

Blockchain Node QPS Benchmark Report:

Performance Analysis and Bottlenecks

Generated Time: 2025-10-26 05:30:16

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

Performance Summary

Metric	Value
Average CPU Usage	13.1%
Peak CPU Usage	27.4%
Average Memory Usage	59.7%
DATA Device Avg IOPS	7517
ACCOUNTS Device Avg IOPS	188
Monitoring Data Points	1,049

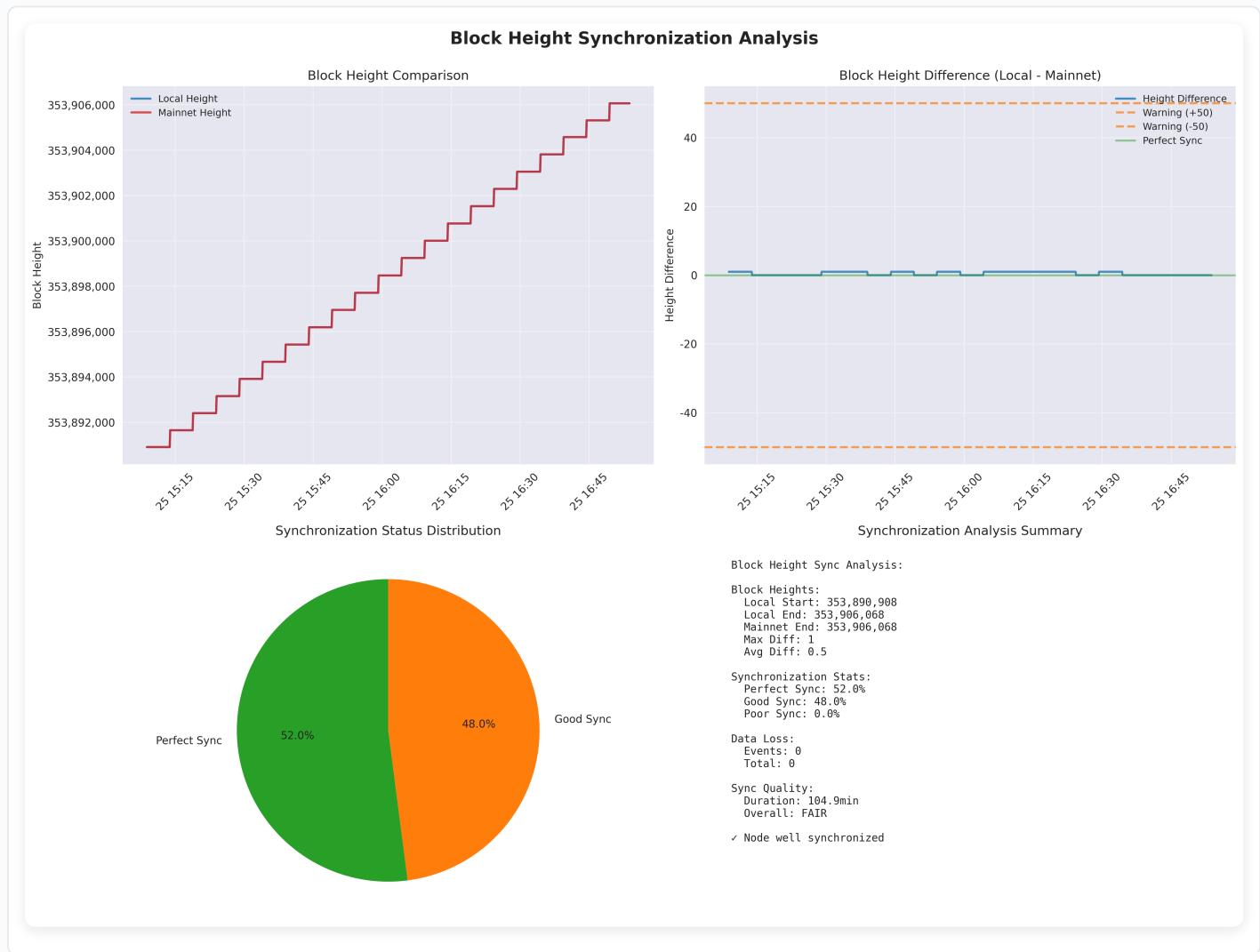
Configuration Status Check

Configuration Item	Status	Value
Blockchain Node Type	<input checked="" type="checkbox"/> Configured	Solana
DATA Device	<input checked="" type="checkbox"/> Configured	nvme2n1
ACCOUNTS Device	<input checked="" type="checkbox"/> Configured	nvme1n1
DATA Volume Type	<input checked="" type="checkbox"/> Configured	io2

Configuration Item	Status	Value
ACCOUNTS Volume Type	Configured	io2

🔗 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 (± 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	353906068	353906068	0
Average	353898427	353898428	0
Min	353890908	353890909	0
Max	353906068	353906068	1

⚠ 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

✓ **No performance anomaly detected**

📈 AWS EBS Baseline Performance Statistics

Device	Metric	Baseline (Config)	Min	Avg	Max
DATA Device	IOPS	30000	0	4420	31463
	Throughput (MiB/s)	4000	0.0	184.8	3558.5
ACCOUNTS Device	IOPS	30000	0	131	13136
	Throughput (MiB/s)	4000	0.0	6.3	1371.4

📈 iostat Raw Sampling Data Statistics

Device	Metric	Min	Avg	Max
DATA Device	IOPS	0	7517	31463

Device	Metric	Min	Avg	Max
ACCOUNTS Device	Throughput (MiB/s)	0.0	184.8	3558.5
	Utilization (%)	0.0	44.0	100.1
	Latency (ms)	0.00	0.56	1.18
	IOPS	0	188	13136
	Throughput (MiB/s)	0.0	6.3	1371.4
	Utilization (%)	0.0	2.6	95.7
	Latency (ms)	0.00	0.23	0.74

EBS Bottleneck Analysis

No EBS Bottleneck Detected

No EBS performance bottleneck found during testing. Storage performance is good and will not limit overall system performance.

Performance Chart Gallery

Total Charts Generated: 32

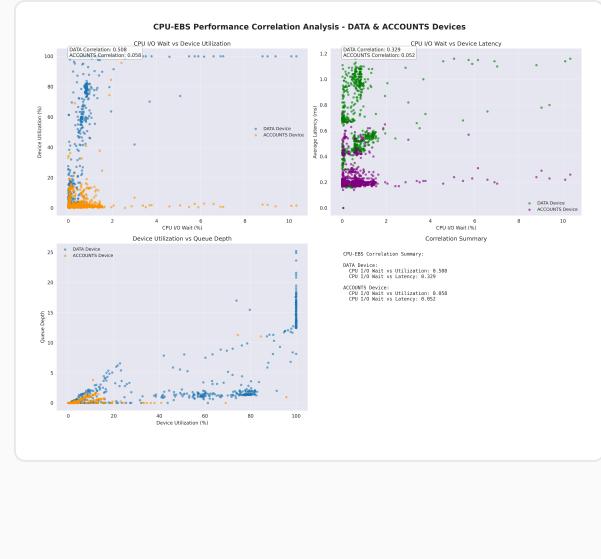
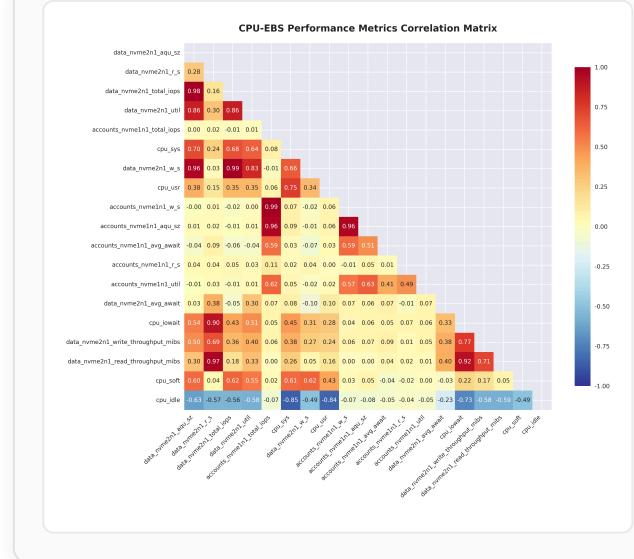
Advanced Analysis Charts (7 charts)

Comprehensive Correlation Matrix

Comprehensive correlation matrix heatmap of all monitoring metrics

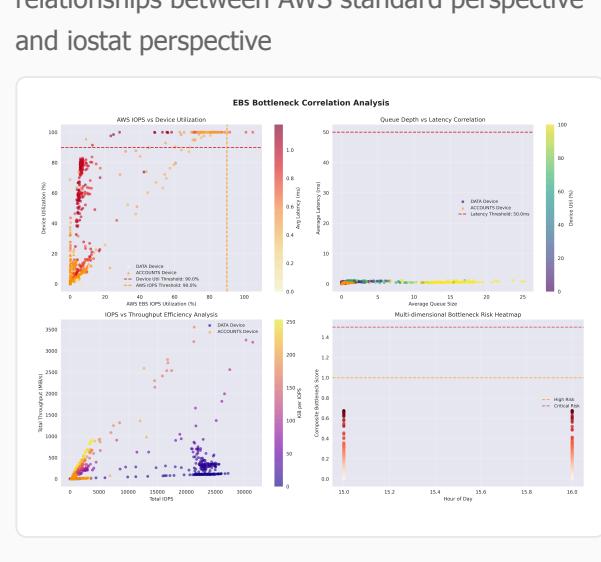
CPU-EBS Correlation Visualization

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

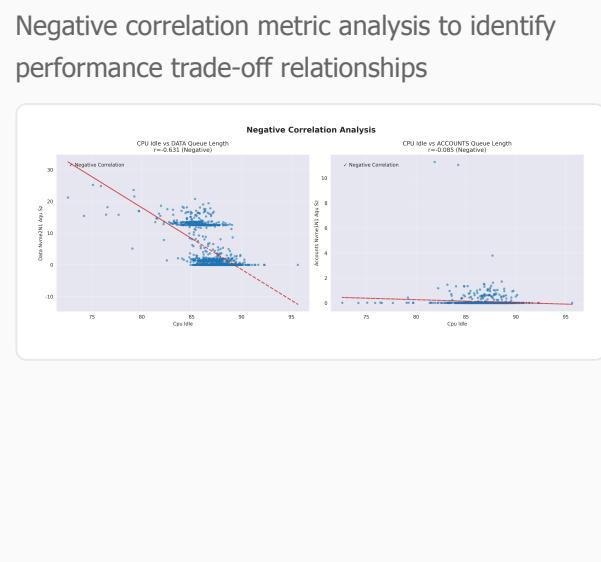


EBS Bottleneck Correlation Analysis

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

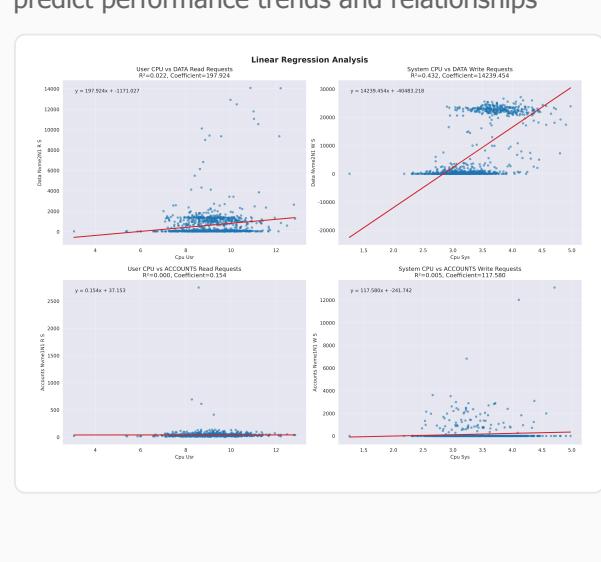


Negative correlation metric analysis to identify performance trade-off relationships

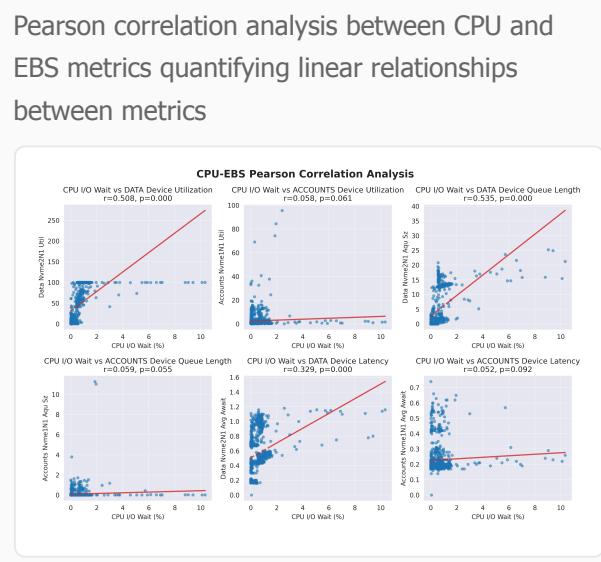


Linear Regression Analysis

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

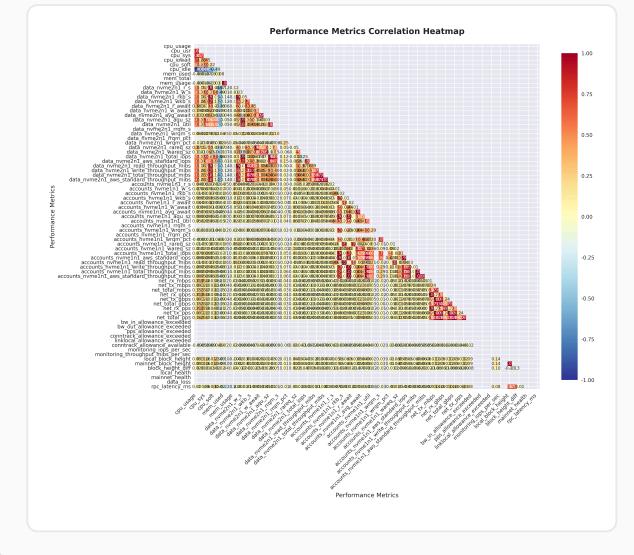


Pearson Correlation Analysis between CPU and EBS metrics quantifying linear relationships between metrics



Performance Correlation Heatmap

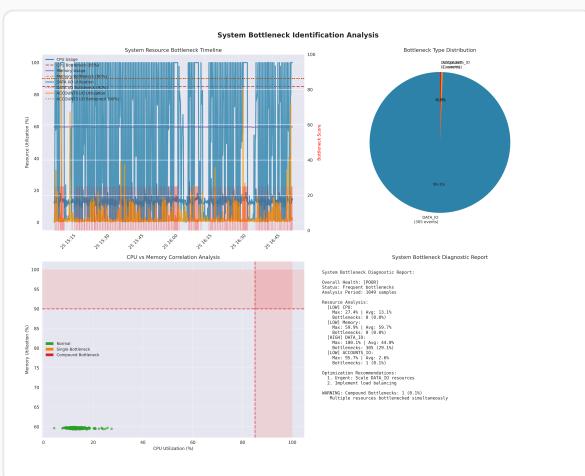
Heatmap display of performance metric correlations intuitively showing relationship strength between metrics



EBS Professional Charts (7 charts)

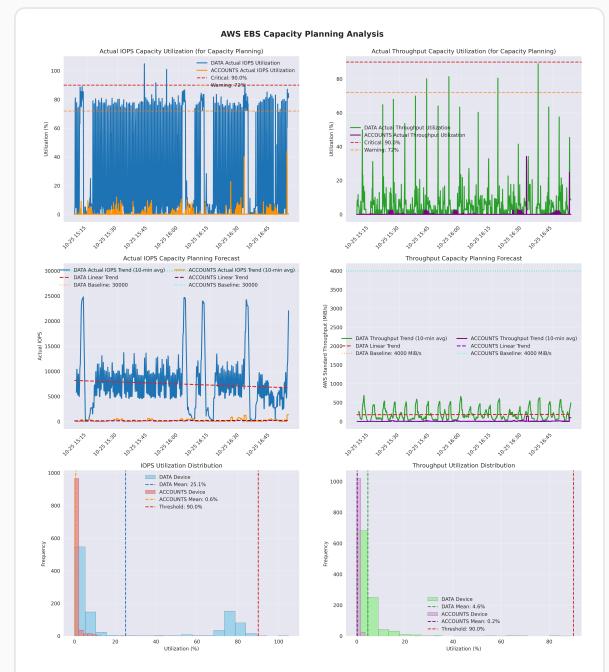
Bottleneck Identification

Automatic bottleneck identification results marking performance bottleneck points and influencing factors



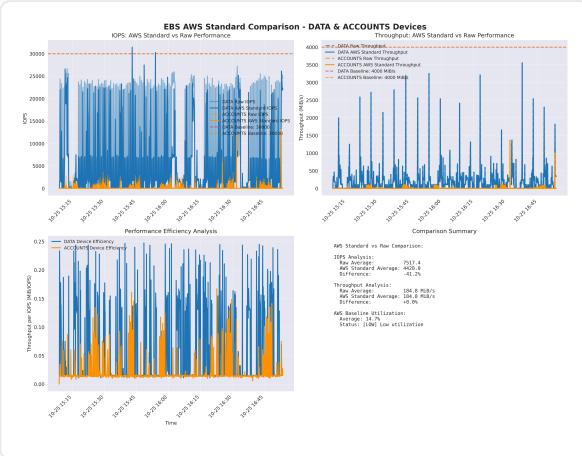
EBS AWS Capacity Planning Analysis

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



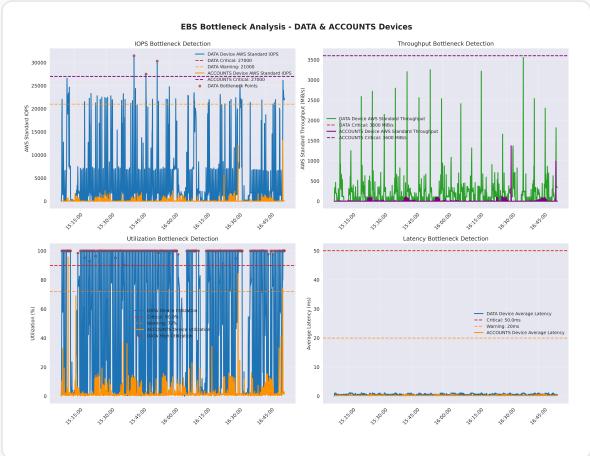
EBS AWS Standard Comparison

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



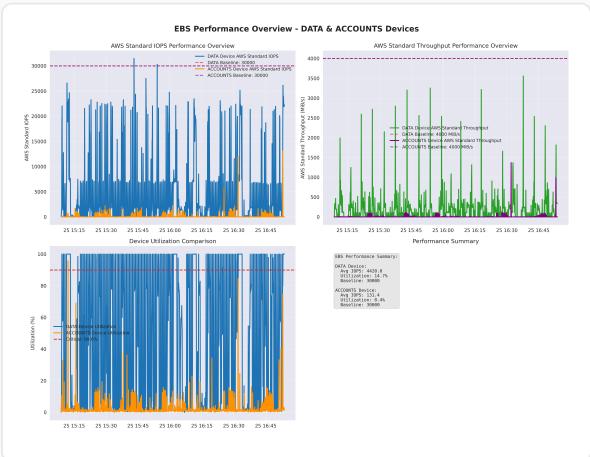
EBS iostat Performance Analysis

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

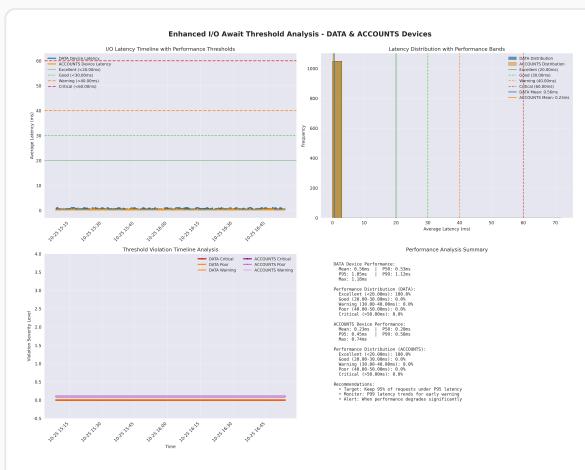
EBS performance time series analysis showing multi-metric time dimension change trends



Core Performance Charts (10 charts)

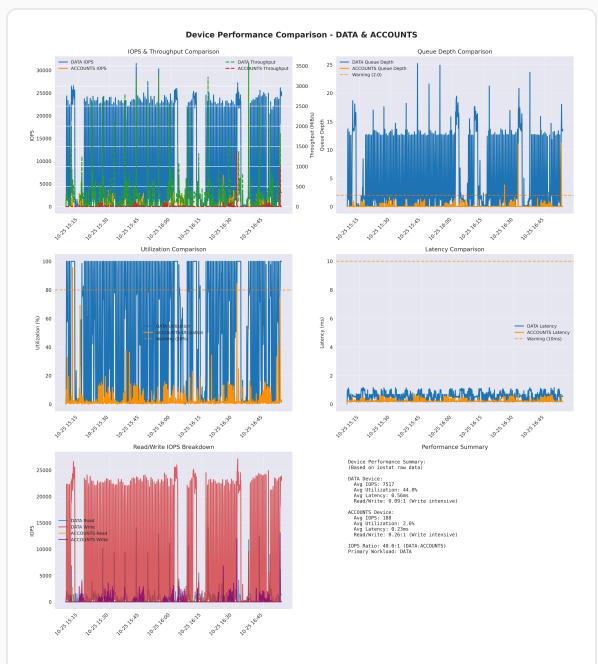
Await Time Threshold Analysis

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



Device Performance Comparison

Performance comparison analysis between DATA Device and ACCOUNTS Device

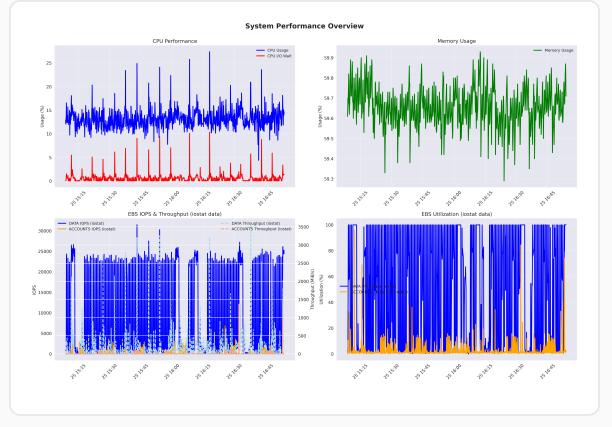


Performance Cliff Analysis

Performance cliff detection and analysis identifying causes of sharp performance drops

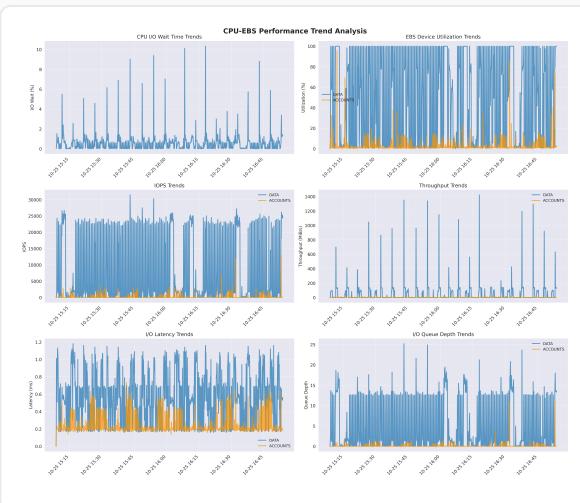
Performance Overview

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



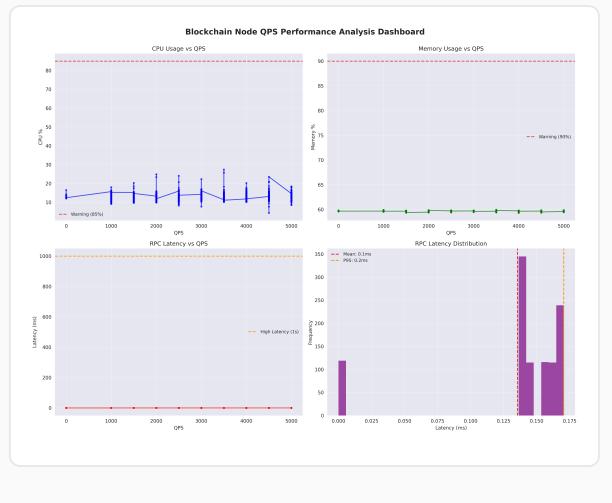
Performance Trend Analysis

Long-term performance trend analysis to identify performance change patterns



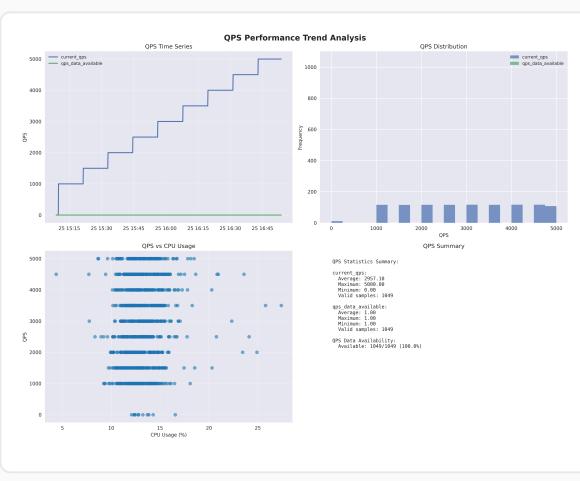
QPS Performance Analysis

Specialized QPS performance analysis charts deeply analyzing QPS performance characteristics



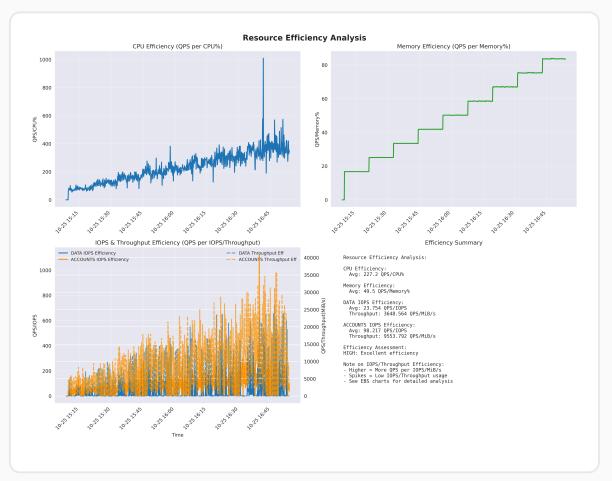
QPS Trend Analysis

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



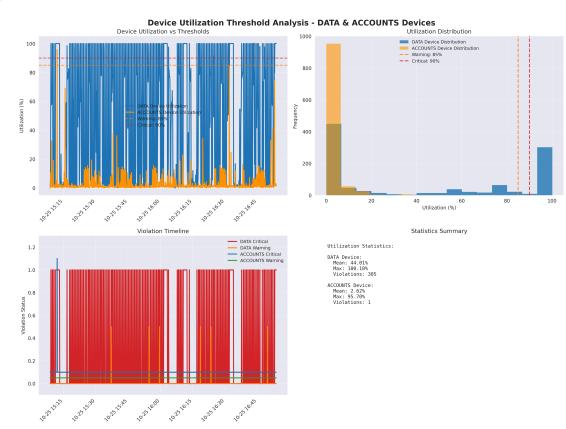
Smoothed Trend Analysis

Utilization Threshold Analysis

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



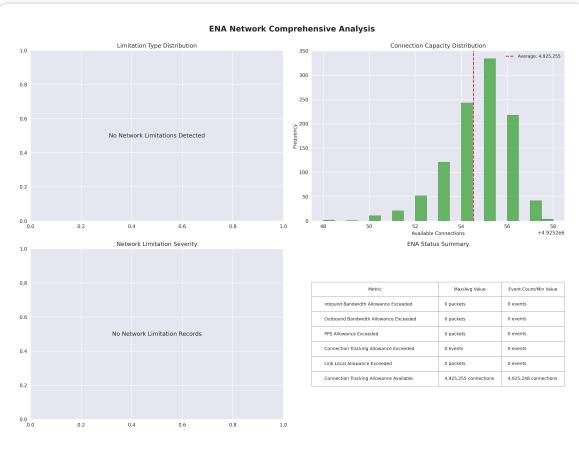
Device Utilization threshold analysis to evaluate resource usage efficiency



Network & ENA Charts (3 charts)

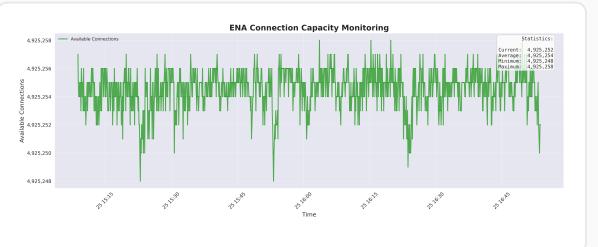
ENA Comprehensive Status Analysis

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



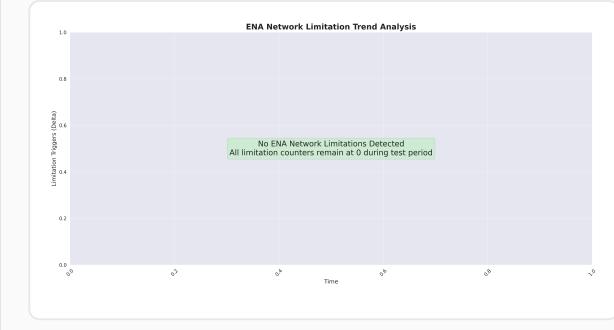
ENA Connection Capacity Monitoring

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



ENA Network Limitation Trends

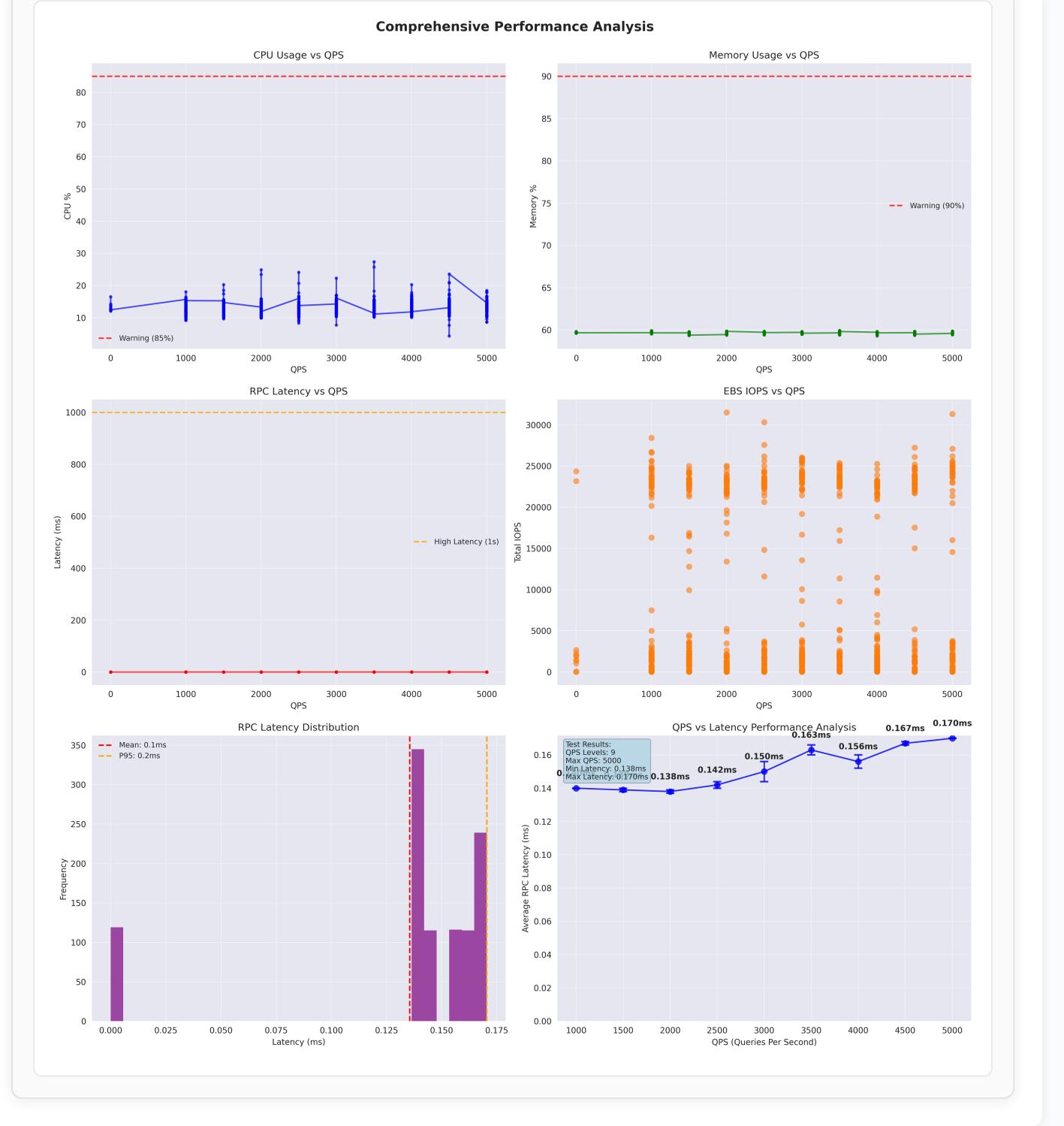
AWS ENA network limitation trend analysis showing time changes of PPS, bandwidth, connection tracking limits



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	13.35%
Average Memory Usage	59.66%

Resource Usage Comparison Analysis

Resource Type	Monitoring System	Blockchain Node	Other Processes
CPU Usage	1.10% (8.24%)	12.51% (93.69%)	0.00%
Memory Usage	0.00%	69.72%	0.00%
Memory Usage Amount	16.62 MB	516.09 GB	228961.71 MB
Process Count	6	9	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:

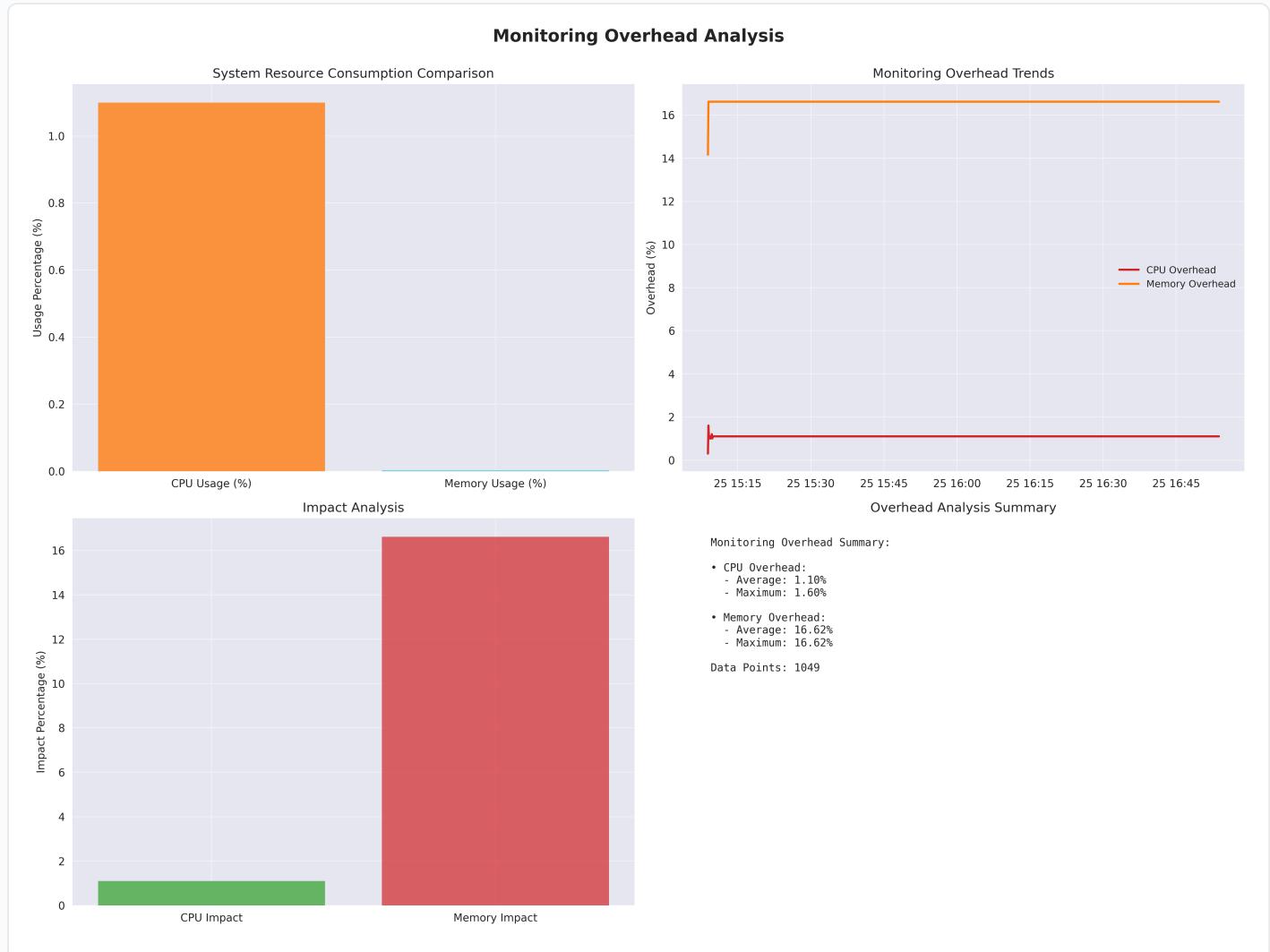
- CPU overhead: 8.24%
- Memory overhead: 0.00% (16.62 MB)
- I/O overhead: 0.00 IOPS

Blockchain node resource consumption analysis:

- CPU usage: 93.69%
- Memory usage: 69.72% (516.09 GB)

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

Monitoring Overhead Detailed Analysis

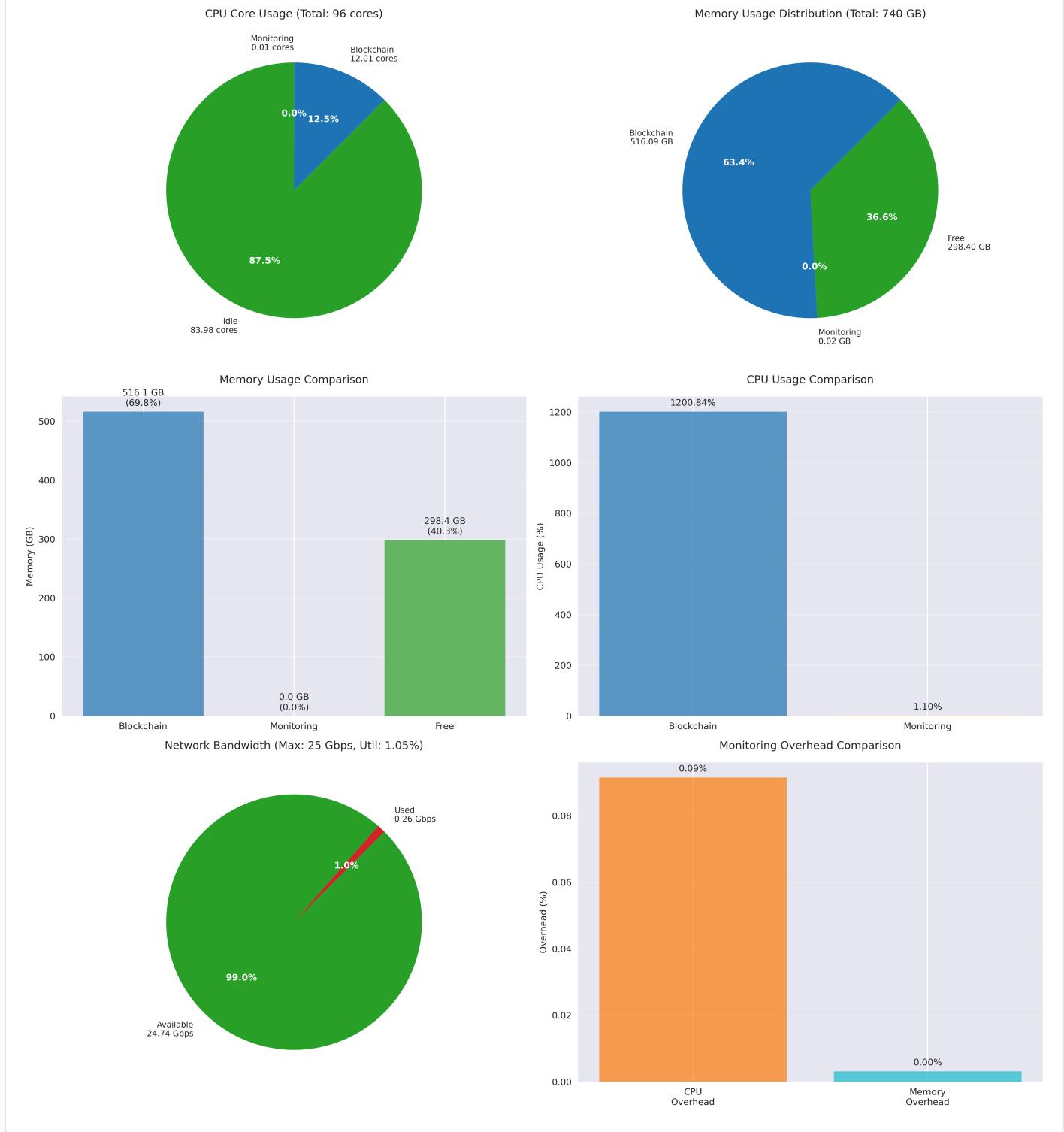


This chart shows the trend of system resource usage during testing, including:

- **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

System Resource Distribution Analysis

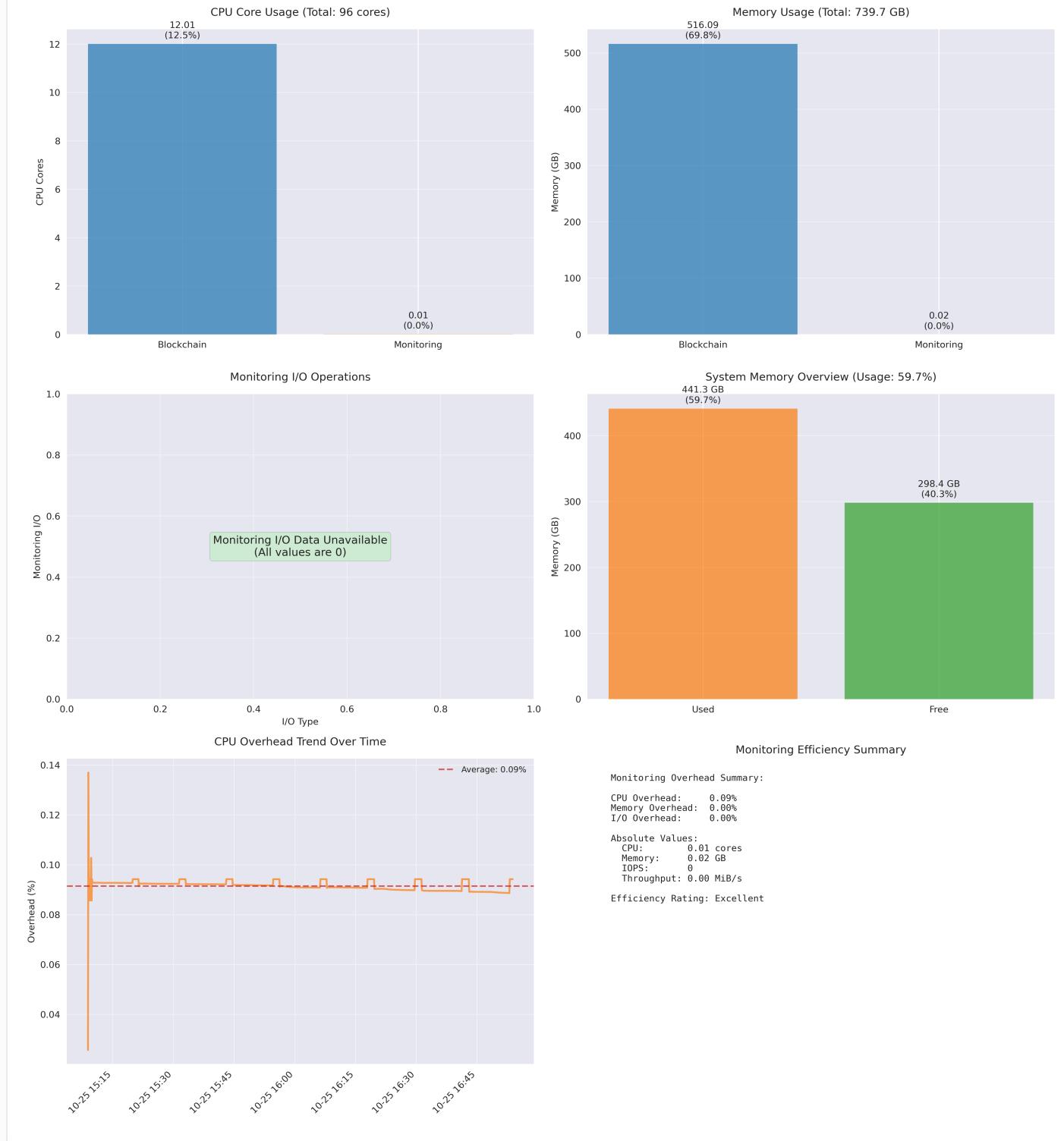


This chart shows the proportion of system resources occupied by different components:

- **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

Monitoring Overhead Impact Analysis



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

🎯 Production Environment Resource Planning Recommendations

Test Conclusion Summary

Based on performance test results, we conclude:

- Main bottleneck: **No obvious bottleneck found**
- Monitoring system resource usage: Significant
- Blockchain node resource demand: Low

Performance Optimization Recommendations

Component	Optimization Recommendation	Expected Effect
Monitoring System	<ul style="list-style-type: none"> • Reduce monitoring frequency • Use separate monitoring overhead log • Regularly clean up historical monitoring data 	Significantly reduce monitoring overhead
EBS Storage	<ul style="list-style-type: none"> • Current configuration suitable for workload • Keep current storage type • Current device configuration is reasonable 	Maintain good storage performance
Blockchain Node	<ul style="list-style-type: none"> • Current CPU configuration suitable for workload • Current memory configuration suitable for workload • Optimize blockchain node configuration parameters 	Maintain stable node performance

Device Type	Analysis Item	Correlation Coefficient	P Value	Statistical Significance	Correlation Strength	Valid Sample Count	Data Integrity
DATA	CPU I/O Wait vs Device Utilization	0.5077	0.0000	Highly Significant (***)	Moderate Correlation	1049	100.0%
DATA	CPU I/O Wait vs I/O Queue Length	0.5351	0.0000	Highly Significant (***)	Moderate Correlation	1049	100.0%
DATA	CPU I/O Wait vs Read Latency	0.5430	0.0000	Highly Significant (***)	Moderate Correlation	1049	100.0%
DATA	CPU I/O Wait vs Write	0.2689	0.0000	Highly Significant (***)	Weak Correlation	1049	100.0%

Device Type	Analysis Item	Correlation Coefficient	P Value	Statistical Significance	Correlation Strength	Valid Sample Count	Data Integrity
	Latency			(***)			
DATA	User Mode CPU vs Read Requests	0.1498	0.0000	Highly Significant (***)	Very Weak Correlation	1049	100.0%
DATA	System Mode CPU vs Write Requests	0.6569	0.0000	Highly Significant (***)	Strong Correlation	1049	100.0%
ACCOUNTS	CPU I/O Wait vs ACCOUNTS Device Utilization	0.0578	0.0615	Not Significant	Very Weak Correlation	1049	100.0%
ACCOUNTS	CPU I/O Wait vs I/O Queue Length	0.0592	0.0552	Not Significant	Very Weak Correlation	1049	100.0%
ACCOUNTS	CPU I/O Wait vs Read Latency	0.1233	0.0001	Highly Significant (***)	Very Weak Correlation	1049	100.0%
ACCOUNTS	CPU I/O Wait vs Write Latency	0.0124	0.6882	Not Significant	Very Weak Correlation	1049	100.0%
ACCOUNTS	User Mode CPU vs Read Requests	0.0017	0.9552	Not Significant	Very Weak Correlation	1049	100.0%
ACCOUNTS	System Mode CPU vs Write Requests	0.0736	0.0172	Significant (*)	Very Weak Correlation	1049	100.0%

📊 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

📊 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	Average Throughput	Data Completeness
iostat Monitoring	0.33%	0.64%	3.3 MB	5.0 MB	< 0.0001	< 0.0001	< 0.0001 MiB/s	100.0%
sar Monitoring	0.22%	0.48%	2.5 MB	3.3 MB	< 0.0001	< 0.0001	< 0.0001 MiB/s	100.0%
vmstat Monitoring	0.11%	0.24%	1.7 MB	2.5 MB	< 0.0001	< 0.0001	< 0.0001 MiB/s	100.0%
Data Collection Script	0.33%	0.64%	6.6 MB	8.3 MB	< 0.0001	< 0.0001	< 0.0001 MiB/s	100.0%
Total Monitoring Overhead	1.10%	1.60%	16.6 MB	16.6 MB	< 0.0001	< 0.0001	< 0.0001 MiB/s	100.0%

📊 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

Production Environment Recommendation: 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