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SSTF Algorithm in Cloud Storage Management

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Abstract
Shortest Seek Time First (SSTF) is one of the disk scheduling algorithms which is used in memory management systems. This algorithm is primarily used in disk scheduling within an operating system that has the core principle of prioritizing requests based on proximity can be adapted for cloud storage management, particularly in optimizing data retrieval and resource allocation. Cloud computing is on-demand delivery of computing resources such as servers, storage, databases, networking, and software, over the internet which allows the users to access and use them without managing the underlying infrastructure. SSTF and Cloud computing has many real-life applications in day to day activities such as-Content Delivery Networks (CDNs), Database Systems, Object Storage.

Keywords: *SSTF; Cloud Computing; Schedule.*

1. Introduction
The SSTF (Shortest Seek Time First) algorithm is a disk scheduling algorithm that aims to reduce the seek time by always selecting the request closest to the current disk head position. It is primarily used in hard disk drives (HDDs) to optimize disk head movement, thereby improving performance in terms of disk access time. Shortest Seek Time Fist (SSTF) selects the request with minimum seek time from the current head position. To compare to FCFS gives substantial improvement [1]. Figure 1 shows Shortest Seek Time First.

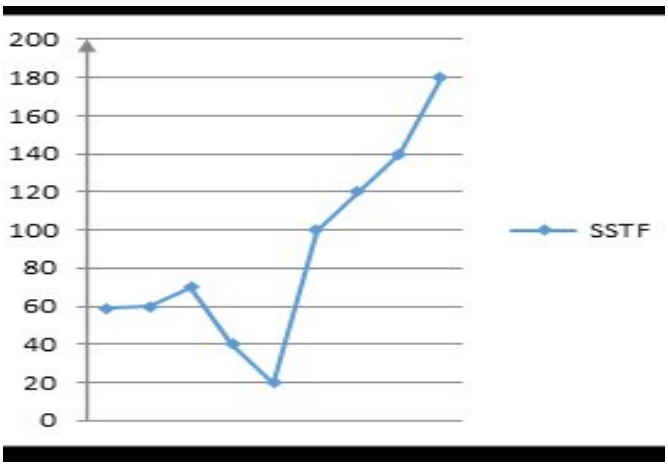

Figure 1 Shortest Seek Time First

The concept of cloud computing has roots in the 1960s, with the development of time-sharing, which allowed multiple users to access a single computer simultaneously. However, the modern concept of cloud computing, which involves the delivery of computing resources over the internet, was first proposed in the late 1990s. The term “cloud computing” was first used by computer scientist Ramnath Chellappa in a paper published in 1997, in which he described the emerging paradigm of delivering computing services over the internet [2]. In cloud storage management, the use of SSTF can be leveraged for improving file access speed, but it must be understood that the cloud typically abstracts away the physical disk management from the user. However, elements of disk scheduling like SSTF could apply to the underlying infrastructure that the cloud provider uses for managing virtual disks or physical storage in data centers. Here’s how SSTF might fit into cloud storage management:

1.1 Virtualized Disks
Cloud storage systems like Amazon S3, Google Cloud Storage, or Azure Blob Storage typically work with virtualized storage devices. Though the cloud provider handles the physical disk management,

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within a virtualized storage infrastructure, a system similar to SSTF could be used internally to optimize read/write access times.

1.2 Latency Reduction in Disk Access

In cloud environments, especially when virtual machines (VMs) or containers request storage reads and writes, the cloud provider can use algorithms like SSTF to optimize access times by minimizing disk seek time for the physical storage devices.

1.3 Load Balancing Across Storage Nodes

SSTF could also be part of a broader strategy to balance load among storage nodes. If multiple storage devices or nodes are being used, SSTF could reduce the internal disk head movement between nodes in the data center to achieve faster access time.

1.4 Impact on Cloud Storage Performance

For high-performance cloud applications requiring rapid access to large volumes of data (e.g., databases, real-time analytics, or media streaming), SSTF might help reduce the time it takes for requests to be served by ensuring that the nearest block is accessed first. This is similar to how SSTF works on physical disk drives.

1.5 Data Access Patterns

In cloud storage, SSTF can benefit applications that exhibit predictable data access patterns, such as sequential file access or highly localized file requests. By choosing the nearest request to the current disk head position, SSTF can reduce latency and improve efficiency.

2. Adaptation of SSTF in Cloud Storage

2.1 Core Concept

- **Traditional SSTF:** In disk scheduling, SSTF selects the nearest track to the current head position, minimizing physical seek time 814.
- **Cloud Adaptation:** "Seek time" translates to access latency, influenced by:
  - Geographical proximity of storage nodes to users.
  - Network congestion and bandwidth availability.
  - Node load (CPU, memory, I/O utilization).
  - Replica selection (choosing the nearest/most responsive data copy). Figure 2 shows Diagram: SSTF in Cloud Storage.

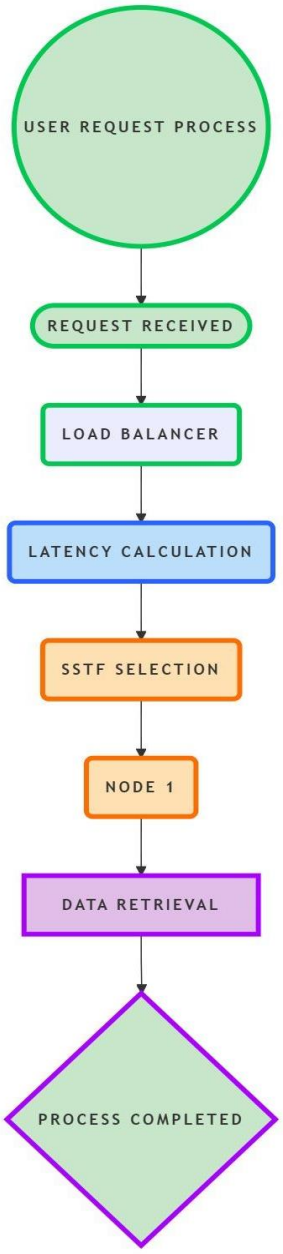

Figure 2 Diagram: SSTF in Cloud Storage

2.2 Components

- **User Requests**: Multiple requests from global users (e.g., Asia, Europe, Americas).
- **Replica Nodes:** Distributed storage nodes with varying latency (e.g., Node 1: 15 ms, Node 2: 30 ms).
- **SSTF Scheduler**: Selects the node with the shortest latency (Node 1).
- **Load Balancer:** Redirects requests based on real-time metrics.

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Conclusion

SSTF's cloud adaptation significantly reduces latency but requires balancing efficiency with fairness. Hybrid models integrating predictive analytics and fairness mechanisms are critical for scalable cloud storage systems. Future work could explore AI-driven SSTF variants to handle dynamic IoT-generated data

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