

# Blockchain Node QPS

## Benchmark Report:

## Performance Analysis and

## Bottlenecks

Generated Time: 2025-10-31 16:49:06

Unified Field Naming | Complete Device Support | Monitoring Overhead Analysis  
| Blockchain Node Specific Analysis | Bottleneck Detection Analysis



### System-Level Bottleneck Analysis



⚠ System-Level Performance Bottleneck Detected



Max Successful QPS

**67500**



Bottleneck Trigger QPS

**70000**



**3.7%**

### 🔍 Bottleneck Details

**Detection Time:** 2025-10-30T19:42:58+00:00

**Severity Level:** **LOW**

**Bottleneck Reason:**

**Consecutive Detections:** 3



### System-Level Bottleneck Criteria

**Framework uses 5-scenario logic with dual verification mechanism:**

#### 1. Detection Dimensions (8 metrics):

- Resource Metrics: CPU>85%, Memory>90%, EBS AWS Standard IOPS/Throughput>90%, Network>80%
- **RPC Performance (Mandatory Conditions):** Success Rate<95% OR P99 Latency>1000ms
- RPC Errors: Error Rate>5%, Connection Failures

#### 2. 5-Scenario Decision Logic:

- **Scenario A-Resource:** Resource exceeded + Node healthy → False positive → Reset counter → Continue
- **Scenario A-RPC:** RPC performance violated (mandatory) → True bottleneck → Accumulate count → 3 consecutive → Stop
- **Scenario B:** Any bottleneck + Node unhealthy → True bottleneck → Accumulate count → 3 consecutive → Stop
- **Scenario C:** No bottleneck + Node persistently unhealthy →

Node failure → Stop immediately

- **Scenario D:** All normal + Node healthy → Continue testing

### 3. Node Health Verification:

- Criteria: Block height diff > 50 AND duration > 300s
- Purpose: Distinguish false positives (Scenario A-Resource) from true bottlenecks (Scenario B)
- **Key Note:** RPC performance violations are mandatory conditions and do NOT require node health verification

## Performance Summary

Metric	Value
Average CPU Usage	55.7%
Peak CPU Usage	100.0%
Average Memory Usage	61.3%
DATA Device Avg IOPS	7883
ACCOUNTS Device Avg IOPS	183
Monitoring Data Points	1,061

## ⚙️ Configuration Status Check

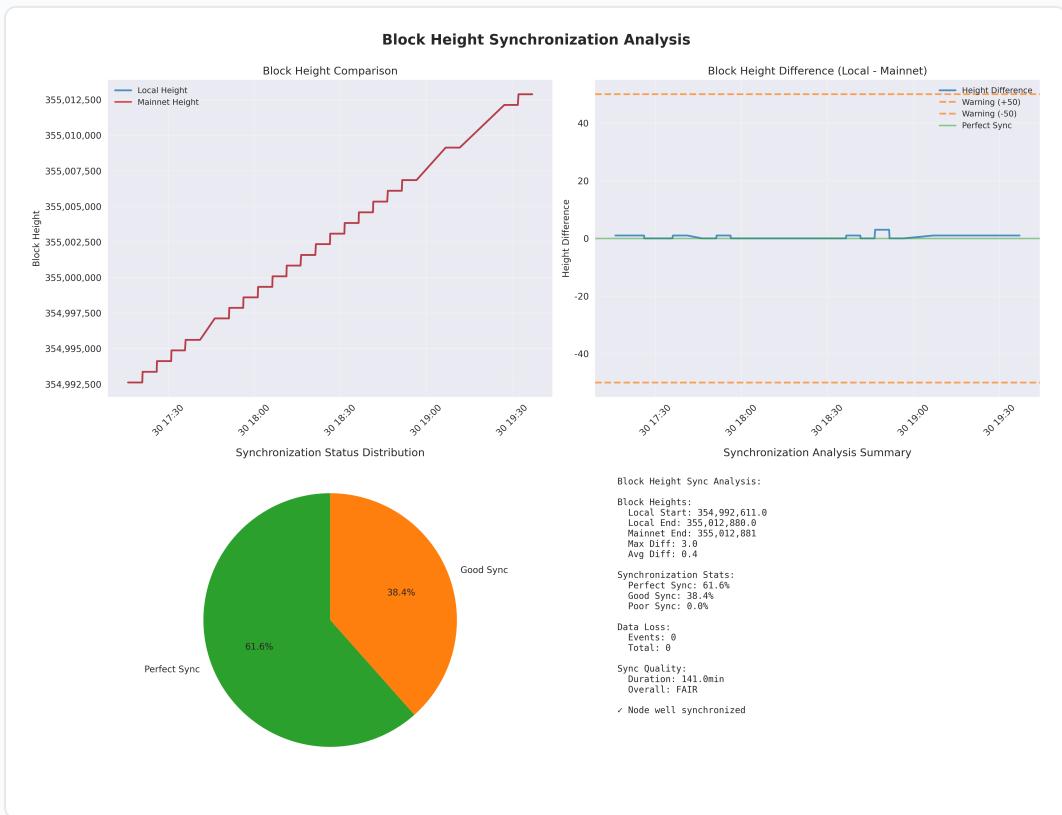
Configuration Item	Status	Value
Blockchain Node Type	✅ Configured	General
DATA Device	✗ Not Configured	N/A
ACCOUNTS Device	⚠️ Not Configured	N/A
DATA Volume Type	⚠️ Not Configured	N/A
ACCOUNTS Volume Type	⚠️ Not Configured	N/A

**Note:** ACCOUNTS Device not configured, only monitoring DATA Device performance. Recommend configuring ACCOUNTS\_DEVICE for complete storage performance analysis.



# Blockchain Node Sync Analysis

## Block Height Sync Time Series



This chart shows the block height difference between local node and mainnet during testing:

- **Blue Curve:** Block height difference (Mainnet - Local)
- **Red Dashed Line:** Anomaly threshold ( $\pm 50$  blocks)
- **Red Area:** Time periods with detected data loss
- **Statistics Info:** Sync quality statistics displayed in top left corner

## Block Height Data Comparison

Metric	Local Block Height	Mainnet Block Height	Block Height Diff
Current	355012880	355014400	1

Metric	Local Block Height	Mainnet Block Height	Block Height Diff
Average	355000684	355002089	0
Min	354992611	354992612	0
Max	355012880	355014400	3

### ⚠ Data Loss Statistics

data\_loss\_stats.json file not found. Possible reasons:

- No data loss events detected during testing
- Stats file not properly archived
- block\_height\_monitor.sh not running properly

## EBS Performance Analysis Results

### ⚠ Performance Warnings

#### 📊 Warning Statistics

Device	Type	Count	Max Value	Time Range
nvme2n1	High IOPS	6	28059.00	17:54:35 - 19:42:58

💡 Tip: View warning time distribution in "EBS Professional Charts" section below → Click "EBS Bottleneck Analysis" and "EBS Time Series Analysis" charts

## Detailed Warnings (All / 6)

#	Device	Type	Value	Time
1	<b>nvme2n1</b>	High IOPS	<b>27331.00</b>	17:54:35
2	<b>nvme2n1</b>	High IOPS	<b>27044.00</b>	17:54:41
3	<b>nvme2n1</b>	High IOPS	<b>27153.00</b>	18:03:04
4	<b>nvme2n1</b>	High IOPS	<b>28059.00</b>	18:51:22
5	<b>nvme2n1</b>	High IOPS	<b>27738.00</b>	19:17:38
6	<b>nvme2n1</b>	High IOPS	<b>27166.00</b>	19:42:58

## ↗ AWS EBS Baseline Performance Statistics

Device	Metric	Baseline (Config)	Min	Avg	Max
<b>DATA Device</b>	IOPS	N/A	10	7883	28059
	Throughput (MiB/s)	N/A	2.1	259.8	3089.4
<b>ACCOUNTS Device</b>	IOPS	N/A	10	183	10203
	Throughput (MiB/s)	N/A	1.0	6.6	1222.2

## ↗ iostat Raw Sampling Data Statistics

Device	Metric	Min	Avg	Max
<b>DATA Device</b>	IOPS	10	7883	28059
	Throughput (MiB/s)	2.1	259.8	3089.4

Device	Metric	Min	Avg	Max
ACCOUNTS Device	Utilization (%)	1.0	53.8	100.5
	Latency (ms)	0.10	0.64	1.25
	IOPS	10	183	10203
	Throughput (MiB/s)	1.0	6.6	1222.2
	Utilization (%)	1.0	3.0	96.7
	Latency (ms)	0.17	0.23	1.03

## Performance Chart Gallery

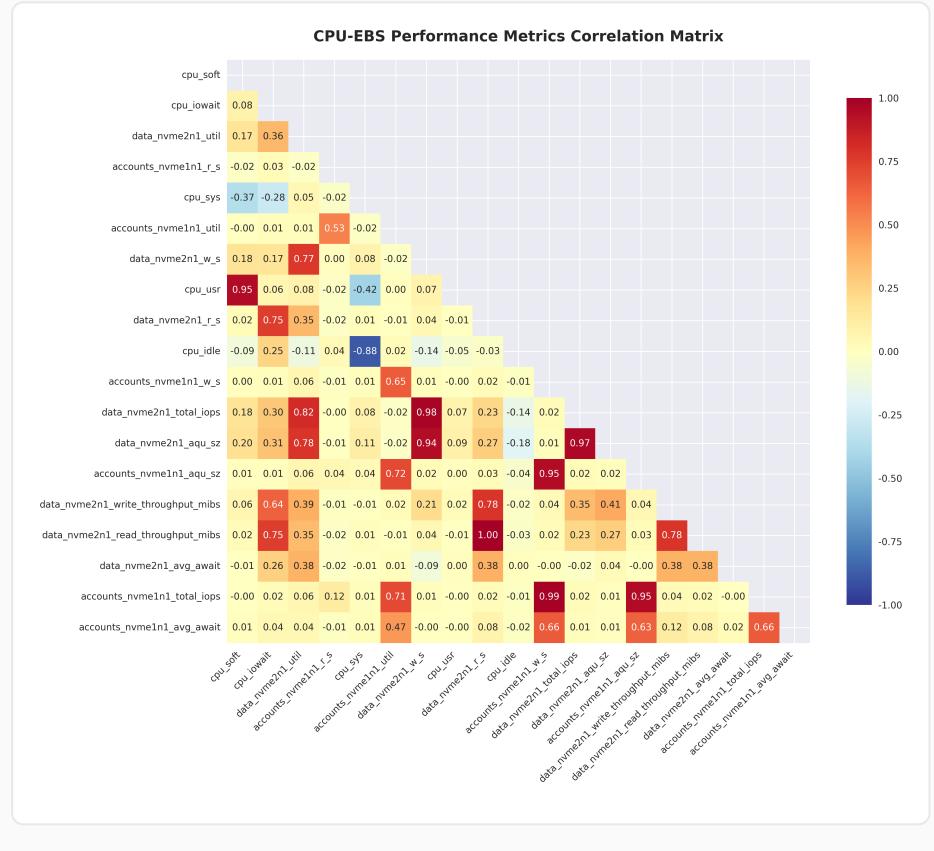
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**Total Charts Generated:** 32

## 📈 Advanced Analysis Charts (7 charts)

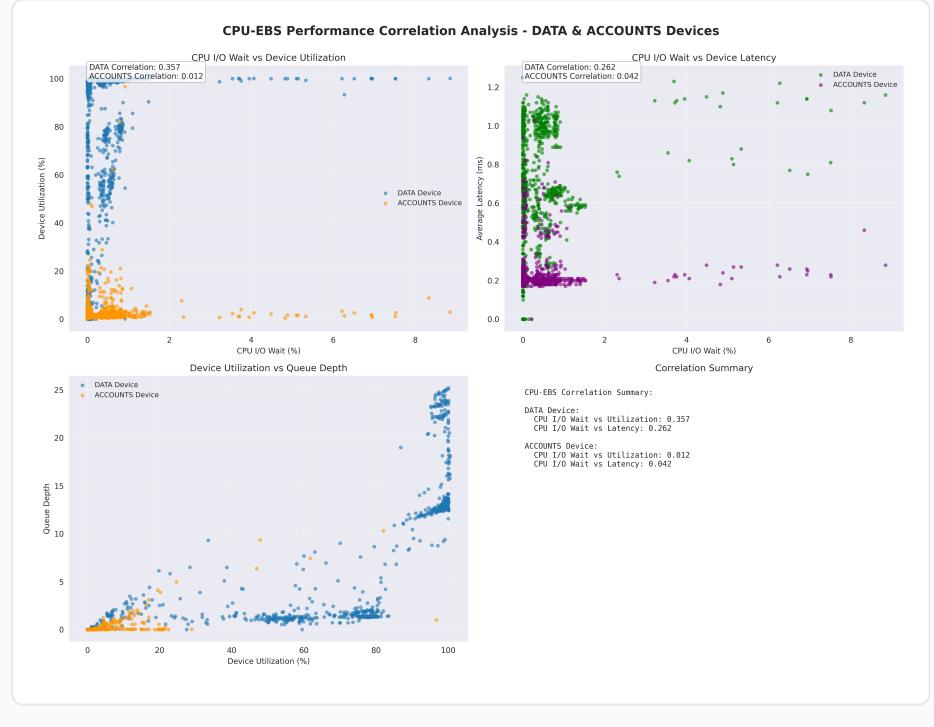
### Comprehensive Correlation Matrix

Comprehensive correlation matrix heatmap of all monitoring metrics



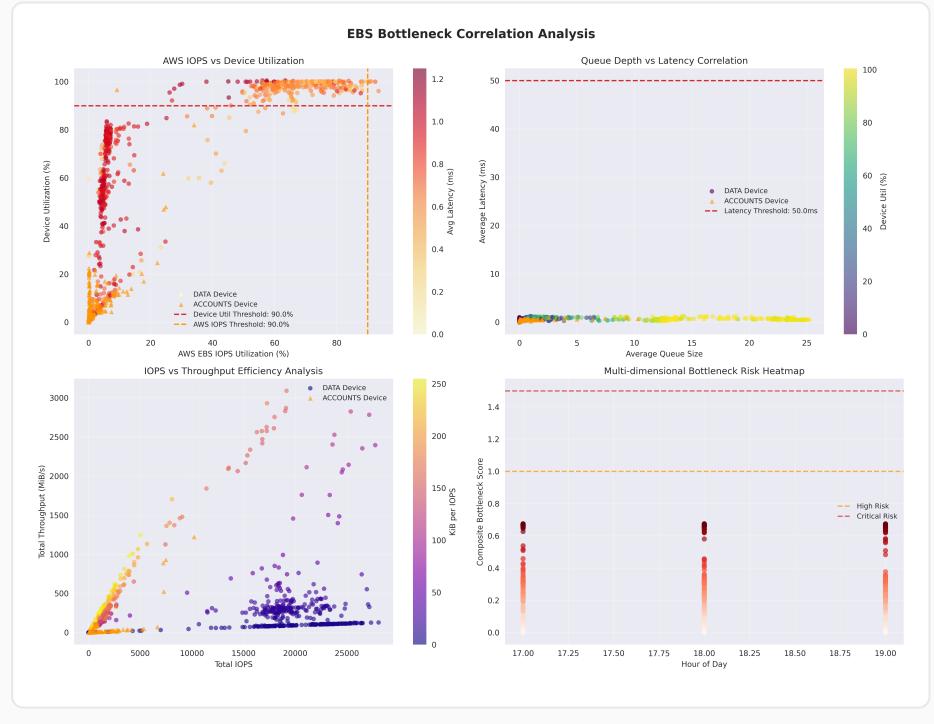
## CPU-EBS Correlation Visualization

Correlation analysis between CPU Usage and EBS performance metrics to help identify I/O bottlenecks



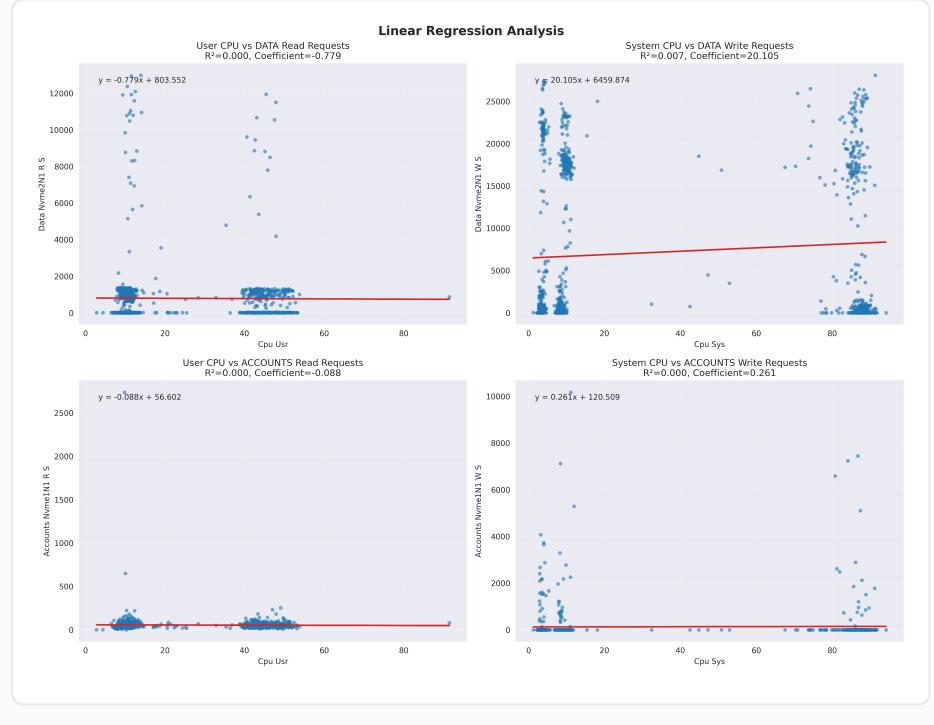
## EBS Bottleneck Correlation Analysis

EBS bottleneck correlation analysis showing relationships between AWS standard perspective and iostat perspective



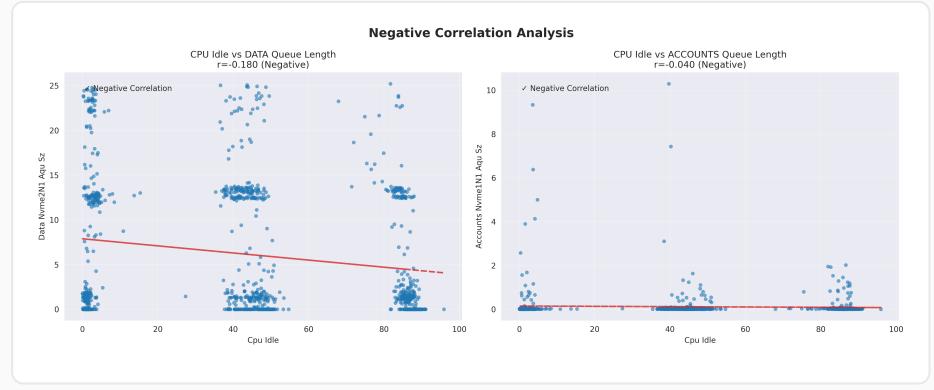
## Linear Regression Analysis

Linear regression analysis of key metrics to predict performance trends and relationships



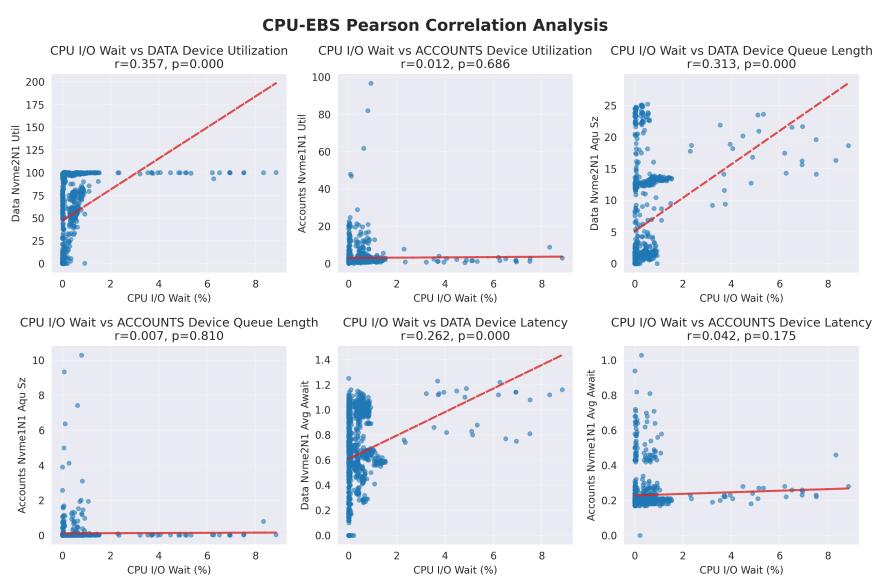
## Negative Correlation Analysis

Negative correlation metric analysis to identify performance trade-off relationships



## Pearson Correlation Analysis

Pearson correlation analysis between CPU and EBS metrics quantifying linear relationships between metrics



## Performance Correlation Heatmap

Heatmap display of performance metric correlations intuitively showing relationship strength between metrics

# EBS Professional Charts (7 charts)

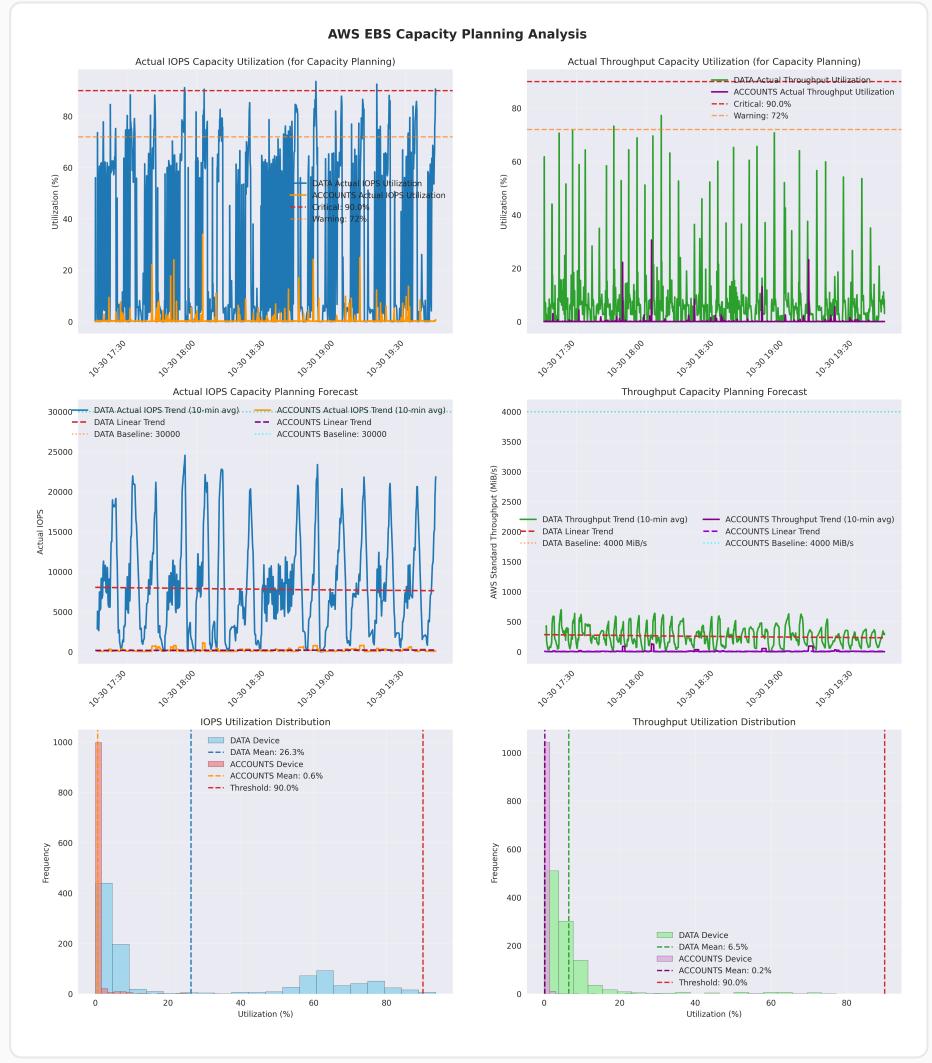
## Bottleneck Identification

Automatic bottleneck identification results marking performance bottleneck points and influencing factors



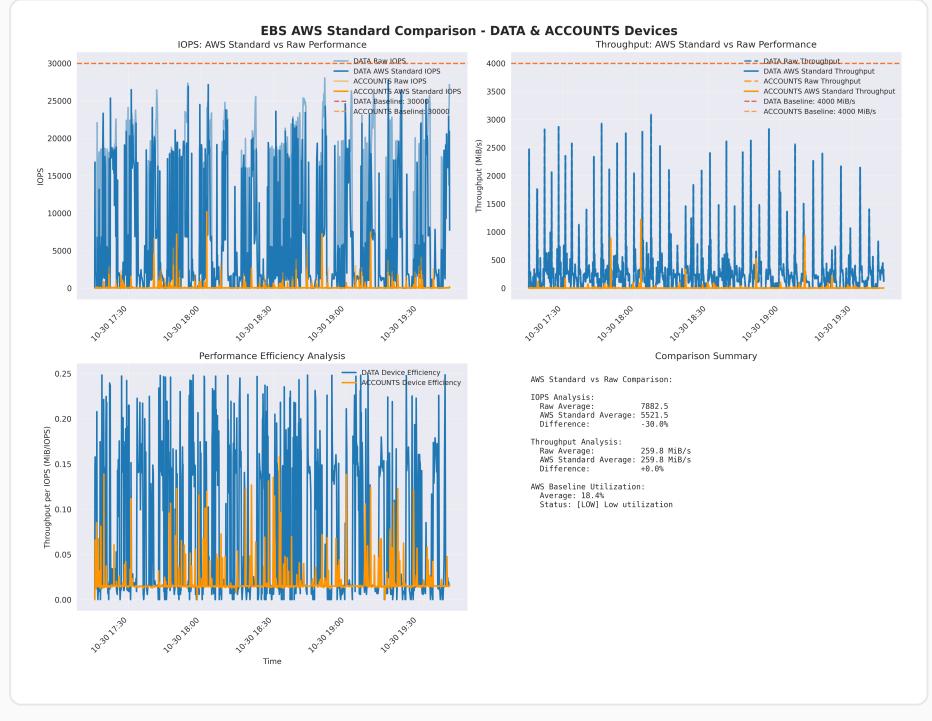
# EBS AWS Capacity Planning Analysis

AWS EBS capacity planning analysis including IOPS and throughput utilization prediction supporting capacity planning decisions



## EBS AWS Standard Comparison

AWS standard values vs raw iostat data comparison analysis evaluating performance standardization level



## EBS Bottleneck Detection Analysis

EBS bottleneck detection analysis automatically identifying IOPS, throughput and latency bottleneck points



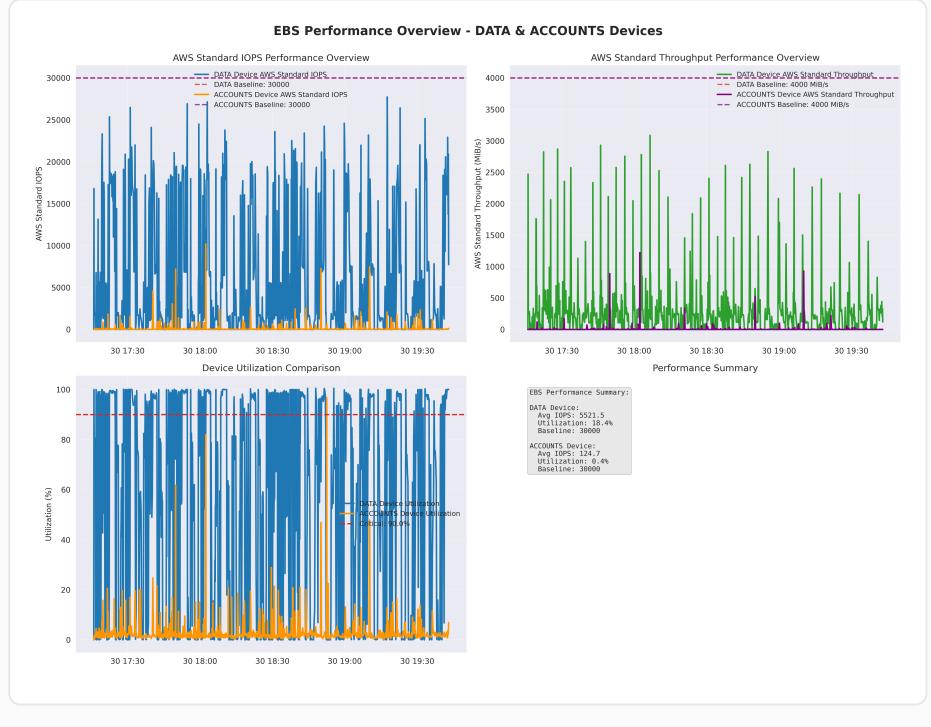
## EBS iostat Performance Analysis

EBS device iostat performance analysis including read/write separation, latency analysis and queue depth monitoring



## EBS Performance Overview

EBS comprehensive performance overview including AWS standard IOPS, throughput vs baseline comparison



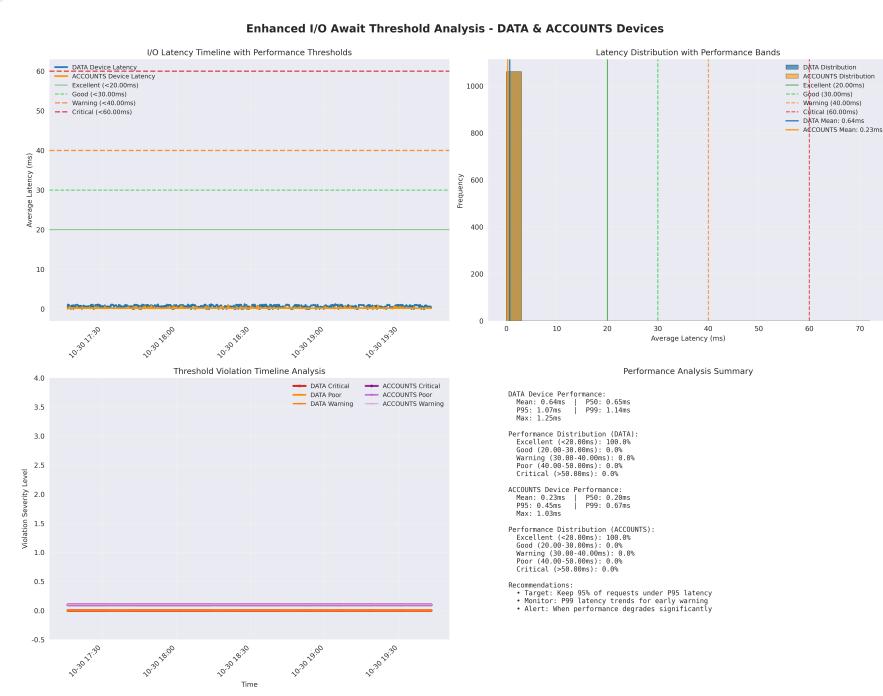
## EBS Time Series Analysis

EBS performance time series analysis showing multi-metric time dimension change trends

## Core Performance Charts (10 charts)

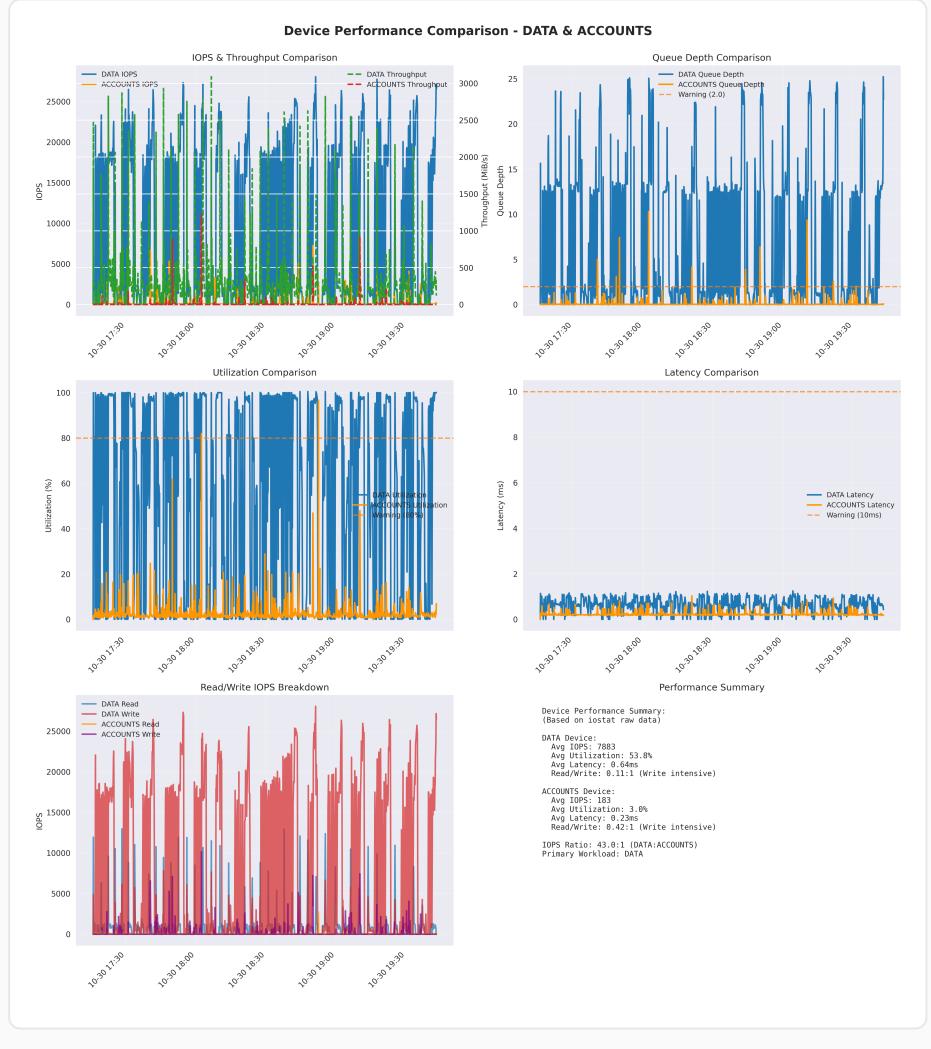
### Await Time Threshold Analysis

I/O wait time threshold analysis to identify storage performance bottlenecks



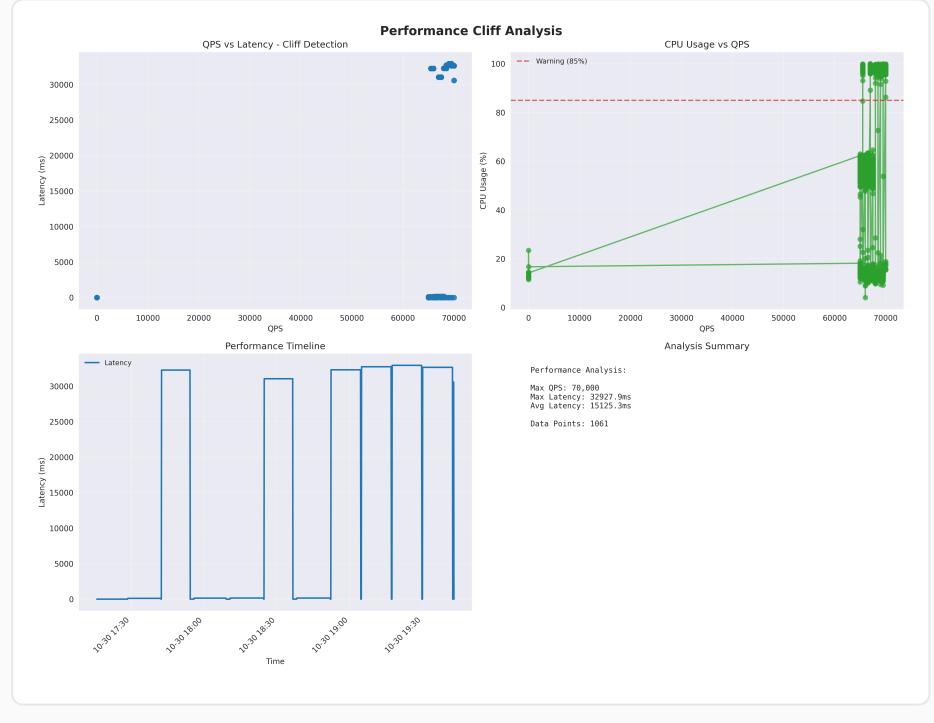
# Device Performance Comparison

Performance comparison analysis between DATA Device and ACCOUNTS Device



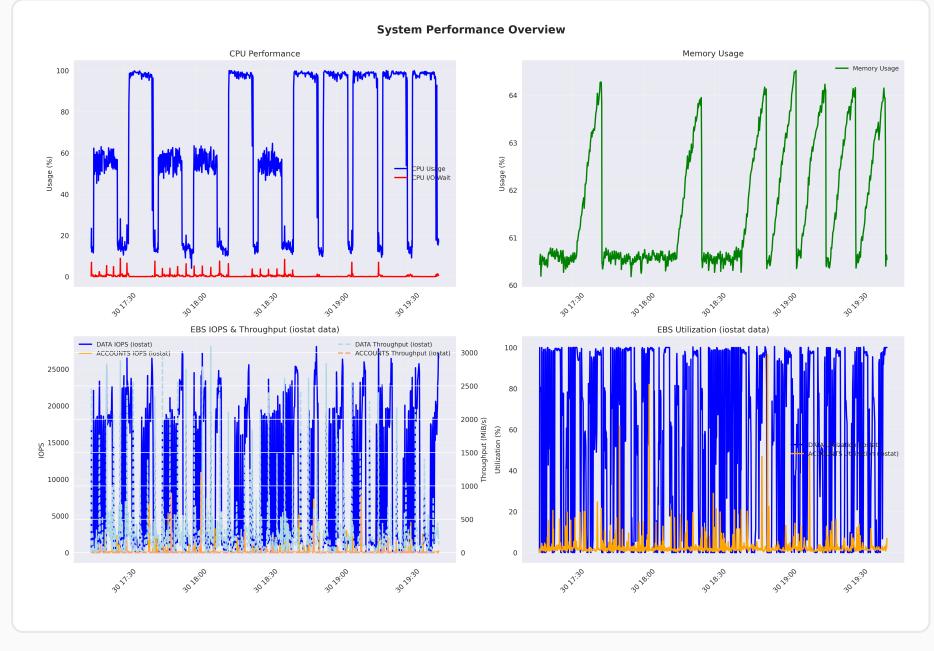
# Performance Cliff Analysis

Performance cliff detection and analysis identifying causes of sharp performance drops



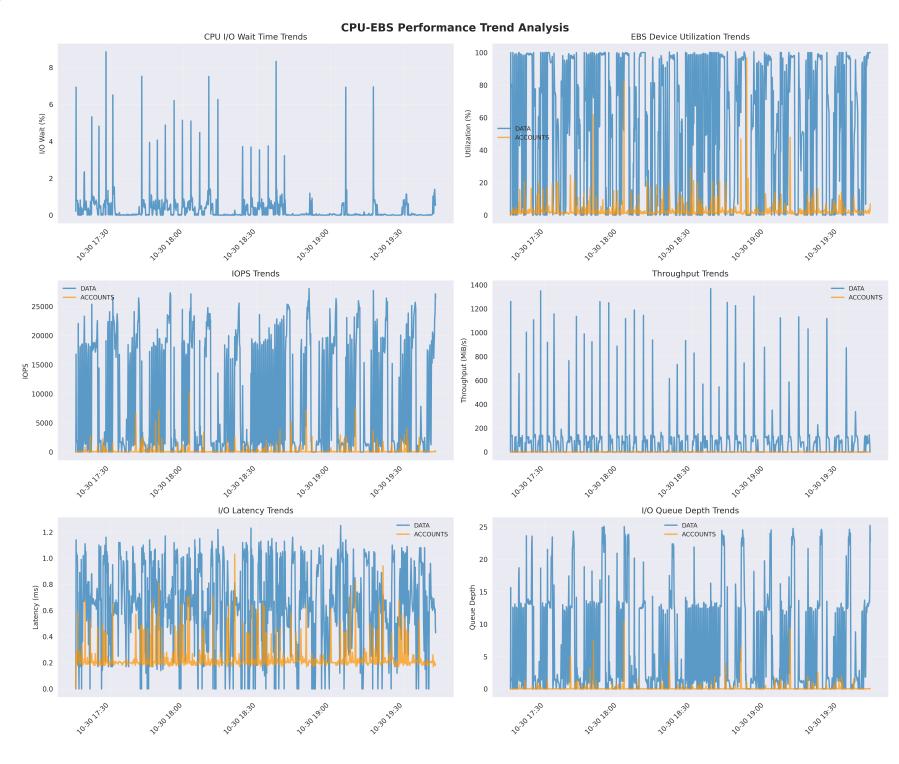
## Performance Overview

System overall performance overview, including time series display of key metrics such as CPU, Memory, EBS



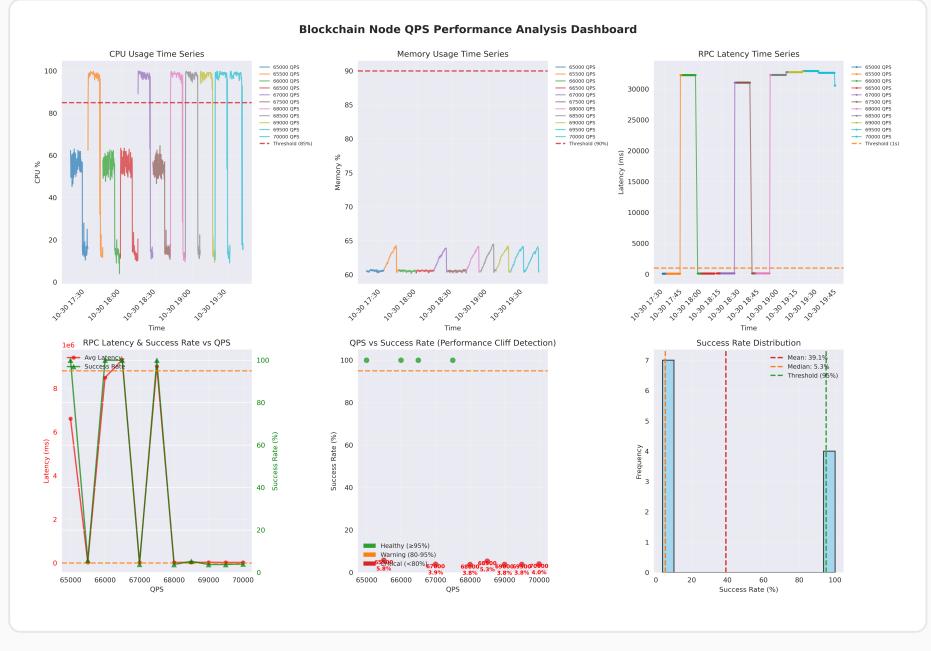
## Performance Trend Analysis

Long-term performance trend analysis to identify performance change patterns



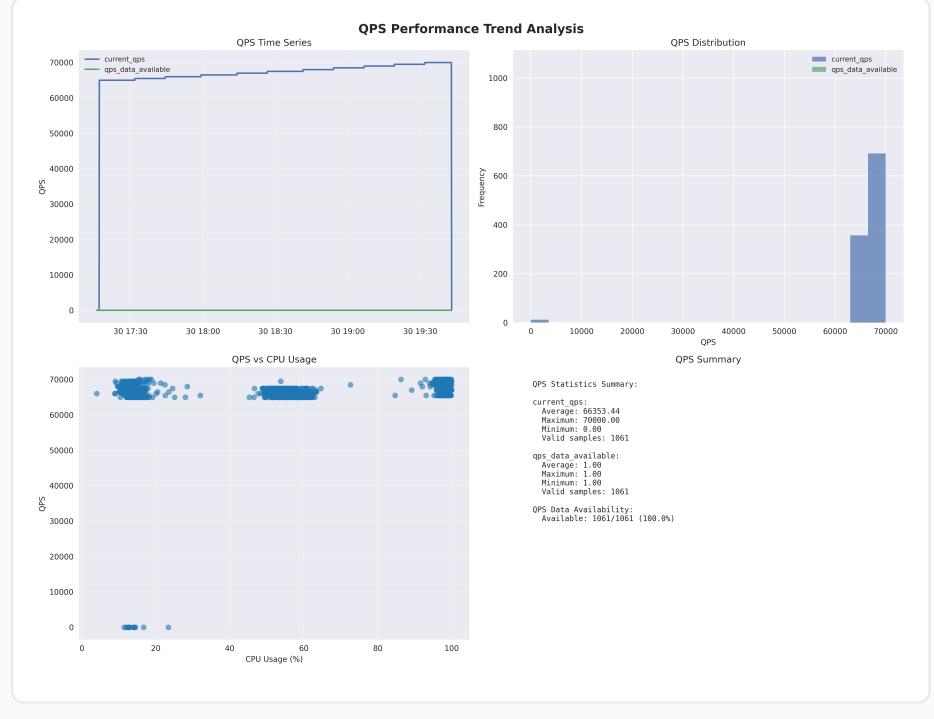
# QPS Performance Analysis

Specialized QPS performance analysis charts deeply analyzing QPS performance characteristics



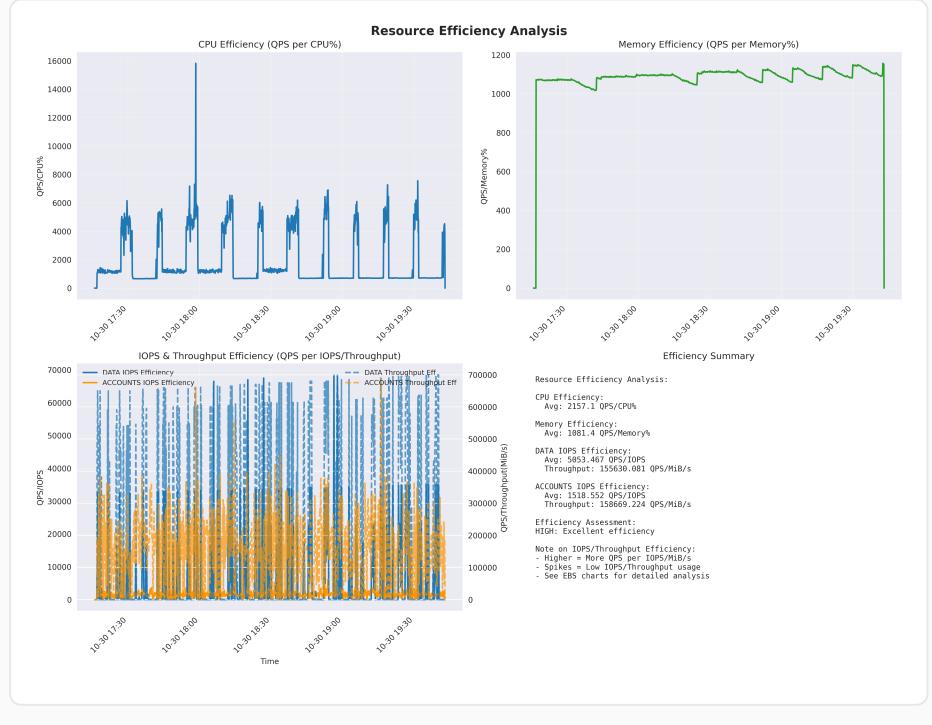
## QPS Trend Analysis

Detailed QPS performance trend analysis showing QPS changes during testing



## Resource Efficiency Analysis

Efficiency analysis of QPS vs resource consumption to evaluate resource cost per QPS



## Smoothed Trend Analysis

Smoothed trend analysis of performance metrics showing performance change trends after noise elimination



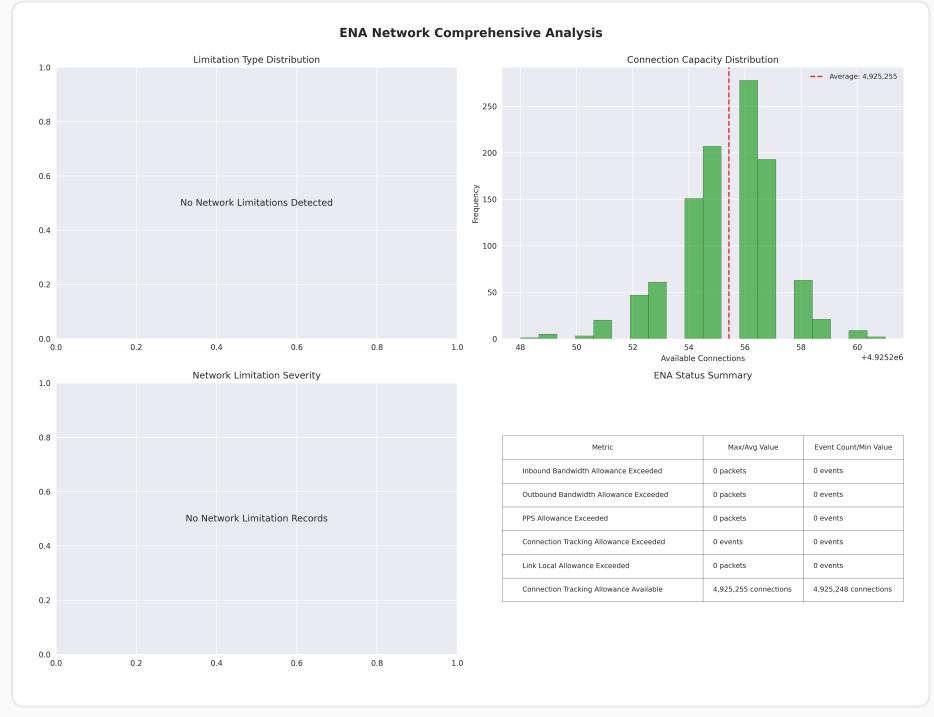
## Utilization Threshold Analysis

Device Utilization threshold analysis to evaluate resource usage efficiency

## Network & ENA Charts (3 charts)

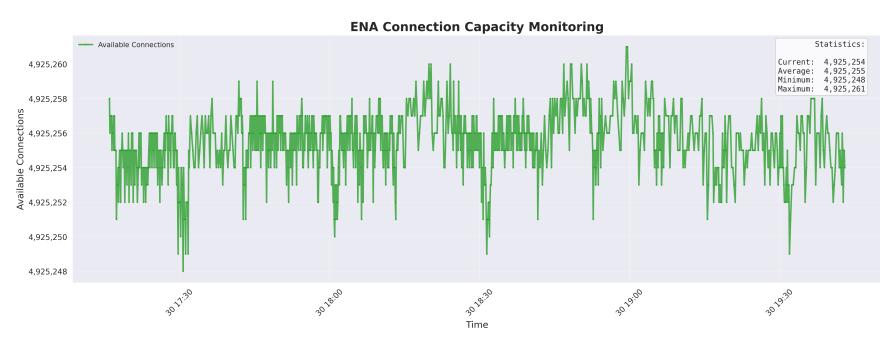
### ENA Comprehensive Status Analysis

ENA network comprehensive status analysis including limitation distribution, capacity status and severity assessment



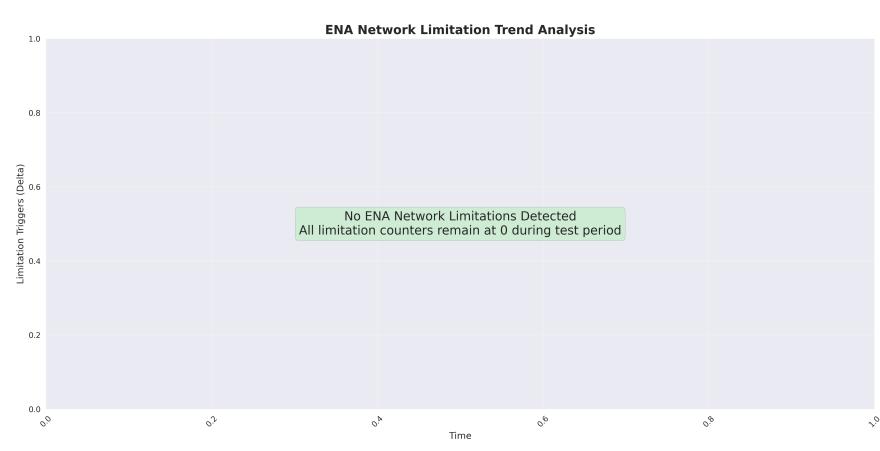
## ENA Connection Capacity Monitoring

ENA connection capacity real-time monitoring showing available connection changes and capacity warnings



## ENA Network Limitation Trends

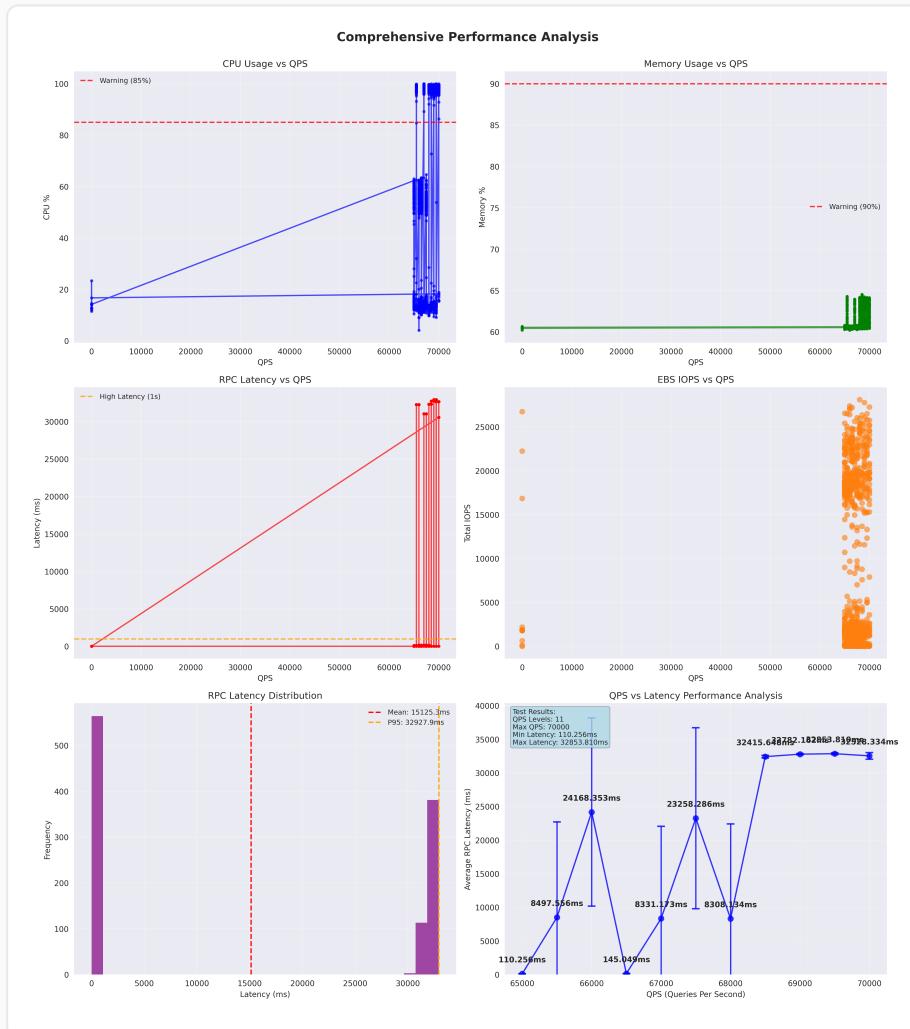
AWS ENA network limitation trend analysis showing time changes of PPS, bandwidth, connection tracking limits



## Additional Charts (1 charts)

### Comprehensive Analysis Charts

Comprehensive performance analysis chart collection fully displaying system performance status



# Monitoring Overhead Comprehensive Analysis

## System Resource Overview

Metric	Value
CPU Cores	96
Total Memory	739.70 GB
Average CPU Usage	56.21%
Average Memory Usage	61.27%

## Resource Usage Comparison Analysis

Resource Type	Monitoring System	Blockchain Node	Other Processes
CPU Usage	1.11% (1.97%)	51.64% (91.87%)	3.46%
Memory Usage	0.00%	72.79%	0.00%
Memory Usage Amount	16.83 MB	539.17 GB	205330.76 MB
Process Count	7	10	N/A

Percentages in parentheses represent the proportion of total system resources

## Monitoring System I/O Overhead

Metric	Average	Maximum
IOPS	0.00	0.00
Throughput (MiB/s)	0.00	0.00

## Monitoring Overhead Conclusion

Monitoring system resource consumption analysis:

- CPU overhead: 1.97%
- Memory overhead: 0.00% (16.83 MB)
- I/O overhead: 0.00 IOPS

Blockchain node resource consumption analysis:

- CPU usage: 91.87%
- Memory usage: 72.79% (539.17 GB)

Monitoring system impact on test results: **Minor** (monitoring CPU overhead below 5%)



# Monitoring Overhead Detailed Analysis



## Resource Usage Trends



This chart shows the trend of system resource usage during testing, including:

- **Monitoring system resource usage:** CPU, memory, I/O overhead changes over time
- **Blockchain node resource usage:** CPU and memory usage trends of blockchain process
- **Total system resource usage:** CPU and memory usage of the entire system

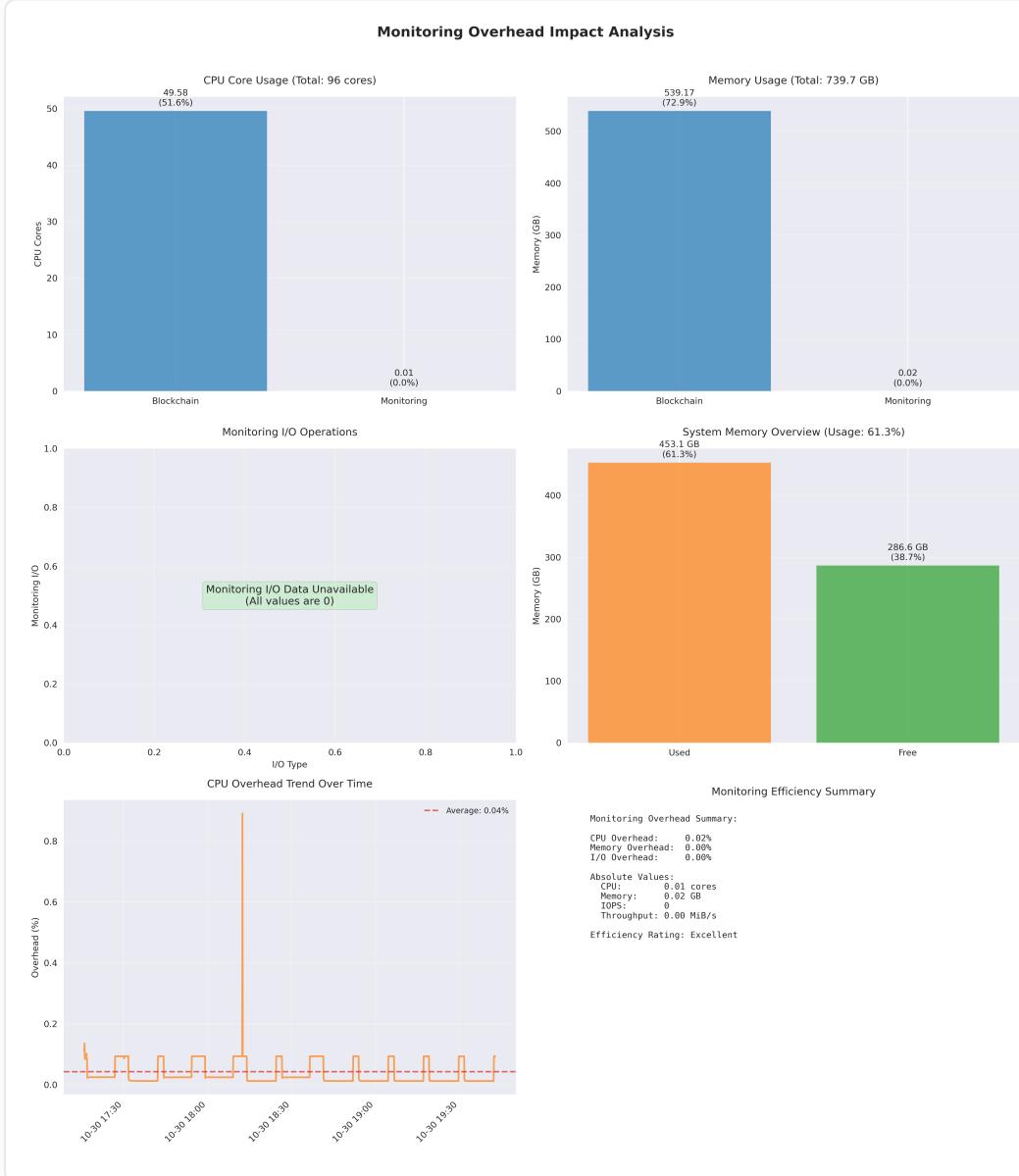
# Resource Proportion Analysis



This chart shows the proportion of system resources occupied by different components:

- **Monitoring System:** All monitoring processes resource proportion
- **Blockchain Node:** Blockchain-related processes resource proportion
- **Other Processes:** Other system processes resource proportion

# Monitoring Overhead and Performance Relationship



This chart analyzes the correlation between monitoring overhead and system performance metrics:

- Monitoring CPU Overhead vs QPS:** Relationship between monitoring CPU usage and system throughput
- Monitoring I/O Overhead vs EBS Performance:** Relationship between monitoring I/O and storage performance

# Monitoring Overhead Component Breakdown

## Monitoring Overhead Detailed Data

The following data shows the resource consumption of each monitoring component during testing, helping to evaluate real resource requirements in production environment.

Monitoring Component	Average CPU Usage	Peak CPU Usage	Average Memory Usage	Peak Memory Usage	Average IOPS	Peak IOPS	Avg Time
iostat Monitoring	0.33%	4.24%	3.4 MB	6.6 MB	< 0.0001	< 0.0001	< 10ms
sar Monitoring	0.22%	3.18%	2.5 MB	4.4 MB	< 0.0001	< 0.0001	< 10ms
vmstat Monitoring	0.11%	1.59%	1.7 MB	3.3 MB	< 0.0001	< 0.0001	< 10ms
Data Collection Script	0.33%	4.24%	6.7 MB	10.9 MB	< 0.0001	< 0.0001	< 10ms
<strong>Total Monitoring Overhead</strong>	<strong>1.11%</strong>	<strong>10.60%</strong>	<strong>16.8 MB</strong>	<strong>21.9 MB</strong>	<strong>&lt; 0.0001</strong>	<strong>&lt; 0.0001</strong>	<strong>&lt; 10ms</strong>

## Monitoring Overhead Analysis Notes

- **Monitoring Component:** Resource consumption breakdown of each system monitoring tool (estimated based on overall monitoring data)
- **CPU Usage:** CPU percentage used by monitoring tools
- **Memory Usage:** Memory size used by monitoring tools (MB)
- **IOPS:** Disk I/O operations generated by monitoring tools (tiny values shown as < 0.0001)
- **Throughput:** Disk Throughput generated by monitoring tools (MiB/s)
- **Data Completeness:** Data completeness percentage of monitoring data

Total monitoring overhead usually accounts for 1-3% of system resources and can be ignored.

### Reasons for IOPS/Throughput Being 0:

- Monitoring system mainly reads /proc virtual filesystem, kernel does not count physical I/O statistics
- Actual I/O overhead < 0.00005 IOPS/s, even with 4 decimal precision (%.4f) still shows as 0.0000
- This proves the monitoring system is efficiently designed with almost no impact on production environment
- To view tiny values, increase precision to %.6f or higher in source code

## CPU-EBS Correlation Analysis

Device Type	Analysis Item	Correlation Coefficient	P Value	Statistical Significance	Correlation Strength	Valid Sam Cou
DATA	CPU I/O Wait vs	<b>0.3570</b>	0.0000		<b>Weak Correlation</b>	1061

Device Type	Analysis Item	Correlation Coefficient	P Value	Statistical Significance	Correlation Strength	Valid Sample Count
	Device Utilization			Highly Significant (***)		
DATA	CPU I/O Wait vs I/O Queue Length	<b>0.3134</b>	0.0000	Highly Significant (***)	<b>Weak Correlation</b>	1061
DATA	CPU I/O Wait vs Read Latency	<b>0.2229</b>	0.0000	Highly Significant (***)	<b>Weak Correlation</b>	1061
DATA	CPU I/O Wait vs Write Latency	<b>0.2131</b>	0.0000	Highly Significant (***)	<b>Weak Correlation</b>	1061
DATA	User Mode CPU vs Read Requests	<b>-0.0074</b>	0.8095	Not Significant	<b>Very Weak Correlation</b>	1061
DATA	System Mode CPU vs Write Requests	<b>0.0821</b>	0.0074	Highly Significant (**)	<b>Very Weak Correlation</b>	1061
ACCOUNTS	CPU I/O Wait vs ACCOUNTS Device Utilization	<b>0.0124</b>	0.6856	Not Significant	<b>Very Weak Correlation</b>	1061

Device Type	Analysis Item	Correlation Coefficient	P Value	Statistical Significance	Correlation Strength	Valid Sample Count
ACCOUNTS	CPU I/O Wait vs I/O Queue Length	<b>0.0074</b>	0.8100	Not Significant	<b>Very Weak Correlation</b>	1061
ACCOUNTS	CPU I/O Wait vs Read Latency	<b>0.1342</b>	0.0000	Highly Significant (***)	<b>Very Weak Correlation</b>	1061
ACCOUNTS	CPU I/O Wait vs Write Latency	<b>0.0011</b>	0.9708	Not Significant	<b>Very Weak Correlation</b>	1061
ACCOUNTS	User Mode CPU vs Read Requests	<b>-0.0168</b>	0.5843	Not Significant	<b>Very Weak Correlation</b>	1061
ACCOUNTS	System Mode CPU vs Write Requests	<b>0.0138</b>	0.6527	Not Significant	<b>Very Weak Correlation</b>	1061

### 📊 Correlation Analysis Notes

- **Correlation coefficient range:** -1.0 to 1.0, larger absolute value indicates stronger correlation
- **Statistical Significance:**  $p < 0.001$  (\*\*),  $p < 0.01$  (\*\*),  $p < 0.05$  (\*)
- **Correlation strength classification:**  $|r| \geq 0.8$  very strong,  $|r| \geq 0.6$  strong,  $|r| \geq 0.4$  moderate,  $|r| \geq 0.2$  weak

- **Data Integrity:** Data integrity: Percentage of valid data points out of total data points