

Accepted Manuscript

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PII: S1389-1286(13)00274-0

DOI: <http://dx.doi.org/10.1016/j.comnet.2013.08.011>

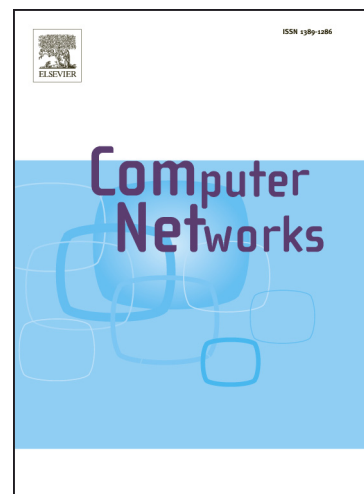
Reference: COMPNW 5079

To appear in: *Computer Networks*

Received Date: 6 July 2012

Revised Date: 19 July 2013

Accepted Date: 17 August 2013



Please cite this article as: M. Manzano, E. Calle, V. Torres-Padrosa, J. Segovia, D. Harle, Endurance: a New Robustness Measure for Complex Networks Under Multiple Failure Scenarios, *Computer Networks* (2013), doi: <http://dx.doi.org/10.1016/j.comnet.2013.08.011>

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Endurance: a New Robustness Measure for Complex Networks Under Multiple Failure Scenarios

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Abstract

Society is now, more than ever, highly dependent on the large-scale networks that underpin its functions. In relatively recent times, significant failures have occurred on large-scale networks that have a considerable impact upon sizable proportions of the world's inhabitants. The failure of infrastructure has, in turn, begot a subsequent loss of services supported by that network. Consequently, it is now vitally important to evaluate the robustness of such networks in terms of the services supported by the network in question. Evaluating network robustness is integral to service provisioning and thus any network should include explicit indication of the impact upon service performance. Traditionally, network robustness metrics focused solely on topological characteristics, although some new approaches have considered, to a degree, the services supported by such networks. Several shortcomings of these new metrics have been identified. With the purpose of solving the drawbacks of these metrics, this paper presents a new measure called *endurance*, which quantifies the level of robustness supported by a specific topology under different types of multiple failure scenarios, giving higher importance to perturbations affecting low percentages of elements of a network. In this paper, *endurance* of six synthetic complex networks is computed for a range of defined multiple failure scenarios, taking into account the connection requests that cannot be satisfied. It is demonstrated that our proposal is able to quantify the robustness of a network under given multiple failure scenarios. Finally, results show that different types of networks react differently depending on the type of multiple failure.

Keywords: Robustness, Complex networks, Multiple failures

1. Introduction

Large-scale networks supporting the provision of telecommunication, electrical power, rail and fuel distribution services are now crucial structures within society. These critical infrastructures, which underpin and fulfill key aspects of modern day living, can be formally defined as a set of three components $\{N, L, DP\}$

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