Transport in Weighted Networks: Partition into Superhighways and Roads[1] ZHENHUA WU, Center for Polymer Studies, Boston University, Boston, Massachusetts 02215, USA, LIDIA A. BRAUNSTEIN, Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Funes 3350, 7600 Mar del Plata, Argentina, SHLOMO HAVLIN, Minerva Center of Department of Physics, Bar-Ilan University, Ramat Gan, Israel, H. EUGENE STANLEY, Center for Polymer Studies, Boston University, Boston, Massachusetts 02215, USA
— Transport in weighted networks is dominated by the minimum spanning tree (MST), the tree connecting all nodes with the minimum total weight. We find that the MST can be partitioned into two distinct components, having significantly different transport properties, characterized by centrality-the number of times a node (or link) is used by transport paths. One component, superhighways, is the infinite incipient percolation cluster, for which we find that nodes (or links) with high centrality dominate. For the other component, roads, which includes the remaining nodes, low centrality nodes dominate. We find also that the distribution of the centrality for the infinite incipient percolation cluster satisfies a power law, with an exponent smaller than that for the entire MST. The significance of this finding is that one can improve significantly the global transport by improving a tiny fraction of the network, the superhighways.

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