# HDFS Namenode Slowness: Root Cause Analysis & Recommendations

### 📅 Issue Summary

We have been observing **HDFS slowness** for the past few weeks/months. After extensive review, several contributing factors have been identified, particularly around disk I/O latency, checkpointing behavior, and job-induced load on the NameNode.

## 🔍 Identified Root Causes

### 1. High Disk I/O Wait on NameNode

1. **Observed Wait Time**: ~500–1200 ms
2. **Impact**: Prolonged I/O wait impacts fsimage write, edit log sync, and RPC responsiveness.
3. **Action**: Infrastructure limitation acknowledged. No further action possible at this time — to be treated as a baseline.

## ✅ Actionable Solutions to Reduce Namenode Load

### A. Reduce Unnecessary Workloads

1. **Observation**: Tools like **Dremio**, frequent Spark jobs, or metadata-heavy operations (e.g., HBase scans, file listings) contribute to load.
2. **Recommendation**: Audit and suppress non-critical or redundant jobs to reduce metadata traffic and RPC queue backlog.

### B. Increase Spark History Server Timeouts

1. **Problem**: Aggressive polling by Spark History Server creates frequent fsync and .inprogress writes to HDFS.
2. **Recommended Settings**:
3. bash
4. CopyEdit
5. spark.history.fs.update.interval=60s # default is 10s
6. spark.eventLog.buffer.kb=2048 # default is 100 KB
7. spark.eventLog.compress=true # reduce write pressure

### C. Enable fsimage Compression

1. **Benefit**: Reduces size of fsimage being transferred to the NameNode.
2. **Setting**:
3. xml
4. CopyEdit
5. <property>
6. <name>dfs.image.compress</name>
7. <value>true</value>
8. </property>

## 🧾 Checkpointing Behavior Review

### ❗ Issue: Frequent Checkpoints (every ~6 minutes)

1. **Expected**: Checkpoints should happen every **3600 seconds (1 hour)** or after large transaction counts.
2. **Observed**: Occurs every 6 minutes, likely due to **timeout/ack failures**, even though image is processed successfully.

### 🔧 Current Relevant Settings

ParameterDescriptionDefaultObserved Behavior

dfs.namenode.checkpoint.period Minimum time between checkpoints 3600s Not respected due to retries

dfs.namenode.checkpoint.check.period Interval to check if checkpoint is due 60s Default

dfs.image.transfer.timeout Timeout for uploading fsimage 60s Too low for current fsimage size

### ✔ Recommendation:

1. Increase timeout to accommodate slower disk/network:
2. xml
3. CopyEdit
4. <property>
5. <name>dfs.image.transfer.timeout</name>
6. <value>300000</value> <!-- 5 minutes -->
7. </property>

## 🧠 Conclusion

While disk I/O limitations cannot be mitigated, we recommend tuning **Spark**, **checkpoint frequency**, and **transfer timeouts** to reduce NameNode pressure. These improvements will:

1. Reduce fsync calls and .inprogress write traffic.
2. Prevent excessive checkpoint retries.
3. Optimize edit log replay and memory utilization.