Modern computer communication has been developed to provide continuous end-to-end connectivity. This design goal has also been carried over to wireless communication, primarily because it is an imperative for voice communication. Continuous connectivity comes at a high cost in wireless networks with mobile users, since it requires seamless coverage over all the areas where users move. There are, however, communication services that are tolerant to disruptions and delay and do not require continuous connectivity: it is time to consider the disconnected network.

This special issue is dedicated to communication over wireless networks with intermittent connectivity due to sparse coverage, power management, or covert operation. The disruptions may result in long delays for the communicating parties. The communication services that may use such intermittent and high-delay connections are typically characterized by a low degree of interactivity, e.g., broadcasting, messaging, and data collection. Opportunistic strategies for caching and communicating may improve the performance in terms of reduced delay and improved probability of delivery, but it should be balanced against the cost in terms of efficiency and energy usage.

Delay and disruption tolerant communication offers the hope of providing wireless services that scale with the density of mobile nodes, fixed access points, and base stations. This tolerance also enables systems to operate in highly challenging communication environments. This issue of J-SAC is dedicated to systems designs and analyses that contribute to the development of delay and disruption tolerant wireless communication systems. We have received a total of 43 submissions and, after a careful review process, we accepted eight papers, covering routing and network coding for spare mobile ad hoc networks, cross-layer design for sensor networks, satellite communication, and DTN architectural issues. The issue opens with a group of papers on routing in sparse networks. The first paper is entitled, “Socially Aware Routing for Publish-Subscribe in Delay-Tolerant Mobile Ad Hoc Networks” by Paulo Costa, Cecilia Mascolo, Mirco Musolesi and Gian Pietro Picco. The authors propose a publish-subscribe scheme for ad hoc networks that they call SocialCast, which uses patterns of movements among communities to identify the best nodes to carry the published information. The performance of the scheme is studied for a mobility model based on a social network and it is validated with human mobility traces.

The second paper is entitled, “A Content-Centric Framework for Effective Data Dissemination in Opportunistic Networks” by Ling-Jyh Chen, Chen-Hung Yu, Cheng-Long Tseng, Hao-hua Chu and Cheng-Fu Chou. This contribution proposes techniques to better facilitate data dissemination based on the characteristics of the content. For three types of content (file, video and web), file-based dissemination methods are compared to methods based on layered multiple description coding (LMDC) in terms of latency and user perceived quality. LMDC-based techniques that enable the user to preview a video file or web content, even before the data has been completely transferred, are shown to improve user perceived quality.

Vania Conan, Jérémie Leguay and Timur Friedman describe a routing scheme for opportunistic networks in their paper “Fixed Point Opportunistic Routing in Delay Tolerant Networks.” They propose a method to estimate the delivery time of packets in a DTN scenario. The assumption is that the packets get forwarded over several hops and that the nodes meet each other with inter-meeting times modeled by Poisson processes. Based upon these estimations, they calculate expected delivery times for the one and two hop cases which they then generalize to multi-hop routing using recursion.

Epidemic routing is a common method for forwarding data in sparse ad hoc networks. The paper entitled, “(p,q)-Epidemic Routing for Sparsely Populated Mobile Ad Hoc Networks” by Takahiro Matsuda and Tetsuya Takine provides a unified, parameterized model of epidemic routing. The analysis in the paper includes a recovery scheme that aims to delete packets that are redundant after a message has been delivered. The tradeoffs in delivery delay versus energy consumption and buffer requirements are also studied.

Epidemic routing is also considered in the paper entitled, “Stochastic Analysis of Network Coding in Epidemic Routing,” by Yunfeng Lin, Baochun Li and Ben Liang. The paper develops an analytical framework to examine whether network coding offers any benefits over simple replication for epidemic routing in disruption tolerant networks. The authors show that network coding is superior when bandwidth and node buffers are limited. In addition, the authors propose a priority based coding protocol that enables a destination to decode a high priority subset of the data much earlier than it can decode any data without the use of priorities.
All of the remaining papers deal with topics other than routing. The first of this set is the paper entitled, “Cross-Layer Protocol Design and Optimization for Delay/Fault-Tolerant Mobile Sensor Networks (DFT-MSN’s)” by Yu Wang, Hongyi Wu, Feng Lin and Nian-Feng Tzeng. The paper addresses the tradeoff between link utilization and energy efficiency in disruption tolerant mobile sensor networks through the development of a two-phase data delivery protocol. In a contention-based first phase, the sender contacts its neighbors to identify a set of appropriate receivers. In the second phase, the sender gains channel control and then multicasts its data message to the receivers. These phases are then optimized to reduce collision probabilities and achieve a high message delivery ratio with low energy consumption and acceptable delay.

The next paper is “A DTN Approach to Satellite Communications” by Carlo Caini, Piero Cornice, Rosario Frrincieli and Daniele Lacamera. The paper discusses pros and cons of the DTN approach for satellite communication compared to enhanced versions of transport protocols, or the insertion of intermediate agents. DTN performance is assessed by considering both fully connected networks and networks where continuous connectivity cannot be guaranteed; performance is evaluated by using a test bed. Comparative results show that DTN performs close to the most effective solutions on satellite channels and it offers greater robustness to disruptions.

This issue concludes with a review of the delay/disruption tolerant networking architecture in the paper entitled, “DTN: An architectural retrospective” by Kevin Fall and Stephen Farrell. The paper presents the rationale behind the architecture as well as a set of open issues worthy of future investigation.

In closing, we would like to thank all of the authors who have submitted papers to this Special Issue and the reviewers who helped evaluate their submissions. We would also like to express our gratitude to Pamela Cosman, Laurel Greenidge and Sue Lange, who provided help and support throughout the process. Finally, we hope the contents of this Special Issue will inspire readers to investigate many of the challenging problems in delay and disruption tolerant wireless communication.

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