

# Implementing Hybrid Protocol in MANETs Using DAWN Technique

SivaKumar.A

*Department of Computer Science and Engineering  
Saveetha Engineering College, Chennai, Tamilnadu, India*

Joel John.M

*Department of Computer Science and Engineering  
Saveetha Engineering College, Chennai, Tamilnadu, India*

Retheesh.D

*Department of Computer Science and Engineering  
Saveetha Engineering College, Chennai, Tamilnadu, India*

**Abstract-** This paper presents DAWN, a declarative platform that creates highly adaptive policy-based mobile adhoc network (MANET) protocols. DAWN leverages declarative networking techniques to achieve extensible routing and forwarding using declarative languages. We make the following contributions. First, we demonstrate that traditional MANET protocols can be expressed in a concise fashion as declarative networks and policy-driven adaptation can be specified in the same language to dictate the dynamic selection of different protocols based on various network and traffic conditions. Second, we propose interprotocol forwarding techniques that ensure packets are able to seamlessly traverse across clusters of nodes running different protocols selected based on their respective policies. Third, we have developed a full-fledged implementation of DAWN using the Rapid Net declarative networking system. We experimentally validate a variety of policy-based adaptive MANETs in various dynamic settings using a combination of ns-3 simulations and deployment on the ORBIT testbed. Our experimental results demonstrate that hybrid protocols developed using DAWN out-perform traditional MANET routing protocols and are able to flexibly and dynamically adapt their routing mechanisms to achieve a good tradeoff between bandwidth utilization and route quality. We further demonstrate DAWN's capabilities to achieve interprotocol forwarding a cross different protocols

**Keywords –** Adaptive protocols, declarative queries, forwarding, mobile adhoc networks (MANETs), routing

## I. INTRODUCTION

In the past decade, there has been intense activity on the development of routing protocols for mobile adhoc networks (MANETs). A wide variety of routing protocols have been proposed, all with their own strengths and weaknesses, and all with varying degrees of success. For example, reactive routing protocols such as DSR [12] and AODV [24] setup routing state on demand and hence are preferred for low traffic. Proactive routing protocols such as OLSR [9] and HSLs [30], on the other hand, expend network bandwidth to gather network topology state with the purpose of amortizing this extra cost over multiple traffic flows hence, these are in general better for environments with greater traffic loads and more number of source-destination pairs. Recently, researchers have focused on routing in MANETs that are at best intermittently connected (a class of disruption tolerant networks or DTNs) examples are epidemic routing protocols [27], [33] and probabilistic/predictive routing protocols [14].

## II. PROPOSED ALGORITHM

Due to a wide range of variability in network connectivity and mobility, and also a wide range of data traffic patterns, we argue that a one-size-fits-all MANET routing algorithm does not exist. Hybrid routing protocols attempt to address the above problem by combining features from various pure protocols, such as those of proactive or reactive types. While extant protocols in the hybrid category (e.g., [10], [11], [23], [25], [28], and [35]) have systematic logic behind their design, they are not very flexible and customizable as they are specified in a stove-piped fashion. As a result, the no-one-size-fits-all argument applies to these hybrid protocols as well. In reality, these protocols perform

well only under certain conditions and require additional heuristics to achieve good performance in scenarios for which they are not designed

#### *DAWN TECHNIQUE*

To address the above challenges, we present Declarative Adaptive Wireless Networking (DAWN), a platform that creates highly customizable hybrid protocols by composing any number of known protocols and utilizes a declarative policy-based framework to define the rules and conditions for switching among different protocols. DAWN achieves these capabilities as follows. First, known protocols such as the ones in the “link-state” and “epidemic” families are specified in a database query-style declarative language. Second, rule-based adaptation policies dictating when to use which protocols and under what conditions are specified in the same language. Finally, the runtime system automatically compiles the protocols and policies into actual implementations.

DAWN has the following benefits: 1) hybrid protocols written in a declarative language are highly customizable because protocols and policies are both specified in the same high-level language as first class concerns, suggesting opportunities for making finer-grained customizations on runtime adaptation; 2) DAWN enables quick prototyping and analysis of complex hybrid protocols in realistic environments in addition to network simulators. The protocol specifications are usually orders of magnitude smaller in size than the corresponding imperative implementations in languages like C/C++. Furthermore, shared protocol components can be reused and composed to create new hybrid protocols.

#### *Overview*

Policy-based adaptive MANET routing: DAWN provides a unified platform based on declarative networking [6], [18] that enables one to implement a variety of MANET routing protocols (proactive, reactive, and DTN) concisely in a few lines of code. Moreover, policy-based decisions for creating hybrid protocols can be expressed in the same declarative language and used to switch between different protocols as the network conditions (e.g., connectivity, mobility and traffic volume and patterns)

**Policy-based interprotocol forwarding:** DAWN’s hybrid approach results in different protocols being executed at different nodes in the network. For instance, some disconnected nodes in the network may utilize DTN routing, while other better connected nodes are running reactive or proactive protocols. We propose interprotocol forwarding techniques that ensure packets are able to seamlessly traverse across clusters of nodes running different protocols. Interestingly, these forwarding policies can themselves be customized using additional forwarding policy rules and applied to packets as they traverse through different techniques.

**1. Hybrid Link-State Routing:** Our first evaluation study involves Hybrid-LS, a policy driven link-state protocol described in Section IV-A. Hybrid-LS utilizes traditional LS routing when the network is stable, and HSLS when unstable. We configure all nodes to execute Hybrid-LS protocol, and fix network connectivity and traffic load, while varying only node mobility. Focusing our initial evaluation on a subset of the generalized hybrid protocol enables us to study in detail effects of policy-based adaptation and protocol switching between LS and HSLS.

**2. Mobility Setup:** To explore extremes in mobility patterns, we alternate at 60-s intervals between three degrees of mobility using the random waypoint model: stationary stage in which all nodes stay in their current positions, moderate stage in which nodes move at a moderate speed of 4 m/s (on average), and fast stage in which nodes move at a speed from 12 m/s (on average) shows the mobility setup in terms of link events

**3. Comparing LS and HSLS:** One of the main advantages of Hybrid-LS over traditional LS and HSLS is that it attempts to find a good balance between communication overhead induced by LSUs and route quality. In the remainder of this section, we try to quantify these tradeoffs by first comparing LS and HSLS

**4. Generalized Hybrid Protocol:** first example illustrates switching the underlying dissemination scheme between two types of proactive protocols using only one metric alone. As an alternative example, in [15], demonstrate that one can utilize the same declarative specifications above to achieve a hybrid proactive-epidemic protocol, useful in a disruption-tolerant setting. This hybrid protocol switches between two modes of operation: 1) single-path LS message forwarding in well-connected parts of the network under low mobility/dynamics; and 2) multipath epidemic-style message flooding in disrupted parts of the network under high mobility/dynamics.

Here, presenting a more general version of an adaptive protocol, which we refer to as generalized hybrid protocol since it adapts across proactive, reactive, and DTN-style routing based on various network conditions. This generalized protocol is in fact a superset of the more constrained hybrid link-state and proactive-epidemic protocols

mentioned earlier. Given the three metrics, the generalized hybrid protocol adapts as follows. In a highly disconnected environment (low connectivity), a DTN protocol (e.g., epidemic routing) is used. When network connectivity is well established, reactive routing is preferred if data traffic is low since its route discovery procedure is only reactively data-driven and there is no overhead of maintaining up-to-date routing tables.

### 5. Policy-based adaptive forwarding

Showing how DAWN can perform protocol switching at each node following a policy-based assessment of network conditions. If the mobility/dynamics and traffic conditions have high spatial diversity, locally optimized decisions can result in a nonuniform spatial distribution of routing protocols that have been chosen to run on various nodes. For instance if a network has high link dynamics in one half of the network and no dynamics in the other half, rules in Section IV can switch the nodes in the stable half to run a proactive link-state protocol, while nodes in the unstable, intermittently connected portion can be instructed to run some epidemic routing scheme. Under such circumstances, if a packet needs to be sent across the two aforementioned portions of the network, there is a necessity of traversing the proactive/epidemic protocol boundary at one or more intermediate nodes in the network. Similarly, if a portion of the network is running reactive routing, the data and control plane mechanisms<sup>4</sup> of various routing protocols in use need to be coordinated at dynamically chosen “gateway” nodes located at the protocol boundaries

## IV. CONCLUSION

We have developed a full-fledged implementation of DAWN using the Rapid Net declarative networking system [4]. We experimentally validate a variety of policy-based adaptive MANET routing protocols in various dynamic settings. Using a combination of ns-3 [1] simulations and deployment on the ORBIT [2] testbed, we evaluate these protocols under varying mobility, connectivity, and traffic patterns and demonstrate that they can outperform traditional MANET routing protocols—in particular, they are able to flexibly and dynamically adapt their routing mechanisms to achieve a good tradeoff between bandwidth utilization and route quality. We further demonstrate DAWN’s capabilities to forward packets in a network consisting of clusters of nodes running proactive, reactive, and DTN routing protocols

## REFERENCES

- [1] “Network Simulator 3,” [Online]. Available: <http://www.nsnam.org/>
- [2] “ORBIT wireless network testbed,” [Online]. Available: <http://www.Orbit-lab.org/>
- [3] “P2: Declarative networking,” [Online]. Available: <http://p2.cs.berkeley.edu/>
- [4] “RapidNet,” University of Pennsylvania, Philadelphia, PA, 2009 [Online]. Available: <http://netdb.cis.upenn.edu/rapidnet/>
- [5] D. Chu, L. Popa, A. Tavakoli, J. M. Hellerstein, P. Levis, S. Shenker, and I. Stoica, “The design and implementation of a declarative sensor Network system,” in *Proc. Senses, 2007*, pp. 175–188.
- [6] T. Clausen and P. Jacques, “Optimized link state routing protocol (OLSR),” RFC 3626 (Experimental), Oct. 2003.
- [7] Z. J. Haas, “A new routing protocol for the reconfigurable wireless networks,” in *Proc. IEEE Int. Conf. Universal Pers. Commun., 1997*, vol. 2, pp. 562–566.
- [8] M. Joa-Ng and I.-T. Lu, “Peer-to-peer zone-based two-level link state Routing for mobile ad hoc networks,” *IEEE J. Sel. Areas Commun.*, vol. 17, no. 8, pp. 1415–1425, Aug. 1999.
- [9] D. B. Johnson and D. A. Maltz, “Dynamic source routing in ad hoc Wireless networks,” in *Proc. Mobile Comput.*, 1996, vol. 353, pp. 153–181.
- [10] E. Kohler, R. Morris, B. Chen, J. Jannotti, and M. F. Kaashoek, “The Click modular router,” *Trans. Comput. Syst.*, vol. 18, no. 3, pp. 263–297, 2000.
- [11] A. Lindgren, A. Doria, and O. Scheln, “Probabilistic routing in intermittently connected networks,” *Comput. Commun. Rev.*, vol. 7, no. 3, pp. 19–20, Jul. 2003.
- [12] C. Liu, R. Correa, X. Li, P. Basu, B. Loo, and Y. Mao, “Declarative policy-based adaptive MANET routing,” in *Proc. IEEE ICNP, 2009*,
- [13] C. Liu, X. Li, S. C. Muthukumar, H. Gill, T. Saeed, B. T. Loo, and P. Basu, “A policy-based constraint-solving platform towards extensible Wireless channel selection and routing,” in *Proc. PRESTO, 2010*, Article no. 9.
- [14] C. Liu, Y. Mao, M. Opera, P. Basu, and B. T. Loo, “A declarative Perspective on adaptive manet routing,” in *Proc. PRESTO, 2008*, pp. 63–68. B. T. Loo, T. Condie, J. M. Hellerstein, P. Maniatis, T. Roscoe, and I. Stoica, “Implementing declarative overlays,” in *Proc. ACM SOSP, 2005*, pp. 75–90.
- [15] Y. Mao, B. T. Loo, Z. Ives, and J. M. Smith, “MOSAIC: United platform for dynamic overlay selection and composition,” in *Proc. ACM Context, 2008*, Article no. 5.
- [16] S. C. Muthukumar, X. Li, C. Liu, J. B. Kopena, M. Opera, R. Correa, B. T. Loo, and P. Basu, “Rapid Mesh: Declarative toolkit for rapid experimentation of wireless mesh networks,” in *Proc. WINTTECH, 2009*,