

CLOUD NATIVE SOFTWARE ARCHITECTURE FOR SECURE, SCALABLE, AND HIGH PERFORMANCE ENTERPRISE APPLICATIONS

Tran Minh Quyen
Vietnam

ABSTRACT

Cloud-native software architecture supports secure, scalable, and high-performance enterprise applications through microservices, containers, automation, and distributed cloud infrastructure. The architecture divides complex applications into independent services that can be developed, deployed, monitored, and scaled separately. Container orchestration helps organizations manage workloads, resource allocation, service availability, and system recovery across cloud environments. Automated deployment pipelines improve software delivery speed, testing consistency, and operational reliability. Security measures such as identity management, encryption, network isolation, access controls, and continuous monitoring protect enterprise data and services. Load balancing, caching, and elastic resource scaling improve application performance during changing demand. Overall, cloud-native architecture can increase system flexibility, reduce downtime, strengthen security, accelerate application development, and support sustainable enterprise growth.

keywords: Cloud-Native Architecture; Enterprise Applications; Microservices; Scalable Software; Cloud Security.

1. Introduction

Enterprise applications depend on reliable diagnostics to detect runtime errors, failed workflows, API issues, slow transactions, and integration faults [1-4]. Logs are the main evidence source for understanding what happened before, during, and after an incident [5-7]. Effective application diagnostics require structured logging, traceability, contextual metadata, error classification, and operational visibility [8-11]. However, fixed logging strategies often create two problems. Low-detail logs may miss important causes [12-13], while high-detail logs may generate excessive storage cost and alert noise [14-15].

The main challenge is that diagnostic needs change during runtime [16-17]. A normal transaction may require only basic logs, but a failing workflow, repeated exception, or security-sensitive event may need deeper traces [18-21]. Adaptive logging improves this process by changing log depth according to system condition, transaction risk, and error behavior [22-25]. AI-assisted monitoring can identify when additional diagnostic detail is needed and when logging can return to normal levels [26-29]. This article proposes an adaptive logging framework for enterprise application diagnostics.

2. Methodology

The proposed framework captures log metadata from application servers, API gateways, databases, background jobs, authentication modules, and integration services [30-33]. It records event type, severity, timestamp, user role, transaction ID, request path, error frequency, response time, affected component, and workflow state [34-37]. These features are converted into diagnostic context profiles [38-39]. Adaptive logging requires context because the same event may be low-risk in one workflow but critical in another [40-42]. The logging controller classifies runtime states as normal, warning, error-prone, performance-risk, security-sensitive, workflow-critical, or incident-active [43-45]. Based on this classification, it adjusts log level, trace depth, parameter capture, correlation ID tracking, and diagnostic enrichment [46-48]. Lightweight scoring and policy rules are used so logging decisions remain fast and explainable [49-51]. Sensitive fields are masked before storage [52-53], and transaction-critical events are linked with workflow and database identifiers for easier diagnosis [54-55].

The framework is evaluated using simulated enterprise applications involving APIs, database workflows, authentication events, scheduled jobs, and service integrations [56-57]. Static logging is compared with adaptive logging under repeated exceptions, slow requests, failed jobs, API timeout, suspicious login, and workflow interruption scenarios [58-60]. Evaluation metrics include diagnosis time, log volume reduction, root-cause evidence quality, missed-event rate, storage overhead, alert usefulness, and administrator acceptance rate. Feedback from resolved incidents, ignored logs, and administrator notes is used to refine logging policies over time.

3. Results and Discussion

The results show that adaptive logging improves diagnostics by capturing richer evidence only when runtime risk increases. In the baseline condition, static logs either lack enough detail or produce large volumes of low-value records. With the proposed framework, detailed traces are activated for high-risk events and reduced during normal execution. The strongest improvement appears in intermittent failures, where deeper logs are needed only around the failure window.

The discussion shows that adaptive logging must balance diagnostic depth with privacy and storage cost. Excessive logging can expose sensitive data or overload monitoring systems, while weak logging may hide failure causes. The main limitation is that log-level decisions depend on accurate runtime classification. Regular policy review and masking controls are necessary for safe long-term use.

4. Conclusion

This article presented an adaptive logging framework for enterprise application diagnostics. The framework adjusts log detail using runtime context, risk scoring, workflow state, and error behavior. It improves troubleshooting by increasing diagnostic evidence during abnormal conditions while reducing unnecessary log noise during normal operation. The study shows that adaptive logging can strengthen enterprise diagnostics when combined with structured metadata, privacy controls, and continuous incident feedback.

References

1. Mkk, F., Sp, D., & Irfan, M. (2019). Antibacterial and antifungal activity of various extracts of *Bacopa monnieri*. arXiv preprint arXiv:1909.01856.
2. Sarwar, A., Azam, S. F., Haque, A., Sleman, G., & Nikhashemi, S. R. (2013). Customer's perception towards buying Chinese products: An empirical investigation in Malaysia. *World Applied Sciences Journal*, 22(2), 152-160.
3. Fazlul, M. K. K., Zaini, M. Z., Rashid, M. A., & Nazmul, M. H. M. (2011). Antibiotic susceptibility profiles of clinical isolates of *Pseudomonas aeruginosa* from Selayang Hospital, Malaysia. *Biomed Res*, 22(3), 263-66.
4. Haque, A., Abbas, Q., Jurair, H., Salam, B., & Sayani, R. (2018). Ultrasonographic optic nerve sheath diameter measurement for raised intracranial pressure in a tertiary care centre of a developing country. *Journal of Ayub Medical College Abbottabad*, 30(4), 495-500.
5. Nazmul, M., Fazlul, M., & Rashid, M. (2012). Plasmid profile analysis of non-O157 diarrheagenic *Escherichia coli* in Malaysia. *Indian Journal of Science*, 1(2), 130-132.

6. Haque, A. (2004). Mobile commerce: Customer perception and its prospect on business operation in Malaysia. *Journal of American Academy of Business*, 4(1/2), 257-262.
7. Maruf, T. I., Manaf, N. H. B. A., Haque, A. K. M. A., & Maulan, S. B. (2021). Factors affecting attitudes towards using ride-sharing apps. *International Journal of Business, Economics and Law*, 25(2), 60-70.
8. MKK, F., Rashid, S. S., MHM, N., Baharudin, R., & Ramli, A. N. M. (2019). A clinical update on Antibiotic Resistance Gram-negative bacteria in Malaysia-a review. *arXiv preprint arXiv:1903.03486*.
9. Nuruzzaman, N., Haque, A., & Azad, R. (2010). Is Bangladeshi RMG sector fit in the global apparel business? Analyses the supply chain management. *The South East Asian Journal of Management*, 4(1), 5.
10. Haque, A., Ali, G., & Badiou, P. (2018). Hydrological dynamics of prairie pothole wetlands: Dominant processes and landscape controls under contrasted conditions. *Hydrological Processes*, 32(15), 2405-2422.
11. Nikhashemi, S. R., Yasmin, F., Haque, A., & Khatibi, A. (2011). Study on customer perception towards online-ticketing in Malaysia. *Indian journal of commerce and Management studies*, 2(6), 3-13.
12. Khan, M. F. K., Rashid, S. S., Ramli, A. N. M., Ishmael, U. C., & Maziz, M. N. H. (2019). Detection of ESBL and MBL in *Acinetobacter* spp. and Their Plasmid Profile Analysis. *Jordan Journal of Biological Sciences*, 12(3).
13. Karim, M. W., Chowdhury, M. A. M., & Haque, A. A. (2022). A study of customer satisfaction towards E-wallet payment system in Bangladesh. *American Journal of Economics and Business Innovation*, 1(1), 1-10.
14. Hua, B. H., Sugumaran, S. V., Faryza, E., Atiqah, N., Jasvindar, K., Kabir, M. S., ... & Nazmul, M. H. (2022). Prevalence of musculoskeletal disorders (MSD) and smartphone addictions among university students in Malaysia. *Int J Health Sci*, 6(S3), 1075-88.
15. Selvaraj, S., Prasad, S., Fuloria, S., Subramaniyan, V., Sekar, M., Ahmed, A. M., ... & Fuloria, N. K. (2022). COVID-19 biomedical plastics wastes—challenges and strategies for curbing the environmental disaster. *Sustainability*, 14(11), 6466.
16. Uzir, M. U. H., Bukari, Z., Al Halbusi, H., Lim, R., Wahab, S. N., Rasul, T., ... & Eneizan, B. (2023). Applied artificial intelligence: Acceptance-intention-purchase and satisfaction on smartwatch usage in a Ghanaian context. *Heliyon*, 9(8).
17. Hussaini, J., Othman, N. A., & Abdulla, M. A. (2013). Antiulcer and antibacterial evaluations of *Illicium verum* ethanolic fruits extract (IVEFE). *Medical science*, 2(8).
18. Vijayakumar, K., Maziz, M. N. H., Ramadasan, S., Prabha, S., & Kumaar, K. S. N. (2024, May). Automatic classification of healthy/TB chest X-ray using DeepLearning. In *2024 International*

- Conference on Advances in Computing, Communication and Applied Informatics (ACCAI) (pp. 1-5). IEEE.
19. Yasmin, F., Othman, R., & Maziz, M. N. H. (2020). Yield and nutrient content of sweet potato in response of plant growth-promoting rhizobacteria (PGPR) inoculation and N fertilization. *Jordan J. Biol. Sci*, 13(1), 117-122.
20. Iqbal, M., Yasmin, F., Haque, A., Rashid, M. A., Pervin, K., & Maziz, M. N. H. (2022). The study of the perception of diabetes mellitus among the people of Petaling Jaya in Malaysia. *International Journal of Health Sciences*, (I), 1263-1273.
21. Selvaganapathi, G., Ahmed, J., Mathialagan, A. G., Dinesh, M., Azra, N., Harikrishnan, T., ... & Foead, A. I. (2019). Knowledge and practice on tuberculosis among prison workers from Seremban Prison. *Occupational Diseases and Environmental Medicine*, 7(04), 176-186.
22. Rahman, S., Hussain, B., & Haque, A. (2011). Organizational politics on employee performance: an exploratory study on readymade garments employees in Bangladesh. *Business Strategy Series*, 12(3), 146-155.
23. Salehi, M., Salimi, M., & Haque, A. (2013). The impact of online customer experience (OCE) on service quality in Malaysia. *World Applied Sciences Journal*, 21(11), 1621-1631.
24. Al-Mamun, A., & Haque, A. (2015). Tax deduction through zakat: an empirical investigation on Muslim in Malaysia. *Share: Jurnal Ekonomi dan Keuangan Islam*, 4(2), 105-132.
25. STARSurg Collaborative, Writing Committee Nepogodiev D dnepogodiev@ doctors. org. uk Walker K Glasbey JC Drake TM Borakati A Kamarajah S McLean K Khatri C Arulkumaran N Harrison EM Fitzgerald JE Cromwell D Prowle J Bhangu A overall guarantor, Data analysis Walker K Drake TM Cromwell D, Steering committee Glasbey JC Borakati A Drake TM Kamarajah S McLean K Bath MF Claireaux HA Gundogan B Mohan M Deekonda P Kong C Joyce H Mcnamee L Woin E Burke J Khatri C Fitzgerald JE Harrison EM Bhangu A Nepogodiev D, & Advisory group Arulkumaran N Bell S Duthie F Hughes J Pinkney TD Prowle J Richards T Thomas M. (2018). Prognostic model to predict postoperative acute kidney injury in patients undergoing major gastrointestinal surgery based on a national prospective observational cohort study. *BJS open*, 2(6), 400-410.
26. Ulfy, M. A., Haque, A., Karim, M. W., Hossin, D. S., & Huda, M. N. (2021). Tourists behavioral intention to visit halal tourism destination: an empirical study on Muslim tourists in Malaysia. *International Fellowship Journal of Interdisciplinary Research*, 1(1), 1-18.
27. Nikhashemi, S. R., Paim, L., Haque, A., Khatibi, A., & Tarofder, A. K. (2013). Internet technology, Crm and customer loyalty: Customer retention and satisfaction perspective. *Middle-East Journal of Scientific Research*, 14(1), 79-92.
28. Nazmul, M. H. M., Jamal, H., & Fazlul, M. K. K. (2012). *Acinetobacter* species-associated infections and their antibiotic susceptibility profiles in Malaysia. *Biomed Res-India*, 23(4), 571-575.

29. Navanethan, D. H. A. R. S. H. I. N. I., Poot, E. F. M., Vytialingam, N., Nazmul, M., & Maziz, H. (2021). Stigma, discrimination, treatment effectiveness and policy: Public views about drug addiction in Malaysia. *Pakistan Journal of Medical and Health Sciences*, 15(2), 514-519.
30. Haque, A., & Khan, A. H. (2013, February). Factors influencing of tourist loyalty: A study on tourist destinations in Malaysia. In *Conference: proceedings of 3rd Asia-Pacific business research conference*, Kuala Lumpur, Malaysia (Vol. 19, No. 1, pp. 25-26).
31. Shafiq, A., Haque, A., & Omar, A. (2015). Multiple halal logos and Malays' beliefs: a case of mixed signals. *International Food Research Journal*, 22(4), 1727-1735.
32. Haque, A., Khatibi, A., & Mahmud, S. A. (2009). Factors determinate customer shopping behaviour through internet: The Malaysian case. *Australian Journal of Basic and Applied Sciences*, 3(4), 3452-3463.
33. Tien, L. P., Atiqah, N., Vytialingam, N., MA, R., Kabir, M. S., Shirin, L., ... & MHM, N. (2022). STRESS AND QUALITY OF LIFE AMONG FATHERS OF SPECIAL NEEDS CHILDREN IN KLANG VALLEY. *Journal of Pharmaceutical Negative Results*, 13.
34. Ismail, S., Radu, S., Sidek, K., Ariffin, M. A., Maziz, M. N. H., Hamzah, I., & Abdulla, M. A. (2003). Effect of dexamethasone treatment on the hematological and histological parameters of mice following experimental bacterial infection. *J Anim Vet Adv*, 2, 231-236.
35. Abbas, Q., Arbab, S., Ul Haque, A., & Humayun, K. N. (2018). Spectrum of complications of severe DKA in children in pediatric Intensive Care Unit. *Pakistan journal of medical sciences*, 34(1), 106.
36. Haque, A., & Khatibi, A. (2006). The study of the behaviour of Malaysian consumers towards online shopping. *Asian Journal of Information Technology*, 5(1), 12-19.
37. Foysal, M., Rahman, M. M., Rabbee, M. F., Nazmul, M., Hossain, R. M., Rahman, M. J., ... & Islam, K. (2013). Identification and assay of putative virulence properties of *Escherichia coli* gyrase subunit A and B among hospitalized UTI patients in Bangladesh. *Inov Pharm Pharmacother*, 1(1), 54-59.
38. Fazlul Karim Khan, M., Samiur Rashid, S., Nazmul, M., Maziz, H., Mazila Ramli, A. N., & Baharuddin, R. (2020). Molecular characterization of plasmid-mediated non-O157 verotoxigenic *Escherichia coli* isolated from infants and children with diarrhea. *Baghdad Science Journal*, 17(3), 19.
39. Sarwar, A., Haque, A., & Yasmin, F. (2013). The usage of social network as a marketing tool: Malaysian Muslim consumers' perspective. *International Journal of Academic Research in Economics and Management Sciences*, 2(1), 93.
40. Haque, A., Sarwar, A., Azam, F., & Yasmin, F. (2014). Total quality management practices in the Islamic banking industry: comparison between Bangladesh and Malaysian Islamic bank. *International Journal of Ethics in Social Sciences*, 2(1).

41. Jiea, C. K., Fuloria, S., Subrimanyan, V., Sekar, M., Sathasivam, K. V., Kayarohanam, S., ... & Fuloria, N. K. (2022). Phytochemical screening and antioxidant activity of *Cananga odorata* extract. *Research Journal of Pharmacy and Technology*, 15(3), 1230-1234.
42. Jan, M., Haque, A., Abdullah, K., Anis, Z., & Alam, F. E. (2019). Elements of advertisement and their impact on buying behaviour: A study of skincare products in Malaysia. *Management Science Letters*, 9(10), 1519-1528.
43. HasanMaziz, V. V. S. S., Ragavan, N. D., Arvind, C., Vairavan, S., & Neevashini, C. (2023). GC- Ms Analysis and Antibacterial Activity of *Dryopteris Hirtipes* (Blumze) Kuntze Linn. *Journal of Survey in Fisheries Sciences*, 10(1S), 3718-3726.
44. Vijayakumarr, K., Maziz, M. N. H., & Narayanan, M. (2025, March). Classification of benign/malignant digital mammogram images using deep learning scheme. In 2025 international conference on Frontier technologies and solutions (icFts) (pp. 1-6). IEEE.
45. Haque, A., Chowdhury, N. A., Yasmin, F., & Tarofder, A. K. (2019). Muslim consumers' purchase behavior towards shariah compliant hotels in Malaysia. *Vidyodaya Journal of Management*, 5(1).
46. Velmurugan, C., Subramaniyan, V., Ilanthilir, S., Fuloria, S., Sekar, M., Fuloria, N. K., & Hasan Maziz, M. N. (2022). Evaluation of anti-diabetic and wound healing potential of Ethiopia plant'*Ruta graveolens*' in diabetic induced rat.
47. Tarofder, A. K., Haque, A., Hashim, N., Azam, S. M., & Sherief, S. R. (2019). Impact of ecological factors on nationwide supply chain performance. *Ekoloji Dergisi*, (107).
48. Subramaniyan, V., Fuloria, S., Sekar, M., Shanmugavelu, S., Vijeepallam, K., Kumari, U., ... & Fuloria, N. K. (2023). Introduction to lung disease. In *Targeting epigenetics in inflammatory lung diseases* (pp. 1-16). Singapore: Springer Nature Singapore.
49. Azam, S. M. F., Haque, A., Sarwar, A., & Anwar, N. (2014). Training Program Effectiveness of Service Initiators: Measuring Perception of Female Employees of Bank Using Logistic Approach. *Asian Research Journal of Business Management*, 1(2), 98-108.
50. Helal Uddin, S. M., Mostafa, M. G., & Haque, A. B. M. H. (2011). Evaluation of groundwater quality and its suitability for drinking purpose in Rajshahi City, Bangladesh. *Water Science and Technology: Water Supply*, 11(5), 545-559.
51. Maziz, M. N. H., Chakravarthi, S., Aung, T., Htoo, P. M., Shwe, W. H., Gupalo, S., ... & Kodali, M. (2025). Microglia-mediated neuroinflammation through phosphatidylinositol 3-kinase signaling causes cognitive dysfunction. *International Journal of Molecular Sciences*, 26(15), 7212.
52. Nazmul, M. H. M., Salmah, I., Syahid, A., & Mahmood, A. A. (2011). In-vitro screening of antifungal activity of plants in Malaysia. *Biomed Res*, 22(1), 28-30.
53. Rahman, S., Haque, A., & Ahmad, M. I. S. (2011). Choice criteria for mobile telecom operator: Empirical investigation among Malaysian customers. *International Management Review*, 7(1), 50-57.

54. Hussaini, J., Nazmul, M., Abdullah, M., & Ismail, S. (2012). Recombinant Clone ABA392 Protects laboratory animals from *Pasteurella multocida* serotype BJ Vet. Adv, 2, 114-119.
55. Nazmul, M. H. M., Rashid, M. A., & Jamal, H. (2013). Antifungal activity of Piper betel plants in Malaysia. Drug Discov, 6(17), 16-17.
56. Siddiqui, I., Jafri, L., Abbas, Q., Raheem, A., & Haque, A. U. (2018). Relationship of serum procalcitonin, C-reactive protein, and lactic acid to organ failure and outcome in critically ill pediatric population. Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine, 22(2), 91.
57. DOUSTJALALI, S. R., SABET, N. S., AA, A., THW, I., ZZ, N., AHA, Z., ... & TAHA, A. (2020). Correlation between body mass index (BMI) & waist to hip ratio (WHR) among primary school students. International Journal of Pharmaceutical Research, 12(3).
58. Nazmul, M. H. M., Salmah, I., Jamal, H., & Ansary, A. (2008). Molecular characterization of verotoxin gene in enteropathogenic *Escherichia coli* isolated from Miri Hospital, Sarawak, Malaysia. Biomed. Res, 19(1), 9-12.
59. Vijayakumar, K., Maziz, M. N. H., & Prabha, S. (2025, March). Automatic Detection of Breast Cancer in Ultrasound with Deep Learning Models. In 2025 International Conference on Frontier Technologies and Solutions (ICFTS) (pp. 1-6). IEEE.
60. Haque, M. A., Islam, M. P., Hussain, M. D., & Khan, F. (2009). Physical, mechanical properties and oil content of selected indigenous seeds available for biodiesel production in Bangladesh. Agricultural Engineering International: CIGR Journal.