), [national-level Internet] backbone direct connection points (骨干直联点), and other facilities and promote the interconnection and interoperability of compute among multiple parties.

Box 2 Integrated compute and network development initiatives
First, we must explore the construction of a multi-level compute scheduling platform and gradually realize the cross-domain scheduling and orchestration of diverse heterogeneous compute resources. **Second,** we must build a compute interconnection system, unify compute resource identification and identity authentication, and carry out pilot verification based on ministerial and provincial compute interconnection platforms. **Third**, we must establish a compute network monitoring mechanism, carry out compute facility carrying capacity assessments, and create a number of compute network city (算网城市) benchmarks. **Fourth**, we

must implement “winner-takes-all open competition[4] among entities with strong compute foundations” (“算力强基揭榜挂帅”), make breakthroughs in a number of landmark technology products and solutions, and accelerate the application of new technologies and products.

(iii) Strengthen Storage Capacity Efficiency, Flexibility, and Assurance

1. Accelerate R&D and application of storage capacity technology. We must promote the innovative development of advanced storage with a focus on technologies such as all-flash storage, Blu-ray storage, high-density hardware, data reduction, encoding algorithms, chip offloading (芯片卸载), and multi-protocol data interoperability. We must encourage the deployment and application of advanced storage technology, realize the upgrade to flash storage, and further enhance the competitiveness of China's all-flash storage technology.

2. Continue to improve storage industry capabilities. We must encourage storage product manufacturing enterprises to continue to improve their independent (自主) R&D and manufacturing levels for key storage components and create an industrial ecosystem in which storage media, storage chips, storage systems, and storage applications promote each other and develop collaboratively.

3. Promote the collaborative development of storage, compute, and networks. We must accelerate the R&D and application of storage network technology, promote the integrated design of computing and storage, promote the coordinated development of storage, networks, and computing, guide the reasonable configuration of storage and compute ratios, and realize the efficient flow of data within and between compute centers.

[4] Translator's note: The idea behind "winner-takes-all open competition" (揭榜挂帅), in the context of Chinese science and technology projects, is that the government openly lists the technological breakthrough(s) it desires. Any individual or group in society, not just a select few, are then eligible to win a cash award if they succeed in making the breakthrough. This concept is also known as the "bounty system" (悬赏制).

Box 3 Collaborative storage and compute development initiatives
First, we must study and evaluate the maturity of data center storage capabilities, improve storage service capabilities in all scenarios, and promote the balanced development of storage, compute, and networks. **Second,** we must encourage the use of independent storage devices in critical information infrastructure and promote the application of domestically produced key storage components through all-flash storage machines. **Third,** we must strengthen the monitoring of data center storage capacity and regularly publish the *China Storage Capacity Development Report* (中国存力发展报告).

(iv) Deepen Compute-Enabled Industry Applications

1. Build an integrated compute service system. We must create compute services that integrate multi-party compute resources and development platforms, encourage localities to provide inclusive compute resources for small and medium-sized enterprises and scientific research institutions, reduce compute usage costs and thresholds, and guarantee demand for compute usage. We must promote the application of compute in more scenarios in work and daily life, support the immersive scenario application of personal augmented reality (AR) and virtual reality (VR) devices in the social networking and entertainment fields, and ensure the supply of compute for smart home applications such as home appliance control, environmental controls, and security alarms. We must improve public compute support capabilities and meet the compute needs of intelligent services in libraries, art galleries, gymnasiums, and other large venues that provide public benefits. We must continue to promote the support of compute for innovative applications and promote the expansion and application of compute in new business formats such as the metaverse and digital twins.

2. "Compute + Industry." In response to the real-time data compute requirements in scenarios such as "intelligent factories," we must accelerate the deployment of industrial edge data centers, promote compute-enabled intelligent detection, failure analysis, human-computer collaboration, and other technological iterations, and continuously improve the business processing capabilities of different industrial scenarios. For fields such as raw materials, equipment manufacturing, consumer goods, and electronic information, we must focus on the characteristics of industrial production such as multiple types, long production time, and high quality requirements as well as difficulties such as high safety and pollution hazards and low level of intelligentization, aim to move toward becoming high-end, intelligentized, and green, gradually build an integration system for industrial basic compute resources and application capabilities, meet the compute, network, storage, and application needs of different types of industrial enterprises in R&D and design, production and manufacturing, warehousing and logistics, marketing and services, and other areas, promote the technological transformation, cost reduction, efficiency improvement, and green transformation of industrial enterprises, and accelerate the application of compute to empower new industrialization (新型工业化) construction.

3. "Compute + Education." We must encourage scientific research institutes to appropriately build compute resources as needed and effectively support the development and innovation of major projects or topics. We must promote the campus coverage of public compute resources, encourage all types of colleges, universities, and vocational schools to actively use compute platforms to provide support for progress in the construction and transformation of school internship experimental training environments, platforms, and bases, promote educational equity, and comprehensively raise the intrinsic quality level of the education system.

4. "Compute + Finance." We must accelerate the innovative application of compute in the financial field, build a distributed compute resource architecture with multiple parallel nodes, and provide efficient management of cross-regional resources and the ability to deploy core businesses in multiple locations. We must develop and deploy intelligent edge computing nodes with a focus on low-latency business scenarios such as high-frequency transactions in the financial market, achieve screening, integration, and processing of edge-side data for financial services, and provide precise and efficient compute support for financial business development.

5. "Compute + Transportation." To meet the needs of smart transportation, we must accelerate the deployment of "center-region-edge" multi-level computing facilities, support standardized access and data aggregation of sensing, communication, and control-related devices, and provide flexible and efficient compute support for cross-domain comprehensive information applications such as refined (精细化) road traffic management and intelligent operation of stations and hubs as well as low-latency and high-reliability applications such as vehicle-road collaborative autonomous driving and automated production in ports and mines.

6. "Compute + Healthcare." We must coordinate the construction of national and provincial medical big data centers, improve region-wide health compute platforms covering entire populations, and support the high-quality development of the "Internet + Healthcare" application system. We must accelerate the construction of grassroots health and hygiene edge data centers, strengthen edge compute support for medical institutions at all levels, and effectively embed medical compute resources.

7. "Compute + Energy." We must accelerate the construction of energy compute application centers, support intelligent energy production and dispatching systems, and achieve source-grid-load interaction, multi-energy synergy and complementarity, and intelligent regulation of energy demand. We must promote and encourage leading enterprises to build high-standard data centers in a green, intelligentized, and customized manner, make full use of the advantages of existing energy resources, and provide compute integrating “energy flows, business flows, and data flows” based on their own application needs.

Box 4 Compute application innovation initiatives
First, we must publish the *Computing Power Industry Map* (算力产业图谱) and *Strong Computing Power Product Catalog* (算力强基产品目录) on a rolling basis, encourage industry organizations to actively carry out compute power enterprise exchanges and product promotion activities, and accelerate the industrialized development of compute applications. **Second,** we must organize and carry out assessments of compute empowerment and promote in-depth compute empowerment in various industries. **Third,** we must hold the “Huacai Cup” (华彩杯) competition for innovative applications of compute, and other activities, and select mature compute application solutions that are deeply aligned with industry needs for inclusion in a database (入库).

(v) Promote the Development of Green and Low-Carbon Compute

1. Raise the carbon efficiency level of resource utilization and compute. We must continue to build national green data centers, encourage enterprises to strengthen green design, accelerate the deployment of high-energy-efficiency, low-carbon-emissions compute, network, and storage equipment, and promote collaboration between software and hardware to save energy. We must support the application of new technologies such as liquid cooling and energy storage, explore the use of geographical conditions such as oceans and caves to build data centers with natural cooling sources, optimize the power utilization efficiency, water resource utilization efficiency, and carbon utilization efficiency of compute facilities, and improve the carbon efficiency of compute.

2. Guide market applications of green and low-carbon compute. We must actively introduce green energy, encourage compute centers to adopt technologies such as source–grid–load–storage (源网荷储), support the integrated development and nearby consumption of renewable energy such as wind power and photovoltaic power, and gradually increase the utilization rate of green power in compute facilities. We must accelerate the exploration and construction of a market-oriented green and low-carbon compute application system and promote innovation in business models, billing models, and management models.

3. Empower green and low-carbon transformations of industries. We must push compute facilities to play an application-enabling role in key industries such as the industrial sector, support industry data analysis, dynamic monitoring, process optimization, and other production stage innovations, promote the digitized and intelligentized development of enterprise business activities, help industries save energy and reduce emissions, a build "compute+" green and low-carbon ecosystem, and reduce total carbon emissions across society.

Box 5 Green and low-carbon compute initiatives
First, we must conduct research on green and low-carbon technologies and compute carbon efficiency models, conduct evaluations of green and low-carbon compute parks, and publish an annual report on the green and low-carbon development of compute facilities. **Second,** we must construct a "carbon neutrality level" capability index system for compute centers and compute applications and conduct verifications and assessments on the carbon efficiency of compute facilities and compute applications. **Third,** we must guide all stages in the production chain such as power supply, cooling, servers, networks, and storage to organize data and calculate carbon footprints, publish a catalog of innovative low-carbon products and solutions, and promote energy conservation and emission reduction throughout the entire compute application production chain.

(vi) Strengthen the Construction of Security Assurance Capabilities

1. Enhance network security assurance capabilities. We must strictly implement the requirements of cybersecurity laws and regulations and carry out communication network security protection work. We must strengthen the construction of technical measures for security, strengthen security monitoring and analysis of network traffic, activity logs, data flows, and shared interfaces, promote the transformation of threat handling into early risk warning and pre-event prevention, establish a closed-loop threat handling and collaborative linkage mechanism, and improve the scientific nature, precision, and timeliness of threat handling.

2. Strengthen data security protection capabilities. We must strengthen the categorized and graded (分类分级) protection of data and implement precise and strict management for important and core data in accordance with regulatory requirements. We must formulate security protection requirements and operating procedures for the entire life cycle of data, build supporting technical means for monitoring data security risks, and strengthen analysis, judgment, early warning, and handling capabilities for data security risks.

3. Strengthen production chain and supply chain security. We must strengthen collaborative linkages of the production chain, gradually form independently controllable (自主可控) solutions, encourage the construction of compute infrastructure using secure and trustworthy basic software and hardware, and ensure the security of the supply chain. We must strengthen key technology R&D and innovation and improve software and hardware collaboration and security assurance capabilities. We must leverage integrated compute application security assurance systems and form "cloud–network–edge–terminal" security situational awareness and network collaboration protection capabilities. We must promote the application of intelligentized analysis and decision-making in independent capture and defense versus unknown security risks and continue to improve compute security capabilities.

4. Ensure the smooth operation of compute facilities. We must strengthen compute network assurance, adopt dual-node and dual-routing configurations for important network facilities, and avoid single points of failure. We must strengthen the protection of physical facilities, conduct regular patrols and inspections, formulate emergency response plans, and improve emergency response capabilities. For important systems and data, we must establish hot standby and active-active mechanisms, apply new technologies such as simulated canary testing and chaos engineering, and discover and eliminate potential risks in software systems.

Box 6 Compute security assurance initiatives
First, based on the demand for computing data production and consumption, we must conduct protection and management for the entire life cycle of data and achieve efficient data flow and data security protection and computation for integrated compute and networks. **Second,** we must promote the construction of a security standards system for compute construction, operation, and application, promote the research and application of security standards from multiple perspectives, conduct security level-based testing on compute facilities, and summarize best practices in security governance. **Third,** we must focus on key products such as central processing units (CPUs), graphics processing units (GPUs), operating systems, and storage, promote pilot verification of key technologies, form benchmark application products and solutions, and build an ecosystem in which software and hardware can adapt to each other and develop in a coordinated manner.

III. Assurance Measures

(i) Strengthen Coordination and Linkages

We must strengthen departmental coordination, implement a division of labor to organize and ensure the completion of key tasks, and join forces to promote the development of compute facilities. We must encourage local governments to formulate targeted and operable implementation plans based on actual conditions, explore mechanisms for the transition from “dual control”[5] of energy consumption to “dual control” of carbon emissions and comprehensive tax assessment mechanisms for compute applications, and promote the construction of compute facilities and industrial development suited to local conditions. We must establish a compute strategy expert advisory committee (算力战略咨询专家委员会) to conduct research on forward-looking and strategic issues and provide advice on major decisions affecting compute development.

(ii) Increase Financial Support

We must give full play to the guiding role of national government investment funds and national industry-finance cooperation platforms, encourage local governments to explore and implement the “S&T Industry Financial Integration” (“科技产业金融一体化”) special project and the “Subsidies, Loans, and Guarantees” (“补贷保”) linkage pilot project, and increase support for key compute projects. We must encourage eligible projects to apply for and issue real estate investment trust funds in the infrastructure field and support the flow of social capital[6] to the compute industry. We must encourage financial institutions to increase credit support for green and low-carbon compute infrastructure and support qualified companies in issuing green bonds.

(iii) Deepen Exchanges and Collaboration

We must give full play to the organizational and guiding role of industry alliances and standards organizations and promote exchanges and cooperation in technological R&D, industrialization promotion, infrastructure construction, talent training, and other areas. We must support domestic compute companies in going global and actively

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[5] Translator's note: The term "dual control" (双控) refers to (1) controlling energy consumption per user so that this number steadily drops, indicating improved energy efficiency, and (2) controlling China's overall energy consumption so that it does not grow excessively. The Chinese government also uses the term "dual control" in the context of limiting both carbon emissions per user and overall carbon emissions.

[6] Translator's note: The Chinese term 社会资本, translated literally as "social capital," and its synonyms "social funding" (社会资金), "social investment" (社会投资), and "social financing" (社会融资), refer to any source of funding outside of government budget outlays. These terms encompass investment by private individuals and private institutions. However, investment from state-funded entities such as state-owned enterprises (SOEs), including state-run banks, also falls under the umbrella of "social capital."

expand international cooperation channels. We must encourage domestic enterprises, research institutions, and universities to strengthen international exchanges and cooperation around compute technology and standards.

(iv) Strengthen Platform Support

We must improve Chinese compute platform construction and data collection mechanisms, push large-scale data centers to join the network collaboration system, and continue to strengthen quality evaluation and tracking for typical cases. We must explore the collaborative alignment of compute, network, and storage resources, strengthen the promotion of excellent demonstrations and typical cases, and effectively promote technological innovation collaboration and resource sharing up and down the production chain.

Appendices: 1. Glossary

2. Metrics for the High-Quality Development of Computing Power Infrastructure

Appendix 1

Glossary

1. Compute Infrastructure

Compute infrastructure is a new information infrastructure that integrates information compute, network carrying capacity, and data storage capacity and can achieve centralized computation, storage, transmission, and application of information. This infrastructure features characteristics such as diversification, ubiquity, intelligence, agility, security, reliability, greenness, and low carbon. It is of great significance for promoting industrial transformation and upgrading, empowering S&T innovation in China, meeting the needs of the people for the good life, and achieving high-efficiency social governance.

2. Computing Power (Compute)

Compute is the ability of a data center server to process data and output the result. It is a comprehensive indicator to measure the computing capabilities of a data center, including general purpose computing power, supercomputing power, and intelligent computing power. Its common unit of measurement is the number of floating-point operations performed per second (FLOPS; 1 EFLOPS = 10^18 FLOPS). The larger the value, the greater the comprehensive compute provided. According to estimates, 1 EFLOPS is approximately equivalent to five Tianhe-2A supercomputers, or 500,000 mainstream server CPUs, or 2 million mainstream notebook computers.

The calculation formula is: $\text{Compute} = \text{Compute}_{\text{general}} + \text{Compute}_{\text{intelligent}} + \text{Compute}_{\text{super}}$.

3. Carrying Capacity[7]

Carrying capacity refers to the data transmission capability of computing facilities that includes the network architecture, network bandwidth, transmission latency, intelligentized management and scheduling, and other factors. It is a comprehensive indicator that measures the network transmission and scheduling capabilities for network transmission within and between data centers.

4. Storage Capacity[8]

[7] Translator's note: The Chinese source text provides the English translation "network power" for the Chinese word 运载力. The translator judges that "carrying capacity" is a more accurate translation.
[8] Translator's note: The Chinese source text provides the English translation "storage power" for the Chinese word 存储力. The translator judges that "storage capacity" is a more accurate translation.

Storage capacity refers to the comprehensive ability of the data center in four areas: data storage capacity, performance, security and reliability, and greenness and low carbon. It is a comprehensive indicator to measure the data storage capacity of a data center, including external storage devices such as storage arrays and built-in storage devices in servers. The common unit of measurement for storage capacity is exabytes (EB, 1 EB= 2^60 bytes), the common unit of measurement for performance is the number of reads and writes per second per unit capacity (input/output operations per second per terabyte; IOPS/TB), and the disaster recovery percentage (灾备比例) is an important measure of security and reliability.

5. Compute Center

Compute centers are mainly composed of heating, cooling, water, and electricity infrastructure and IT software and hardware equipment and possess compute, carrying capacity, and storage capacity. Compute center types include general purpose data centers, intelligent computing centers, and supercomputing centers.

6. Compute Carbon Efficiency

This is a comprehensive indicator that takes into account the carbon emissions and compute performance of a server. It measures the ratio of the carbon emissions generated during the server's life cycle to the compute performance provided, providing an important reference for the design and selection of server equipment. According to actual measurements, in a five-year use cycle, the carbon emissions per unit of compute performance are generally between 20 and 60 kg, and the emissions of CPUs with good energy efficiency are under 30 kg.

7. Theoretical Latency

Theoretical latency calculates the delay between egress routers based on the optical transmission speed using the network distance (路网距离) between locations as a reference.

8. Key Application Sites

Key application sites include regional Party and government agencies (at the district/county level and above), financial institutions (banking, securities, insurance, etc.), key universities and scientific research institutions, hospitals of tier 3 and above (三级以上医院), the headquarters and branch locations of large industrial enterprises, and development zones and industrial parks at the county level and above.

9. Optical Transport Network (OTN)

OTN is a transmission network that realizes service signal transmission, multiplexing, routing, and monitoring in the optical domain and ensures its performance indicators and survivability.

10. IPv6 Segment Routing (SRv6)

This is based on the source routing concept design and the segment routing technology of the IPv6 network. The usage ratio refers to the number of SRv6 nodes on the network side.

11. Advanced Storage (AS)

This refers to a storage module that applies advanced storage components such as all-flash arrays and solid state drives (SSDs), adopts advanced technologies such as separation of storage and compute (存算分离) and high density, and has a per unit capacity data operation performance of more than 10,000 input/output operations per second (IOPS).

12. Compute Penetration

This refers to the comprehensive value of the breadth and depth of compute applications in a region or industry, reflecting the popularity and application depth of compute in the region or industry. It is one of the important indicators used to evaluate compute empowerment.

13. Compute Resources

This refers to the technologies and facilities that possess the information computing, transmission, storage, and application capabilities required for the development of digital society, including but not limited to computing resources such as CPUs and GPUs, network resources such as switches and routers, storage resources such as storage arrays and distributed storage, security resources such as firewalls and intrusion detection systems, and support and assurance resources such as heating, cooling, water, and electricity.

14. Intelligent Computing Centers

This refers to facilities that use large-scale heterogeneous compute resources, including general purpose compute (CPUs) and intelligent compute (GPUs, field-programmable gate array [FPGAs], application-specific integrated circuit [ASICs], etc.) to provide the compute, data, and algorithms needed for AI applications (such as AI deep learning model development, model training, and model inference). Intelligent compute centers are composed of facilities, hardware, and software and can provide full-stack capabilities from compute at the bottom layer to application enablement at the top layer.

15. Data Center Power Usage Effectiveness (PUE)

PUE is the ratio of the total data center power consumption to the IT equipment power consumption in the data center, generally given as the average annual PUE value. For detailed calculation and measurement requirements, refer to YD/T 2543 *Energy Consumption Evaluation Method for Telecom Internet Data Center (IDC)*. The PUE value is greater than 1. The closer it is to 1, the higher the proportion of electricity used for IT equipment, and the lower the proportion of energy consumption by non-IT equipment such as cooling and power supply and distribution.

Calculation formula: $PUE=P_{Total}/P_{IT}$

Where:

P_{Total}—Total power consumption to maintain normal data center operations, in kWh.

P_{IT}—Power consumption of the IT equipment in the data center, in kWh.

16. Water Usage Effectiveness (WUE)

WUE is the ratio of the total data center water consumption to the IT equipment power consumption in the data center (unit: L/kWh), generally given as the average annual WUE value. The smaller the WUE value, the more efficiently the data center uses water resources.

Calculation formula: $WUE=(\sum L_{Total\ water\ consumption})/\sum P_{IT}$

Where:

$L_{Total\ water\ consumption}$—Total amount of water that enters the data center, in L.

P_{IT}—Power consumption of the IT equipment in the data center, in kWh.

17. Carbon Usage Effectiveness (CUE)

CUE is the ratio of the total CO_2 emissions of the data center to the energy consumption of the IT load in kg/kWh. The smaller the CUE value, the lower the data center's carbon emissions intensity.

Calculation formula: $CUE=(E_{Total\ emissions})/\sum P_{IT}$

Where:

$E_{Total\ emissions}$—Use the proportion of data center energy supplied by different sources (such as electricity, natural gas, diesel, etc.) and the carbon emission factor and total emissions from each source to convert emissions into CO_2 equivalents and obtain the total carbon emissions, in kg.

P_{IT}—Power consumption of the IT equipment in the data center, in kWh.

18. Source–Grid–Load–Storage

This is an operation model that uses an overall solution covering “power sources, electrical grids, loads, and energy storage.” This is an important way for data centers to achieve carbon neutrality. It can improve the safe operation level of the power grid and solve problems such as power grid volatility in the process of clean energy consumption.

Appendix 2

Metrics for the High-Quality Development of Computing Power Infrastructure

	No.	Indicator	2023	2024	2025
Compute	1	compute scale (EFLOPS)	220	260	300
	2	Intelligent computing centers (individual)	30	40	50
	3	Intelligent compute proportion (%)	25	30	35
Carrying capacity	4	Optical transport network (OTN) coverage of key application sites (%)	50	65	80
	5	Proportion using innovative technologies such as SRv6 (%)	20	30	40
	6	Inter-cluster network latency compliance rate of national hub node data centers (%)	65	75	80
Storage capacity	7	Total storage capacity (EB)	1200	1500	1800
	8	Advanced storage capacity proportion (%)	25	28	30