ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 2, Issue 2, pp: (15-21), Month: April - June 2014, Available at: www.researchpublish.com

A Routing In Predictable Networks Using Firewall Detection for Satellite Networks

Naga Lekshmi. S

II M.E CSE, Ponjesly College Of Engineering, Nagercoil, India.

Abstract: **In predictable mobile networks, network nodes move in a predictable way and therefore have dynamically changing but predictable connectivity. This model is used to develop a predictable dynamic topologies as sequences of static snapshots. This model is used to design and evaluate a predictable mobile-routing protocol based on link-state routing, the routing protocol accounts for occurrences of additional, unpredictable changes, as well as their interaction with predictable changes. The protocol evaluates using simulations based on randomly generated topologies and spacecraft-network scenarios. This is also using the firewall detection, to control the information to the third party. This can be controlled by satisfying certain set of rules and conditions.**

Keywords: **Routing, predictable mobility, spacecraft networks, space link.**

---

1. INTRODUCTION

SPACECRAFT networks are a topic of growing importance within space agencies and industry. Existing and emerging applications call for efficient routing within an interconnected space environment [1]. Future spacecraft networks will exhibit characteristics different from existing terrestrial networks. Spacecraft networks are mobile networks with independent, heterogeneous nodes but without spontaneous movement. In regular operation, each spacecraft flies along a predictable trajectory that can be computed well in advance. Hence, spacecraft networks constitute a subclass of mobile ad hoc networks that is characterized by its predictability. As in other networks, unpredictable changes may still occur and influence the evolution of the topology, in particular, when nodes or links fail. It presents a formal topology model for predictable mobile networks that describes the topology evolution by a sequence of static network-topology snapshots. In this way, we incorporate predictability while abstracting away from details such as flight dynamics for individual orbits and flight paths. We used this model to develop a general purpose Predictable Link-State Routing (PLSR) protocol that accounts for both predictable and unpredictable changes and their interaction. It evaluate the performance of PLSR in two ways. First, we use simulations based on randomly generated topologies and mobility patterns to show that PLSR's performance exceeds that of LSR. We also make comparisons with OLSR. Second, we evaluate PLSR by simulating communication using data from future space-mission scenarios based on realistic mobility patterns and failure assumptions. In particular, we investigate two mid-term spacecraft-network scenarios that are under consideration by ESA, NASA, and other agencies [2].

1. A hybrid Low Earth Orbit (LEO)/Geostationary Earth Orbit (GEO) spacecraft network that supports Earth observation operations.
2. A communication infrastructure for a surface mission, such as a Mars rover.

It use the AGI Satellite Toolkit (STK) [3] to construct sequences of topology snapshots for the above scenarios.STK is a state-of-the-art tool for solving location and intervisibility problems associated with space scenarios. Afterwards, for both scenarios, we perform network traffic routing simulations using an implementation of PLSR in the ns-2 network simulator and we measure PLSR's performance against that of link-state routing.

Satellite communication is traditionally one of two kinds: either 1) direct point-to-point links from control centers to spacecraft or 2) bent-pipe communication applications, where spacecraft relays a data stream. Neither approach uses network routing technologies. Earlier attempts to use more sophisticated spacecraft communication models in the form of Low Earth Orbit constellations with inter spacecraft links [4], [5] had limited commercial success due to their inability to integrate the spacecraft network with other terrestrial networks [1]. Emerging application areas for space missions [2] require integrated multipurpose spacecraft networks and constellations supporting spacecraft of different sizes, types, and flight dynamics. These spacecraft may also communicate with different terrestrial end-user terminals or networks, ranging from rovers on Mars to satellite telephones on the Earth. Spacecraft routing solutions using the traditional communication methods introduced above would result in a setup that is solely based on manual commanding of the individual point-to-point links. As the number of nodes grows, such a non-autonomous setup becomes unmanageable from the perspective of planning and commanding. Hence, a topology model and a routing protocol for space networks must cope with a large variety of differently behaving nodes and links with the property of predictability.

Spacecraft networks are controlled and managed by a control center that is connected to the network via one or more ground stations. We will restrict our attention to the case of a single ground station in this paper. This is without loss of generality as multiple ground stations can always synchronize over a terrestrial network. NASA, ESA, and other space agencies are planning the next generation of networked space infrastructures to support current and future space missions. NASA has identified a number of realistic mid-term scenarios [2], including LEO/GEO and Mars networks.

A. Spacecraft Network Properties

Spacecraft networks have the following properties, which we take into consideration when developing our topology model and routing protocol.

Predictable high mobility: spacecraft move at high velocities and the communication opportunities between them are, therefore, often very short and change rapidly. However, since spacecraft follow predictable flight paths, the network topology changes in a predictable way. Hence, one can compute in advance the time points when nodes or links come or go as well as changes in link properties.

Presence of one or more central processing units: all spacecraft networks are controlled from ground control centers, which have substantial computational resources. This effectively allows one to redistribute tasks from the spacecraft to the ground.

Rare occurrences of unpredictable changes: while unpredictable changes can occur at any time in spacecraft networks, e.g., due to solar flares orequipment failures, they are uncommon.

B. Related Work

These approaches often lack the wide mix of track and topologies found in real networks, they can incur substantial expense, and repetition of experiments under controlled conditions can be midcult. Multi-protocol network simulators can provide a rich environment for experimentation at low cost. A common simulation environment used across disparate research efforts can provide substantial benefits to the networking community. These benefits include improved validation of the behavior of existing protocols, a rich infrastructure for developing new protocols, the opportunity to study large-scale protocol interaction in a controlled environment, and easier comparison of results across research efforts.

This paper presents the results of a detailed packet-level simulation comparing four multi-hop wireless ad hoc network routing protocols that cover a range of design choices: DSDV, TORA, DSR, and AODV. We have extended the ns-2 network simulator to accurately model the MAC and physical-layer behavior of the IEEE 802.11 wireless LAN standard, including a realistic wireless transmission channel model, and present the results of simulations of networks of 50 mobile nodes.Low earth orbit (LEO) and medium earth orbit(MEO) based satellite networks have become the focus of attention as they promise lower delays and better bit error rate performance for Internet and multi-media services than geostationary (GEO) satellites. LEOs and MEOs also provide higher bandwidth and high-speed links to end-users.

Routing in such networks is difficult as their topology keeps changing dynamically (but in a predictable fashion). Several strategies have been proposed to deal with this issue. We feel that IP routing for satellite networks is not efficient since it involves large overheads for each packet to be transmitted over the network. Thus, the bandwidth of the network may not be used efficiently.

It shows how the tree changes, when the length of thelink from node 2 to node 5 decreases to 2, while the length of the link from node 2 to 4 remains at 6. If the delay on line AB improved, but AB was not originally in the shortest path tree, the algorithm firms t determines whether B can take advantage of ,this improvement. Since the delay from I to A cannot be improved, the delay to B using the line AB will be equal to the original distance to A plus the new delayof AB.

II. SYSTEM DESIGN

A system architecture or systems architecture is the conceptual design that defines the **structure** and/or **behavior** of a **system**. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the **system** components or building blocks...and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

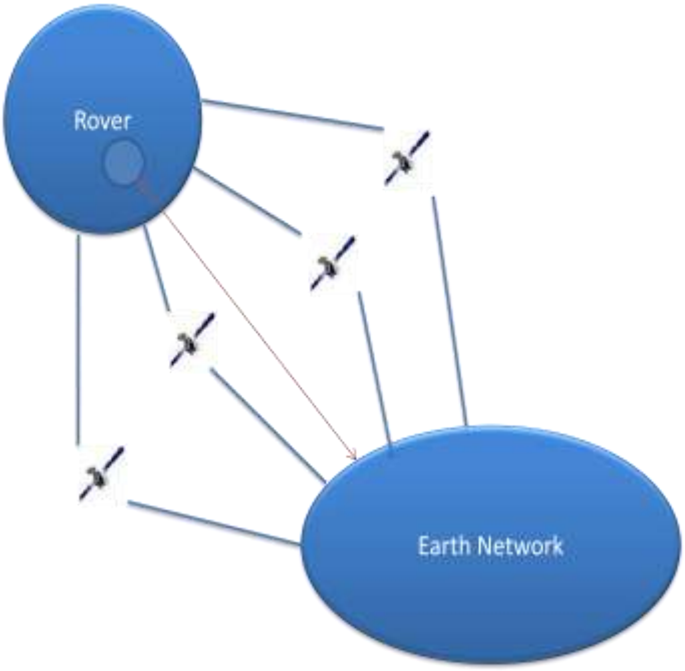

Figure (a): Overall Architecture

Rovers will play an increasingly important role in exploring the solar system and Mars in particular. They gather scientific data and communicate frequently with the Earth. Rovers have limited energy and computing resources.

A. Node Creation

To create a network we need number of nodes for communication, so in this module numbers different nodes in proper name, Create IP address and port number for data communication. Number of nodes are created to form a complete network.

B. Network Creation

Creating a network and maintaining communication among various nodes peer to peer network which helps us to share the data.The network, numerous nodes are interconnected and exchange data or services directly with each other. It provides connection to the node whenever there is a request from another node. If the entire node adds successfully to display the node connection frames.

C. PLSR

Predictable Link-State Routing (PLSR) protocol that accounts for both predictable and unpredictable changes and their interaction. The unpredictable changes cause snapshots to deviate from reality their interaction with predictable changes must be specifically addressed. When unpredictable changes can occur at any time in spacecraft networks, due to solar flares or equipment failures, they are uncommon. The PLSR stores the currently valid unpredictable changes at each node. Our protocol is correct and performs well compared to other routing protocols in a topology that has been generated. During the time interval within a snapshot, PLSR operates as the basic link-state routing. An unpredictable change that is detected, together with a time stamp indicating the reception or detection time of the most recent unpredictable change. If an unpredictable change results in the addition of a new node, this node must be provided.

D. Firewall Detection

In this module we use a technique called Firewall detection, using this technique we provide more security to the satellites.Hence the information between the satellites cannot be hacked by the third parties.This provides information only to nodes that satisfies certain rules and conditions.

E. Data Interaction

The data interaction takes place between the rover and the Earth network. The rover is mobile and maintains a link with the base station. The base station is used as a communications relay. It maintains links with the rover, the deep-space ground station.

III. RESULTS AND DISCUSSION

While we use the snapshot approach, other approaches exist to model dynamically changing topologies. Borrel et al. [14] investigate Delay Tolerant Network (DTN) network classifications and introduce a notion of evolving graphs, which are essentially equivalent to snapshot sequences. Shao and Wu [15] also discuss routing approaches for DTN networks based on evolving graphs, where a routing path between two nodes does not always exist and packets must then wait at intermediate nodes for links to become available. A similar approach is taken by Merungu et al. [16]. Snapshot sequences, however, provide better possibilities for decomposing the topology evolution into information that can be distributed by the ground stations. Ferreira [17] presents a combinatorial model for MANETs along with approaches for solving different routing-over-time problems. In deep-space communication, long propagation delays and intermittent connectivity links may be present in the network. The DTN approach [18] addresses this problem by introducing an overlay layer. DTNs are compatible with the connectionless packet-switched network that we assume. In [19], Jain et. al discuss routing problems in DTNs. While their focus is on routing with finite buffers, they also address DTN routing and flow control with complete knowledge. They do not, however, address unpredictable failures and their impact on the topology snapshots. Several routing protocols have been proposed for Earthorbiting spacecraft constellations, including datagram routing [20], optimal topological design [21], and routing tailored to Asynchronous Transfer Mode technology [22].

All of these protocols are limited to LEO constellations and have numerous architectural restrictions (such as a fixed constellation). These are based on the properties of LEO spacecraft networks that we introduced in Section 8.1. They lack the level of flexibility required in modern heterogeneous spacecraft networks. In [23], the authors describe their ASCoT routing mechanism which provides a position-based routing architecture for space networks. Similar to the PLSR protocol, ASCoT exploits predictability. In contrast to PLSR, ASCoT treats all nodes as equal in terms of routing protocol behavior and proactively propagates connection informatioon current and future links between nodes. This increases ASCoT’s overhead compared to PLSR.

A. *Comparion of routing overhead to LSR*

It compares PLSR’s routing protocol overhead to that of LSR. the overhead measurements for nominal operations and the three failure configurations. The x-axis shows the simulation configurations and the y-axis shows the traffic overhead on a logarithmic scale. As was expected, by exploiting network predictability, PLSR has a clear advantage over LSR. This advantage is largest for the simulation without unpredictable changes, where LSR produces about 2,000 times more packet overhead and 1,000 times more byte overhead. In this nonfailure case, PLSR produces only the minimal overhead required to upload snapshot sequences and no overheadrelated to the distribution of LSA messages.for all three failure configurations, unpredictable failures cause a slight increase in PLSR’s routing overhead. This comes from the need to communicatethese changes to all nodes. Still, PLSR’s advantageis substantial. For the failure configurations 2 and 3, the duration of an unpredictable failure does not significantly impact the overhead produced by PLSR. This is because PLSR stores the currently valid unpredictable changes at each node. At snapshot transition points, the nodes modify their new LSDBs with the unpredictable changes that they have currently stored. If an unpredictable change is invalidated by a predictable change or another unpredictable change, the information is deleted from the nodes. This obviates the need for generating additional LSAs after each transition point. Also, once information on an unpredictable change has propagated through the network, no additional messages occur until another unpredictable change occurs.The slight drop in PLSR routing overhead in cresults from the minimal network connectivity at the time when the link comes back up again. Fewer links areactive at this time and therefore fewer LSA messages are required during flooding.

B. *Traffic Throughput*

It measures the stability of the payload-data streams and, in particular, the number of traffic packets and bytes successfully transmitted from the LEO spacecraft to the sink ground station. We conduct these measurements in the nominal (nonfailure) situation as well as in the three failure configurations. In all configurations, PLSR has a higher throughput than LSR, although the differences are not substantial. The additional loss of packets in LSR only occurs in the time between a change and its discovery through link sensing as well as during the time required for the LSA messages to propagate the change. Therefore, in the LEO/GEO spacecraft scenario, the difference in throughput performance can be explained by the fact that the communication delays between the spacecraft are low, the LSA messages in LSR will quickly reach all nodes, and the routing tables converge. FISCHER ET AL.: PREDICTABLE MOBILE ROUTING FOR SPACECRAFT NETWORKS 1183 In the absence of unpredictable changes, we see that PLSR provides maximum throughput and no packets are lost. This is because link breakdowns are known in advance (through the use of communication windows) and PLSR can react before a link goes down and choose another link if a route is affected. In real-world scenarios, the inter spacecraft links would be bandwidth optimized to achieve maximum link saturation. Additional traffic on these links, caused by routing overhead, thereby reduces payload-data throughput. Therefore, in reality, the total traffic throughput in LSR would actually be less since traffic packets are dropped in favor of LSA packets if the links are saturated. In PLSR, this effect only takes place for rare snapshot updates and LSAs associated with unpredictable changes, and is negligible in the measurements. Note also that, should the control and data transfer links be separate, which is often the case in practice, the low bandwidth (4-6 Kbit/s) control links will be much more affected by the routing overhead.

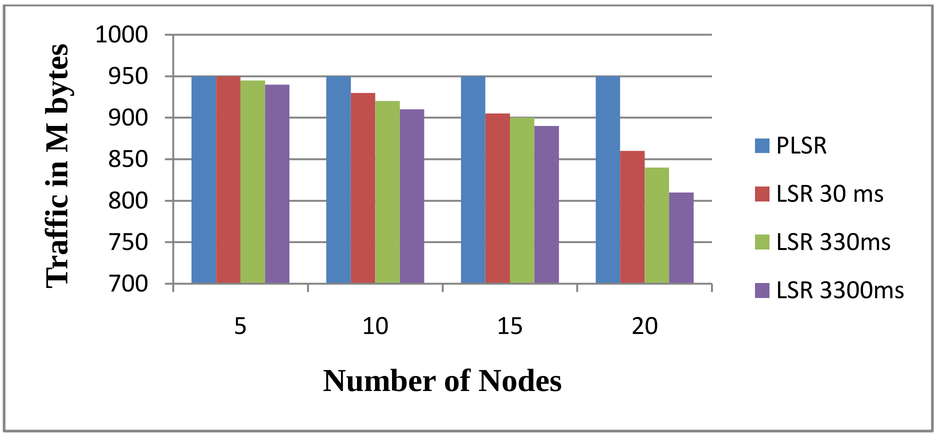

Figure (b): traffic Throughput

C. Conclusion And Future Enhancement

It have presented a model for predictable mobile topologies and used it to design the PLSR routing protocol. Our protocol is correct and performs well compared to other routing protocols in an topology that has been generated using a random-waypoint model.

It has carried out the first detailed study of predictable routing for space networks. Using realistic simulations based on two application scenarios, we showed that PLSR is efficient and offers advantages over competing protocols. Our simulations are based on actual flight-dynamics data and show the superiority of PLSR over LSR. Together with the generic simulations, our results provide strong evidence of PLSR's general usability.

As future work, we would like to utilize additional scenario-specific factors to further optimize routing using PLSR, for example, by accounting for the rover's energy budget or antenna-pointing information. With such extensions, PLSR would also support services for other layers than the network layer (such as the DTN bundle layer). For the Mars rover scenario, this would allow the autonomous adaptation of the rover to its changing environment. Finally, since space assets are part of a critical infrastructure, we will also investigate how to best integrate security services with PLSR.

REFERENCES

[1] B. Evans, M. Werner, E. Lutz, M. Bousquet,G.ECorazza, G. Maral, R. Rumeau, and E. Ferro, "Integration of Satellite and Terrestrial Systems in Future Multimedia Communications," Wireless Comm., vol. 12, no. 5, pp. 72-80, Oct. 2005.

[2] "Space Communications Architecture Working Group. NASA Space Communications and Navigation Architecture Recommendations for 2005-2030," NASA technical report, May 2006.

[3] "Satellite Tool Kit Fundamentals,"Analytical Graphics Inc. technical report, Nov. 2007.

[4] R.J. Leopold and A. Miller, "The Iridium Communications System," IEEE Potentials, vol. 12, no. 2, pp. 6-9, Apr. 1993.

[5] D.P. Patterson, "Teledesic: A Global Broadband Network," Proc. IEEE Aerospace Conf., pp. 547-552, Mar. 1998.

[6] V.V. Gounder, R. Prakash, and H. Abu-Amara, "Routing in LEOBased Satellite Networks," Proc. Emerging Technologies Symp. Wireless Comm. and Systems, pp. 22.1-22.6, Apr. 1999.

[7] AtmelCooperation, "TSC695F Sparc 32-Bit Space Processor – User Manual," 2003.

[8] J.M. McQuillan, I. Richer, and E.C. Rosen, "The New Routing Algorithm for the ARPANET," IEEE/ACM Trans. Comm., vol. 28, no. 5, pp. 711-719, May 1980.

[9] D. Fischer, D. Basin, and T. Engel, "Topology Dynamics and Routing for Predictable Mobile Networks," Proc. 16th Int'l Conf. Network Protocols (ICNP), pp. 207-217, Oct. 2008.

[10] J. Broch, D.A. Maltz, D.B. Johnson, Y.-C. Hu, and J. Jetcheva, "A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols," Proc. ACM/IEEE MobiCom, pp. 85-97, 1998.

[11] S. Bajaj, L. Breslau, D. Estrin, K. Fall, S. Floyd, P. Haldar, M. Handley, A. Helmy, J. Heidemann, P. Huang, S. Kumar, S. McCanne, R. Rejaie, P. Sharma, K. Varadhan, Y. Xu, H. Yu, and D. Zappala, "Improving Simulation for Network Research," technical report, Univ. of Southern California, Mar. 1999.

[12] P. Jacquet, P. Mu¨ hlethaler, T. Clausen, A. Laouiti, A. Qayyum, and L. Viennot, "Optimized Link State Routing Protocol for Ad Hoc Networks," Proc. IEEE Fifth Multi Topic Conf. (INMIC '01), pp. 62- 68, 2001.

[13] P. Baglioni, R. Fisackerly, B. Gardini, G. Gianfiglio, A.L. Praider, A. Santovincenzo, J.L. Vago, and M. Winnendael, "The Mars Exploration Plans of ESA," IEEE Robotics & Automation Magazine, vol. 13, no. 2, pp. 83-89, June 2006.

[14] V. Borrel, M.H. Ammar, and E.W. Zegura, "Understanding the Wireless and Mobile Network Space: A Routing-Centered Classification," Proc. Second ACM Workshop Challenged Networks (CHANTS '07), pp. 11-18, Aug. 2007. [15] Y. Shao and J. Wu, "Understanding the Tolerance of Dynamic Networks: A Routing-Oriented Approach," Proc. 28th Int'l Conf. Distributed Computing Systems Workshops (ICDCS '08), pp. 180-185, June 2008.

[16] S. Merugu, M. Ammar, and E. Zegura, "Routing in Space and Time in Networks with Predictable Mobility," Technical Report GIT-CC-04-07, Georgia Inst. of Technology, 2004.

[17] A. Ferreira, "Building a Reference Combinatorial Model for Manets," IEEE Network, vol. 18, no. 5, pp. 24-29, Oct. 2004.

[18] K. Fall, "A Delay-Tolerant Network Architecture for Challenged Internets," Proc. ACM Conf. Applications, Technologies, Architectures, and Protocols for Computer Comm. (SIGCOMM '03), pp. 27-34, 2003.

[19] S. Jain, K. Fall, and R. Patra, “Routing in a Delay Tolerant Network,” Proc. ACM Conf. Applications, Technologies, Architectures, and Protocols for Computer Comm. (SIGCOMM ’04), pp. 145-158, 2004.
[20] E. Ekici, I. Akyildiz, and M. Bender, “Datagram Routing Algorithm for LEO Satellite Networks,” Proc. IEEE INFOCOM, pp. 500-508, Aug. 2002.
[21] H. Chang, B.W. Kim, C.G. Lee, Y. Choi, S.L. Min, H.S. Yang, and C.S. Kim, “Topological Design and Routing for Low-Earth Orbit Satellite Networks,” Proc. IEEE Global Comm. Conf. (GlobeCom), pp. 529-535, Nov. 1995.
[22] M. Werner, “A Dynamic Routing Concept for ATM-Based Satellite Personal Communication Networks,” IEEE J. Selected Areas in Comm., vol. 15, no. 8, pp. 1636-1648, Oct. 1997.
[23] O. Gnawali, M. Polyakovt, P. Bose, and R. Govindan, “Data- Centric, Position-Based Routing in Space Networks,” Proc. Aerospace Conf., pp. 1322-1334, Mar. 2005.