

# Alarm Correlation in Mobile Telecommunication Networks Based on the Dice Coefficients

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**Abstract:** The mobile telecommunication domain has recently been experiencing huge changes. The introduction of new technologies and services (2G, 3G, 4G(LTE)), combined with a multivendor environment distributed across one geographical area, brings a lot of challenges in network operation routines. Network maintenance activities are becoming more and more complicated and time consuming, as most of the tasks are carried out manually by experts using raw network management information available in the management system via multiple applications and direct database queries. The paper presents a methodology for alarm correlation in mobile telecommunication networks based on the similarity coefficients *Dice*, *Dice1* and *Dice2* for binary representation of alarm symptoms from the network. The calculated values are treated as probability measures of a relationship between alarms which can be used for constructing Fault Propagation Model. The alarm correlation methodology based on a exponentially weighted rolling average of *Dice*, *Dice1* and *Dice2* coefficients shows a satisfactory accuracy, speed and reliability of correlation hypotheses. The methodology generates a reasonable Fault Propagation Models for the Mobile Telecommunication Network. It is very effective from the computing point of view and it is possible to run the algorithm on a PC. The proposed approach of using the *Dice*, *Dice1* and *Dice2* coefficients for generating Fault Propagation Models works very efficiently for models with several thousand symptoms (alarms). The values of conditional probability estimates allow us to filter the most probable symptoms for network problems with the right priorities. The binary temporal shift introduced into the algorithm at the level of four seconds provides a good model of the time correlation window in mobile telecommunication networks and makes it possible to correlate alarms more accurately. The exponentially weighted rolling average of *Dice*, *Dice1* and *Dice2* coefficients simulates reasonably well the impact of alarm propagation time on the value of correlation strength. The methodology is universal and works regardless of the mobile technology which is used in the network (2G,3G,4G). It has been discovered that the methodology provides also a good base for constructing alarm correlation patterns. The patterns obtained could be used as predefined alarm correlation rules for reducing the alarm correlation effort in the future for alarm data sets.

*Keywords:* Fault detection and diagnosis, Mobile Telecommunication Networks, Root Cause Analysis, *Dice*, *Dice1*, *Dice2* similarity coefficients.

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