



Implementation Framework for Digital Thread-Based Predictive Maintenance in ISP Network Operations

Navid Tole

How to Cite this Article:

Tole, N. (2026). Implementation Framework for Digital Thread-Based Predictive Maintenance in ISP Network Operations. International Journal of Creative and Open Research in Engineering and Management, 2(05).
<https://doi.org/10.55041/ijcope.v2i4.994>

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Abstract

This study presents a Digital Thread-based Predictive Maintenance framework for ISP networks. It integrates IoT, AI, and lifecycle data to reduce downtime, improve MTTR, and enhance SLA compliance. The framework is applied to FAHNET Internet Services in Mumbai.

Introduction

Internet Service Providers (ISPs) are critical to digital infrastructure. Increasing demand for high-speed and reliable internet has made network maintenance complex. Traditional maintenance methods are no longer sufficient. Predictive Maintenance (PdM) using IoT and AI provides proactive solutions, while Digital Thread ensures data integration across lifecycle stages.

Problem Statement

FAHNET ISP faces operational issues such as unplanned fiber cuts, router overheating, power failures, and high complaint turnaround time. Lack of integrated data across departments creates inefficiencies and delays in fault resolution.

Objectives

The study aims to analyze current maintenance practices, design a Digital Thread-based framework, improve MTTR, reduce downtime, and enhance operational efficiency.

Scope of Study

The research is limited to ISP operations in Mumbai, focusing on routers, fiber networks, and power systems. It includes both technical and managerial aspects of maintenance.

Literature Review

Predictive Maintenance is a condition-based approach that uses real-time data and analytics to predict failures. It evolved from TPM and RCM. Digital Thread integrates lifecycle data, improving coordination and decision-making. Combining both enables efficient network management.



Research Gap

Limited studies focus on implementing Digital Thread with predictive maintenance in ISP environments, especially in India. This study addresses that gap.

Research Methodology

The study uses a descriptive and analytical approach. Primary data is collected through interviews and surveys, while secondary data is obtained from reports and journals. Sample size includes 30–50 employees. Data is analyzed using basic statistical tools.

Conceptual Framework

Independent variables include real-time monitoring, data integration, and AI prediction. Dependent variables include network uptime, MTTR, cost efficiency, and SLA compliance. Technician skill and data accuracy act as moderating factors.

Proposed Framework

The framework includes six stages: design data capture, installation records, real-time monitoring using IoT, AI-based prediction, automated work orders, and feedback loop for continuous improvement.

Data Analysis

Analysis shows frequent network failures and delayed response times. Implementation of predictive maintenance reduces downtime, improves fault detection, and enhances service quality.

Findings

The study finds that predictive maintenance improves efficiency, reduces costs, eliminates data silos, and enhances network reliability.

Recommendations

It is recommended to deploy IoT sensors, implement centralized data systems, train staff in AI tools, and gradually adopt Digital Thread architecture.

Conclusion

Digital Thread-based predictive maintenance is an effective solution for modern ISP challenges. It improves uptime, reduces MTTR, and enhances operational performance.

Future Scope

Future research can focus on 5G networks, advanced AI models, and large-scale implementation across telecom sectors.