Chapter 9
Solution for Error and Attenuation Detection in Network Services Based on Time Series Decomposition Model:
Pattern Mining Based on Time Series Decomposition via REFII Model and Data Science Methods Usage

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ABSTRACT

This chapter introduces an innovative methodology for error and attenuation detection in network services by unifying the REFII time series model with Bayesian networks (BNs), and complementary data science techniques traditionally applied outside temporal analytics. The proposed framework addresses the critical challenge of identifying rare, high-impact events—such as signal degradation in mobile or fixed networks—that compromise service quality but are often obscured by complex temporal dependencies and imbalanced data distributions. This transformation facilitates non-temporal expansion, a novel interpolation process that enriches time series with contextual events and operational parameters lacking inherent

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temporal markers. Proposed solution unites advanced analytical techniques with decision making process for pattern mining like Bayesian networks, decision trees, FTP, K-Means clustering.

1. INTRODUCTION

Error detection in modern fixed and mobile network infrastructure faces a dual challenge: the inherent volatility of temporal signal characteristics and their often-overlooked correlations with non-temporal system parameters. Conventional error detection mechanisms—ranging from cyclic redundancy checks (CRCs) to parity-based protocols—exhibit critical vulnerabilities when confronted with complex temporal dependencies, such as burst errors masked by periodic network traffic patterns or intermittent signal degradation influenced by environmental factors.

In the realm of network technology, the repetitive occurrence of technical errors can serve as a critical catalyst for initiating a deep investigation into the underlying causes.

These recurrent issues not only disrupt the seamless operation of network services but can also indicate deeper systemic problems that necessitate thorough examination.

Repetitive network technical errors refer to the recurrence of similar faults or malfunctions within a network infrastructure. These errors can manifest in various forms, including connectivity issues, latency spikes, packet loss, and service outages.

Their persistent nature suggests that there may be fundamental issues within the network that require attention. When technical errors occur repeatedly, it is imperative to conduct a comprehensive investigation to identify the root causes. Deep investigations involve the systematic analysis of network logs, performance metrics, and user reports to uncover patterns and correlations.

This process often requires the collaboration of network engineers, data analysts, and cybersecurity experts to ensure a holistic understanding of the problem. Several factors can contribute to the repetitive occurrence of network technical errors.

One prominent factor is the increasing usage of network services. As the user portfolio grows and diversifies, the demand on network infrastructure intensifies, leading to potential overloads and performance bottlenecks.

Specific user behaviors, such as high-frequency data transmissions or resource-intensive applications, can exacerbate these issues.

Another significant factor is the complexity of modern network architectures. The integration of various technologies, including cloud computing, IoT devices, and virtualized environments, adds layers of complexity that can introduce new points of failure. Inadequate network design, configuration errors, and insufficient maintenance can further compound these challenges.

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