MODERN APPROACHES TO DATA STORAGE AND BACKUP METHODS

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Abstract

This thesis analyzes the fundamental concepts, methods, and practical significance of data storage and backup technologies. Traditional storage technologies (HDD, SSD) and modern network storage systems (NAS, SAN), cloud storage, and hybrid solutions have been examined. Differential, incremental, full backup, and CDP models have been covered in detail. Data loss prevention strategies - Disaster Recovery and Business Continuity plans - have been analyzed. RAID technologies (RAID 0, 1, 5, 6, 10) and their impact on data reliability have been studied. Recommendations regarding storage system security, encryption methods (AES-256, RSA), and data protection have been developed.

Keywords: *data storage, backup, cloud storage, NAS, SAN, RAID, HDD, SSD, differential backup, incremental backup, CDP, Disaster Recovery, Business Continuity, AES-256.*

Introduction. Data is the most valuable resource of modern society, and the issue of reliable data storage and backup is of critical importance. With the rapid development of digital technologies, data volumes are increasing daily, placing new demands on storage and backup systems. This research analyzes the fundamental

concepts, methods, and practical significance of data storage and backup technologies. Traditional and modern storage technologies, backup models, data loss prevention strategies, and storage system security issues have been thoroughly examined.

The Significance of Data in Modern Society. In the era of digital transformation, data has become the most important asset of organizations. Business decisions, scientific research, public administration, and all aspects of daily life are based on data. Data loss or corruption can lead to serious financial, legal, and reputational consequences. Millions of terabytes of data are created worldwide each year, and this volume is growing exponentially. The risks associated with data, including hardware failures, software errors, cyber-attacks, natural disasters, and human errors, prove the necessity of reliable storage and backup systems.

Data Storage Methods and Technologies. Traditional storage technologies include Hard Disk Drives (HDD), offering inexpensive and high-capacity storage but with relatively slow speeds, and Solid State Drives (SSD), providing fast and reliable storage with no mechanical components. Network storage systems include NAS (Network Attached Storage), suitable for small and medium enterprises, and SAN (Storage Area Network), designed for large enterprises and data centers. Cloud storage technologies (Amazon S3, Google Cloud Storage, Microsoft Azure) allow data to be stored on remote servers via the internet, offering flexibility, scalability, and cost-effectiveness. Hybrid solutions combine local and cloud storage systems to leverage the advantages of both approaches.

Data Backup Methods and Models. Full Backup creates a complete copy of all data, offering fast and easy recovery but requiring significant time and storage space. Differential Backup saves all changes since the last full backup, being faster and requiring less space. Incremental Backup stores only changes since the last backup of any type, requiring the least time and space but involving a more complex recovery process. Continuous Data Protection (CDP) saves every change in real-time, offering

minimal data loss risk. Backup automation is implemented through scheduled backup plans, automatic monitoring and alert systems, and verification processes ensuring backup integrity.

Data Loss Prevention and Recovery Strategies. Disaster Recovery (DR) is a plan for recovering data and IT systems after a disaster, evaluated based on RTO (Recovery Time Objective) and RPO (Recovery Point Objective). Business Continuity Plan (BCP) ensures the uninterrupted continuation of enterprise operations. Recovery strategies include: Hot Site - a fully prepared backup facility for immediate activation; Warm Site - a partially equipped backup facility; and Cold Site - a backup location with basic infrastructure. The 3-2-1 backup rule is widely recommended: at least three copies of data, on two different media types, with one copy stored offsite.

RAID Technologies and Storage Security. RAID (Redundant Array of Independent Disks) improves data reliability and performance by combining multiple disks. RAID 0 (Striping) increases speed but provides no redundancy. RAID 1 (Mirroring) stores an exact copy of data on a second disk. RAID 5 distributes data and parity across three or more disks, enabling single-disk-failure recovery. RAID 6 tolerates two simultaneous disk failures. RAID 10 combines RAID 0 and RAID 1, offering both high speed and reliability. Data protection employs AES-256 and RSA encryption, RBAC access control, two-factor authentication, and NIST 800-88 data destruction protocols.

Conclusion. Data storage and backup is a field of strategic importance for modern organizations. A transition from traditional storage methods to cloud and hybrid solutions is being observed. Disaster Recovery and Business Continuity plans are of decisive importance in ensuring uninterrupted organizational operations. RAID technologies and modern encryption methods enhance data reliability and security. In the future, quantum encryption, blockchain-based decentralized storage systems, and AI-based automatic backup systems will further advance this field.