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Transportation on Complex Networks: Internet Traffic

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Properties of different types of networks have begun to attract the interest of statistical physicists [1, 2]. The spectrum of network related problems include ordinary traffic in a city , distribution of nutrients in the vascular system, distribution of goods and wealth in economies, queuing problems on information networks biochemical- and gene expression pathways etc. It has been recognized that these networks evolve in time and that their structure emerged as result of microscopic evolution rules [3–5]. Maybe the most prominent example of such a network is the world-wide Web and the Internet. Transport processes on networks, such as traffic of information packets on the Internet or diffusion of signaling molecules in a biological cell, are physical processes which are closely related to the network geometry. The vast research on information traffic on technological networks is motivated to optimize network structure for practical reasons such as, e.g., optimum connection strategies and information flow at minimal costs and risk. Recent empirical studies on Internet traffic suggest a complex interplay of queuing behavior , temporal correlation in packet streams and broad distributions of travel times of packets. Often two general regimes of traffic are recognized in networks: free flow and jammed traffic. A jamming transition is expected when traffic density exceeds a critical value. Our basic aim in this talk is to introduce the essential properties of the jamming transition on simple network geometries. In addition, we try to implement a general numerical model to study packet traffic on several classes of networks with diverse structural characteristics. We try to relate a given network topology to characteristic diffusion parameters such as probability distributions of travel times and packet velocities. Further we want to quantitatively characterize the diffusion on given network topologies within a general framework of non-linear diffusion phenomena.

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