Congestion induced by network multiplexity
Supplemental Material

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FRACTION OF INTER-LAYER SHORTEST PATHS

An important parameter of traffic dynamics in multiplex networks is the fraction of inter-layer shortest paths, i.e. the fraction of shortest paths that contain, at least, one inter-layer edge. Experiments with multiplex networks composed of two layers, each one being a different random Erdős-Rényi network, show that most of the shortest paths are fully contained within a layer, see Figure 1, and this effect becomes more evident as the degree of the layers increases. Therefore, the fraction of inter-layer shortest paths $(1-\lambda)$ is basically negligible, and the main factor influencing the traffic dynamics is the migration of shortest paths from the less efficient layer (the one with larger shortest paths) to the most efficient one. Taking advantage of this fact, we have been able to approximate the critical injection rate of the multiplex by rescaling the critical injection rate of the individual layers.

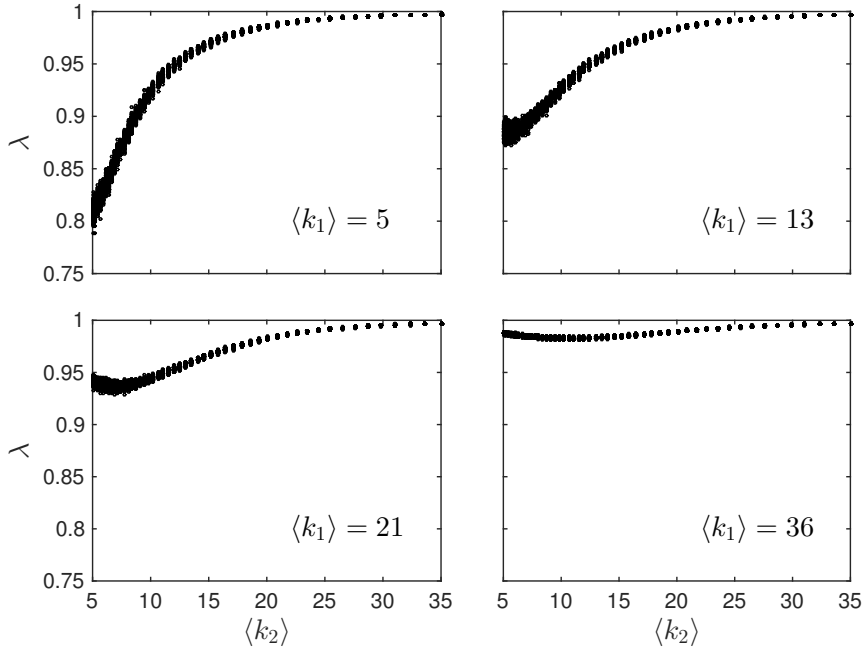

FIG. 1: Fraction λ of paths fully contained within layers. Each multiplex network is formed by two Erdős-Rényi layers of 500 nodes each. We plot 100 random realizations for each pair of mean degrees $\langle k_1 \rangle$ and $\langle k_2 \rangle$.