

Documents

Rahman, N.S.A.^{a b}, Rahim, N.A.^a

Sustainable framework for a geostationary satellite control earth station system using parallel configuration
(2023) *Indonesian Journal of Electrical Engineering and Computer Science*, 30 (3), pp. 1498-1508. Cited 1 time.

DOI: 10.11591/ijeecs.v30.i3.pp1498-1508

^a Department of Electrical and Computer Engineering, Kulliyah of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

^b FPT Software Malaysia, Kuala Lumpur, Malaysia

Abstract

Earth station system plays an important role to ensure that a satellite communication system runs efficiently. Redundancies of the subsystems and regular maintenance planning can improve the earth station system. Organising system affordability can be challenging as more redundancies would acquire more maintenance. Thus, a sustainable framework that considers an earth station system's reliability, cost, and maintainability was modelled. 2-parallel, 3-parallel, and 4-parallel earth station system configurations were studied with five mean time between failures (MTBF). The results showed that an earth station that was configured with 2-parallel configuration provided an optimum reliability system performance though both 3-parallel and 4-parallel configuration provided higher reliability. Moreover, the 2-parallel configuration was also cheaper in terms of operational cost if compared to the 3-parallel and the 4-parallel configurations. Hence, this sustainable framework comprising the reliability and operational cost elements were modelled based on the 2-parallel configuration with the proposed maintenance activities. Moreover, the computed root mean square (RMS) values for both new reliability and new operational cost models yielded smallest values of 20.84% and 22.82% respectively. Thus, these RMS values for both reliability and operational cost models based on 2-parallel configuration are suitable to be applied in the earth station system design. © 2023 Institute of Advanced Engineering and Science. All rights reserved.

Author Keywords

Affordability; Cost; Earth station system; Maintainability; Reliability; Sustainable

References

- (2021) *State - of - the - Art Small Spacecraft Technology*, NASA, NASA Tech. Rep. October, NASA/TP-2020-5008734
- Sharma, S. K., Chatzinotas, S., Ottersten, B.
Integrating packet-level FEC with data carousels for reliable content delivery in satellite broadcast/multicast systems
(2006) *International Journal of Satellite Communications and Networking*,
- Bouwmeester, J., Menicucci, A., Gill, E. K. A.
Improving CubeSat reliability: subsystem redundancy or improved testing?
Reliability Engineering and System Safety, 220, p. 2022.
- Rahim, N. A., Nordin, N.
Reliability model and proposed maintainability activities of earth station system
(2020) *International Journal of Electrical, Electronics and Data Communication*, (5), pp. 20-24.
- Liang, S., Wang, J.
(2020) *Chapter 1 - A systematic view of remote sensing*, Academic Press
- Rahim, N. A., Rahman, N. A., Abdoli, S., Rao, S., Mokhtar, M. I.
Analysis of failure frequency and failure rate of RF/antenna subsystems for an earth station system
(2022) *NeuroQuantology*, 20, pp. 8654-8665.
August

- Pratt, T., Allnutt, J. E.
(2019) *Satellite Communications*,
3rd Ed. Wiley
- Rahman, N. S. A., Rahim, N. A.
Analysis of reliability prediction and maintainability activities of an earth station system using parallel configurations
(2022) *WCSE 2022 Spring Event: 2022 9 th International Conference on Industrial Engineering and Applications*, pp. 1647-1655.
- Ebadi, A. R.
(2017) *Communications Satellite Fundamentals From Design To Launch And Operation*,
2nd ed., MEASAT
- **TTC failure equipment record and repair cost 2017-2019 - with description**
(2021) *MEASAT*,
MEASAT
- Rahim, N. B. A., Ferris, T. L. J.
A method to establish a trade-space of system requirements and life cycle cost
(2020) *IEEE Systems Journal*, 14 (1), pp. 1257-1264.
- Hoque, K. A., Mohamed, O. A., Savaria, Y.
Towards an accurate reliability, availability and maintainability analysis approach for satellite systems based on probabilistic model checking
(2015) *2015 Design, Automation and Test in Europe Conference and Exhibition (DATE)*, 2015, pp. 1635-1640.
April
- Cai, R., Du, J., Yang, L., Pan, C.
Research on reliability model evaluation of satellite communication system
(2021) *Journal of Physics: Conference Series*, 1873 (1).
- Menchinelli, A.
A reliability engineering approach for managing risks in CubeSats
(2018) *Aerospace*, 5 (4).
- Berthoud, L., Swartwout, M., Blvd, L., Louis, S., Cutler, J., Klumpar, D.
University CubeSat project management for success
(2019) *Small Satellite Conference 2019: Driving a Revolution*,
[Online]. Available
- Huang, H., An, H., Wu, W., Zhang, L., Wu, B., Li, W.
Multidisciplinary design modeling and optimization for satellite with maneuver capability
(2014) *Structural and Multidisciplinary Optimization*, 50 (5), pp. 883-898.
- Crowe, D., Feinberg, A.
(2017) *Design for reliability*,
CRC press
- Ayers, M. L.
(2012) *Telecommunications System Reliability Engineering, Theory, and Practice*,
Mark L. Ayers. John Wiley and Sons
- Blanchard, B., Fabrycky, W.
(2011) *Systems engineering and analysis*,
Pearson
- Bobinis, J., Garrison, C., Haimowitz, J., Klingberg, J., Mitchell, T., Tuttle, P.
Affordability considerations: cost effective capability

(2013) *INCOSE International Symposium*, 23 (1), pp. 287-303.

- Bobinis, J., Dean, E., Mitchell, T., Tuttle, P.
Design for affordability
(2011) *2011 ISPA/SCEA Jt. Conference Train. Work*,
- Koury, B., Redman, Q., Bobinis, J., Tuttle, P., Woodward, K., Jong, H. B. A. D.
The role of value engineering in affordability analysis
(2013) *2013-M222 - International Cost Estimating and Analysis Association*, pp. 1-15.
- Sirvio, K. M.
Intelligent systems in maintenance planning and management
(2015) *Intelligent Techniques in Engineering Management: Theory and Applications*, 87, pp. 221-245.
October
- Landau, D. P., Binder, K.
A guide to Monte Carlo simulations in statistical physics
(2014) *A Guid. to Monte Carlo Simulations Stat. Phys*, p. 556.
- Elbert, B.
(2014) *The Satellite Communication Ground Segment and Earth Station Handbook*,
Artech House
- Zhong, S., Pantelous, A. A., Goh, M., Jian, Z.
A reliability-and-cost-based fuzzy approach to optimize preventive maintenance scheduling for o shore wind farms
(2019) *Mechanical Systems and Signal Processing*, 124, pp. 643-663.
- Tchakoua, P., Wamkeue, R., Slaoui-Hasnaoui, F., Tameghe, T. A., Ekemb, G.
New trends and future challenges for wind turbines condition monitoring
(2013) *2013 International Conference on Control, Automation and Information Sciences (ICCAIS)*, pp. 238-245.
- Amaitik, N.
Cost modelling to support optimum selection of life extension strategy for industrial equipment in smart manufacturing
(2022) *Circular Economy and Sustainability*,

Correspondence Address

Rahman N.S.A.; Department of Electrical and Computer Engineering, P.O. Box 10, Malaysia; email: nadirahabdulrahim@iiium.edu.my

Publisher: Institute of Advanced Engineering and Science

ISSN: 25024752

Language of Original Document: English

Abbreviated Source Title: Indones. J. Electrical Eng. Comput. Sci.

2-s2.0-85152098193

Document Type: Article

Publication Stage: Final

Source: Scopus