May 2017

IDA | Research Insights

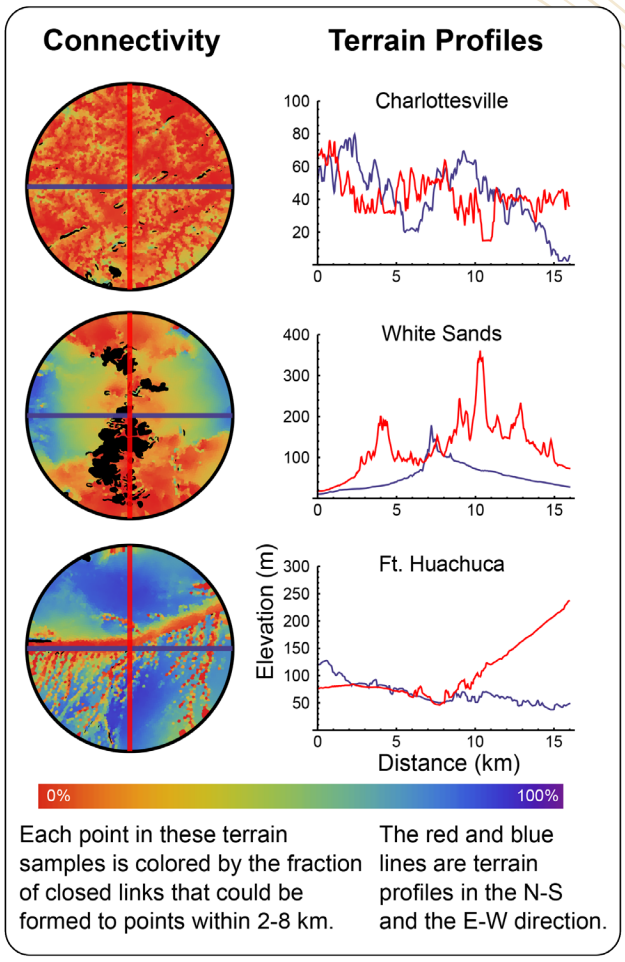
The Challenge of Terrain in Ad Hoc Networking*

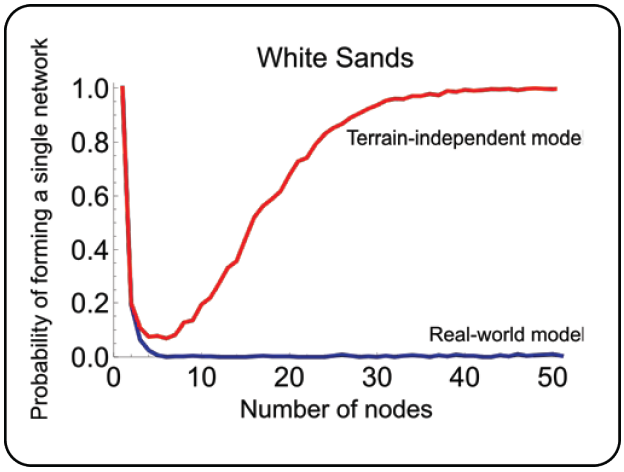
Lance G. Joneckis (ljonecki@ida.org), Corinne M. Kramer (ckramer@ida.org), David A. Sparrow (dsparrow@ida.org), David M. Tate (dtate@ida.org)

Previous attempts to form mobile terrestrial ad hoc networks (MANETs) from high frequency radio links have encountered critical difficulties, often only overcome with an overhead solution. IDA has used new approaches to map connectivity in varied terrain. The impact of terrain features is clearly visible, and the challenge posed in each location readily perceived. Simple terrain, such as gently rolling hills, is particularly challenging.

A terrain-independent network model can be built from these terrain-averaged probabilities. By comparing this model with our terrain-based model, **IDA has been able to characterize some critical mechanisms by which terrain inhibits the formation of useful networks**.

The IDA model shows that in non-ideal terrain, ad hoc networks become more segmented, not less, as nodes are added. The graph below shows the probability that a given number of simulated nodes form a single network in the White Sands region. This counter-intuitive result is driven by substantial regions with poor connectivity to the entire area. This finding, which assumes a static network, provides a partial explanation of past failures in developing robust line-of-sight networks. Mobility imposes additional challenges, as elucidated in the companion investigation.





IDA's research identifed and quantified the constraints that terrain imposes on the creation of mobile ad hoc networks, allowing for additional insights into comparisons of potential solutions to the problem. These alternatives include the use of large numbers of nodes (shown to be prohibitively expensive), the use of an air tier (likely to become overburdened when linking the large numbers of subnets predicted by the IDA model), or a switch to much lower frequencies.

NS D-8513

*Based on IDA NS D-5245, *Network Size and Connectivity in Mobile and Stationary Ad Hoc Networks*, and IDA NS D-5246, *Modeling Terrain Impact on MANET Connectivity*, May 2014. Research sponsored by IDA.

4850 Mark Center Drive
Alexandria, VA 22311-1882