UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
Cloud & Virtualization

Monitoring and Troubleshooting at Scale with Advanced Analytics

Asaf Matatyaou
Vice President, Solutions & Product Management, Cable Access Business
Harmonic, Inc.
OVERVIEW

- Troubleshooting Challenges
- Cloud Native Solutions
- “Time Travel” Debugging
- Advanced Analytics
Troubleshooting

Challenges

Limited Storage

- Log rotation
  - Limited data samples (logs, debug info) stored
  - History of events unavailable
- Logging levels turned down

Result: Issue needs to be reproduced with additional debug info
Challenges

Availability of Expertise

• Analysis requires domain experts

• Result: Delayed problem resolution due to expertise constraints from increased scale and troubleshooting workload
Troubleshooting

Challenges

Security

• Login lists
  • IP addresses, usernames & passwords or other auth info
    • Passwords shared for debugging
  • Jump hosts

• Result: Compromised accounts and hosts jeopardize critical infrastructure
Challenges

Complexity

- Result: Slow root cause analysis
Challenges

Legacy Tools

- OSSI data models
  - Limited information reported
    - Granular monitoring data not defined
  - CLI and SNMP performance
    - Does not scale to large amounts of data
    - Low time resolution

- Result: Stale data and lack of essential troubleshooting information
## Streaming Logs and Telemetry

### Headends, Networks, Nodes

<table>
<thead>
<tr>
<th>Category</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware Status</td>
<td>External Data (environmental, power outage, truck roll, etc.)</td>
</tr>
<tr>
<td>Server Resource Metrics (CPU, RAM, disk, etc.)</td>
<td>Process Statistics (resource usage)</td>
</tr>
<tr>
<td>Software State and Performance Metrics</td>
<td>OSSI-defined Data</td>
</tr>
<tr>
<td>Health Check Status (throughput, etc.)</td>
<td>Other Data</td>
</tr>
<tr>
<td>Containers</td>
<td>OS (kernel, drivers)</td>
</tr>
<tr>
<td>System Processes</td>
<td>Audit</td>
</tr>
</tbody>
</table>

### Cloud (Public or Private)

- Alerts
- Analytics
- Machine Learning
- Customer Apps
- Troubleshooting Tools
- Dashboards

**Flow:**
- Streaming Telemetry
- Metrics Databases
- Streaming Logs
- Log Databases
Streaming Logs and Telemetry

**Scalability**

- Elastic cloud storage
  - Store vast amounts of data
    - No log rotation
    - Richer logs and metrics
- Centrally accessible ➔ Scalable operations
  - No need to maintain access to large number of deployments
Cloud Native Solutions

Streaming Logs and Telemetry

**Advanced Tools**

- Automated data analysis
  - Failure detection
  - SLA violations
  - Alerts
- Data visualization
  - Dashboards ➔ A picture is worth a thousand words
- Explorative analysis
  - Searchable databases
  - Filter out or drill down
- Continuous improvements
  - New algorithms, alerts, dashboards, etc. easily deployable
Cloud Native Solutions

Streaming Logs and Telemetry

Security

• Centrally accessible
  • No need to login to systems for accessing debug data
  • Easy to manage access to centrally-located data and troubleshooting tools

• Streamed **out**
  • No incoming connections to deployments
Time Travel Debugging

Logs and Events

Filter on objects of interest

Visualize statistics

Search for events and logs from the past leading up to a failure

Observe timeline of events

Search across multiple components and even multiple deployments
Time Travel Debugging

State and Metrics

Access internal performance data from software components

Search for data from the past leading up to a failure

Access complete system state and performance data at any point in the past

Visualize change in value of critical metrics
Auto Observability

Logs and Metrics DBs

Error Signature Identification
Threshold Triggers
Anomaly Detection
System State Monitoring
Closed-Loop Interfaces

Fault Detection and Alerting
Operations Support for Updates
Health and Usage Reports and Recommendations
SLA Compliance, Debug Data Gathering
Multi-Variable KPI

**KPIs**
- Support Call Volume
- Internet Speeds
- Ping Latencies
- Costs

**System State**
- FEC Counters
- Scheduling Latency
- Bandwidth Utilization
- Flap Counters

**Available Actions**
- RF Parameters
- Scheduling Policy
- Subscriber Density
- Feature Toggles

**Agent**

**System Configuration**
Fault Isolation

- Logs and Metrics from All Components
- Previous Analysis Labeled with Failure Origin
- Possible Origin of Fault

Analysis Pipeline

Topology and Configuration Info
Some Considerations

Privacy

- Logs and metrics can reveal privacy-sensitive subscriber data
  - Ethical and legal considerations
- Default: Do not collect such data
- Anonymize identifiers
Some Considerations

Cost

Value

• Challenging to calculate
  • Troubleshooting time vs development time
  • Operational improvements
  • Downtime reduction
  • Support costs reduction
  • Customer satisfaction
  • Revenue generation
Some Considerations

Cost

Compute vs Storage
- Compute costlier than storage
- Store raw data, Process on demand
  - Increased data access latency
Some Considerations

Cost

Public Cloud vs On-Prem Infrastructure

- Private can be cheaper
- Service expense vs Capital expenditure
- Support costs
- Scale and elasticity
- Domain still evolving ➔ Prefer public cloud services
**Some Considerations**

### Cost

#### Data Retention

- Huge amounts of data ➔ High storage costs
- Warm or cold storage for older data
  - Higher latency to access
- Discard older data
  - Long-term patterns and seasonal traits may be missed
- Feature generation
  - Store data traits instead of all data
Conclusion

Advanced Analytics Applications are Essential

• Modern solutions generate rich data sets
  • Require new tools and processes to handle scale
• Powerful troubleshooting capabilities
  • “Time travel” debugging
• Advanced applications
  • Automated data analysis
  • Machine learning applications
• Essential for customer satisfaction and successful operations
Thank You!

Asaf Matatyaou
Vice President, Solutions & Product Management, Cable Access Business
Harmonic, Inc.
asaf.matatyaou@harmonicinc.com