International Civil Aviation Organization

Fifth Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/5)

Chengdu, China, 5 – 7 June 2024

Agenda Item 4: ATM Automation System Implementation Experience by States

4.1 ATM Automation System Implementation Issues sharing

INTRODUCTION OF AIOPS APPLICATION IN ATMAS

（Present by China）

SUMMARY

Algorithmic IT Operations (AIOps) provides a novel approach to the technical maintenance for ATMAS. This paper presents the requirements, architecture and implementation of AIOps for ATMAS in China, and demonstrates the future plans to enhance the automation, integration, and intelligence levels of technical maintenance work.

1. INTRODUCTION

1.1 Current technical maintenance for ATMAS has certain limitations, mainly manifesting in: limited maintenance methods, tedious fault troubleshooting, lots of manual repetitive work, and only passive perception of running status without proactive prediction. It heavily relies on human execution, thus there is an urgent need to adopt new measures to overcome these issues. Algorithmic IT Operations (AIOps) utilizes algorithms to analyze big data collected from various tools, enabling real-time and automated detection and response to running status issues. AIOps provides a novel approach to the technical maintenance for ATMAS.

2. DISCUSSION

2.1 Requirements Analysis

2.1.1 General Requirements

The application of AIOps in ATMAS has the characteristics of:

a) Automation: to automate repetitive work and promptly identify issues that are manually undetectable.

b) Integration: to integrate data, resources, and tools that scattered across different domains and processes.

c) Intelligence: to diagnose and predict system running status and take proactive

measures in advance.

2.1.2 Functions Requirements

a) Multi-source data collection

AIOps covers IT infrastructure, networks, software and so on. Therefore, it is necessary to integrate diversified and highly real-time data sources.

b) Data persistence

The monitoring data including system running status, performance metric, and log file should be persisted for postmortem analysis.

c) Application of relevant algorithms and tools

Algorithms and tools, for example, automated programs or scripts, time series analysis algorithms, text mining algorithms, artificial intelligence models, should be put into service .

2.2 Architecture and Implementation

2.2.1 Implementation Progress

Currently, ATMB of CAAC is conducting a test of AIOps application for ATMAS and has integrated the application into a newly deployed backup ATMAS. The factory acceptance test of system has been completed in 2023, during which the AIOps application basically meets the function requirements.

2.2.2 Technical Architecture

The technical architecture is illustrated in the diagram below.

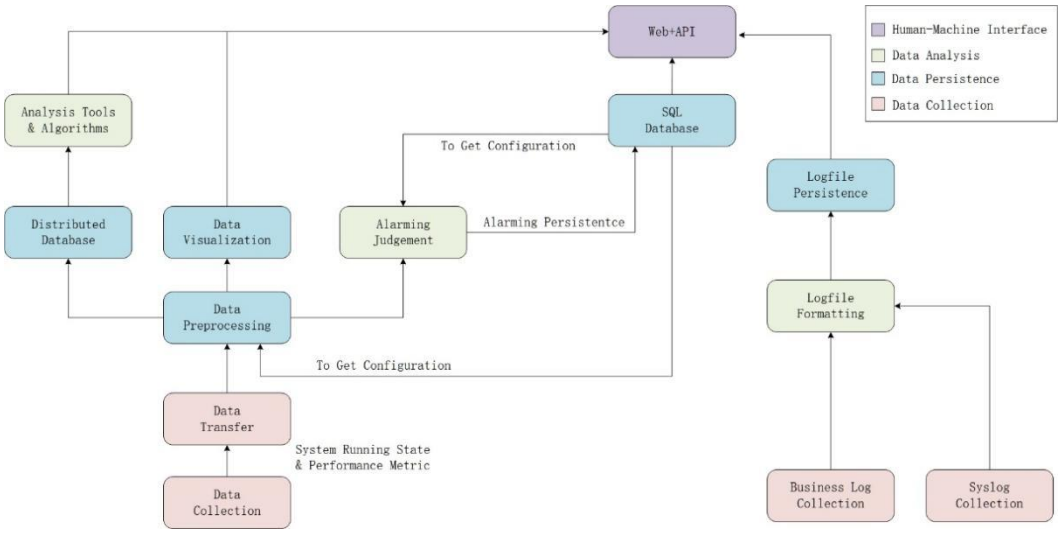

Figure 1 Technical Architecture of AIOps Application

2.2.3 Deploying AIOps application in ATMAS

To avoid any impact on the normal operation of ATM core business, the following factors are considered in the deployment of AIOps:

a) Isolation of service

A stand-alone server is deployed for AIOps applications. The AIOps service is provided based on the Browser/Server architecture, which allowing the maintenance terminal or other terminals to access through browser.

b) Isolation of Network

When AIOps applications is running, only passive reception of monitoring data is allowed on LAN C (for transmission of auxiliary information within ATMAS). Besides, collection and transmission of hardware-related monitoring data are achieved through the out-of-band management network.

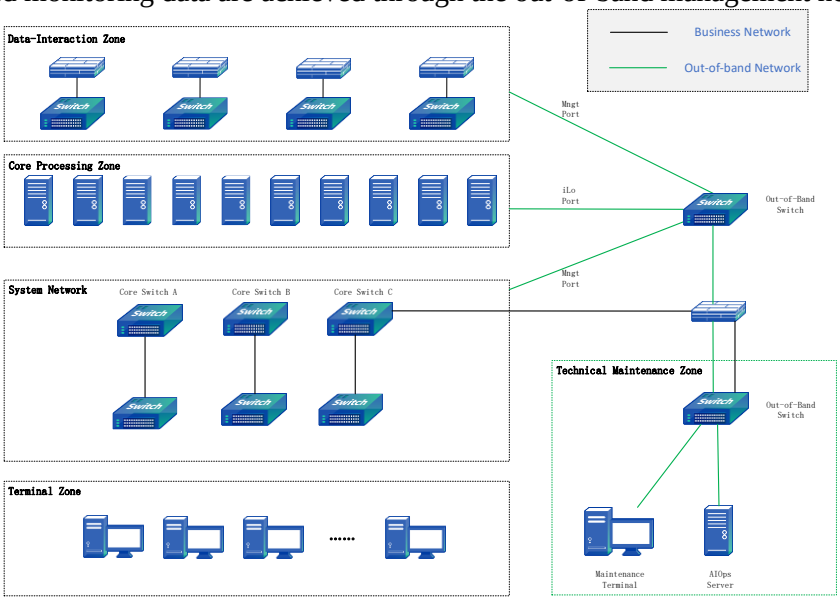

Figure 2 Deployment of AIOps Application

2.2.4 Main Functions

a) Performance Metric Statistics and Forecasting

Currently when system failure occurs, measures have to be quickly adopted in a short period of time. This function forecasts the future trends of performance metric including disk capacity, network traffic, and software memory usage. It also provides early warnings before system failures, which helps to make maintenance plans in advance. As a result, it provides more decision-making support and facilitates reducing the risk of system fault.

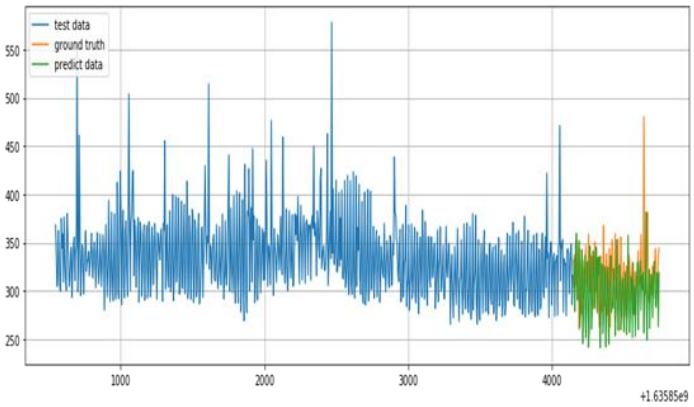

Figure 3 Performance Metric Statistics and Forecasting

b) Automated System Inspection

It performs automated inspection tasks such as checking running status of software, basic configuration, network and signal status, hardware resource usage, etc. This function helps to overcome some drawbacks of manual inspection such as inefficiency with a high risk of errors.

Figure 4 Automated System Inspection

c) Equipment Asset Management

It provides visual representation of the running status of equipment asset, including both hardware and software. This function also presents statistics and analysis of historical monitoring data. So, it only takes a few seconds for staff to know which equipment needs maintenance.

Figure 5 Equipment Asset Management

d) Hardware Health Assessment

Currently, we have no idea about status changes of hardware until failure occurs. This function provides health assessment of hardware including servers, terminals, switches, etc. The health assessment helps to visualize and quantify subtle changes of their running status, thereby assisting staff in making maintenance plans in advance.

Figure 6 Hardware Health Assessment

e) Syslog Collection and Storage

Syslog is useful for audits, troubleshooting, and other essential operational tasks, which is not collected in current ATMAS. This function provides real-time collection and persistence of syslog. It helps to conduct post-incident evidence collection and analysis for the purpose of network security.

Figure 7 Syslog Collection and Storage

f) Log-based Analysis and Troubleshooting

This function provides persistence and rapid query of billions of application logs, which enables second-level system-wide log search within a single window. It also supports the correlation of multiple business logs (surveillance data processing, flight data processing, correlation of surveillance data and flight data, etc.) to achieve end-to-end analysis of target objects.

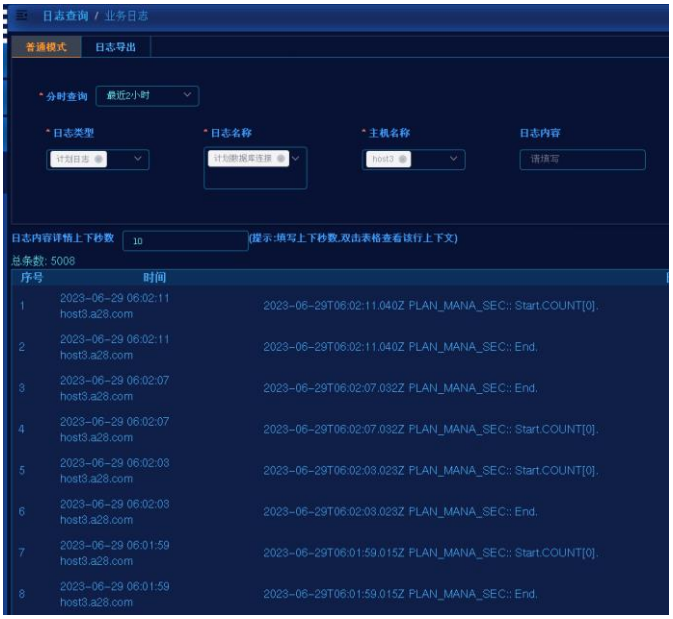

Figure 8 Log-based Analysis and Troubleshooting

2.2.5 Effect of Putting into Operation

Currently, the AIOps application effectively enhances the efficiency of daily maintenance work and helps to promptly identify issues that are manually undetectable, which have earned recognition of the user. The AIOps application is expected to be deployed on operating platform and continue to collect data and optimize algorithms in the future.

2.3 Future Plans

AIOps provides a novel approach to the technical maintenance for ATMAS. Further efforts will be made in the following aspects:

a) To optimize the functionalities with real monitoring data.

b) To provide diversified methods for accurate performance metric forecasting.

c) To optimize the performance of data forwarding and data storage.

d) To continuously investigate business requirements and enhance the practicability of application.

To sum up, this work plays an exemplary role in the evolution of the technical maintenance for China's civil aviation ATMAS. We will continue to validate the rationality of application architecture, enhance the depth and breadth of data analysis, deeply analyze business requirements, and enrich its functions.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate.

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