

event sources restricts system integration with third-party event providers. Therefore, standard Google messaging was introduced to the system.

With the above improvements, performance improvements and usability improvements were achieved in the STHITHIKA system. Further improvements can be done to this system, such as supporting heterogeneous event processing engines. By providing multiple CEP engine support, further improvements in usability can be achieved.

REFERENCES

- [1] O.Etzion and P.Niblett. *Event processing in action*. Manning Publications Co., 2010.
- [2] S. Perera, "How to scale Complex Event Processing (CEP) Systems", *Srinath'sBlog :My views of the World*, 2012. [Online]. Available: <http://srinathsvi.blogspot.com/2012/05/how-to-scale-complex-event-processing.html>. [Accessed: 01- March- 2016]
- [3] K.Isoyama, K.Yuji, S.Tadashi, K.Koji, Y.Makiko, and T.Hiroki "A scalable complex event processing system and evaluations of its performance." *Proceedings of the 6th ACM International Conference on Distributed Event-Based Systems*.ACM, 2012.
- [4] Y.Zhou, A.Karl, and Kian-Lee Tan. "Toward massive query optimization in large-scale distributed stream systems." *Proceedings of the 9th ACM/IFIP/USENIX International Conference on Middleware*. Springer-Verlag New York, Inc., 2008.
- [5] S. Wu, V. Kumar, K. Wu and B. Chin Ooi, "Parallelizing stateful operators in a distributed stream processing system: how, should you and how much?", in *DEBS '12 Proceedings of the 6th ACM International Conference on Distributed Event-Based Systems*, New York, NY, USA, 2012, pp. 278-289.
- [6] B. Schilling, B. Koldehofe, U. Pletat and K. Rothermel, "Distributed heterogeneous event processing: enhancing scalability and interoperability of CEP in an industrial context", in *Proceeding DEBS '10 Proceedings of the Fourth ACM International Conference on Distributed Event-Based Systems*, New York, NY, USA, 2012, pp. 150-159.
- [7] K.Kumarasinghe, G.Tharanga, L.Weerasinghe, U.Wickramarathna, and S.Ranathunga. (2015). VISIRI - Distributed Complex Event Processing System for Handling Large Number of Queries. In Tom Holvoet, MirkoViroli (Eds.), *Coordination Models and Languages*, Volume 9037 of Lecture Notes in Computer Science, 230-245. Springer

- [8] G.Cugola and A.Margara. Processing flows of information: From data stream to complex event processing. *ACM Computing Surveys (CSUR)*. 2012 Jun 1;44(3):15.
- [9] G.Cugola, and A.Margara. "Deployment strategies for distributed complex event processing." *Computing* 95.2 (2013): 129-156.
- [10] S. Suhothayan, K. Gajasinghe, I. LokuNarangoda, S. Chaturanga, S. Perera and V. Nanayakkara, "Siddhi: a second look at complex event processing architectures", in *GCE '11 Proceedings of the 2011 ACM workshop on Gateway computing environments*, New York, NY, USA, 2011, pp. 43-50.
- [11] EsperTech - event stream intelligence.<http://www.espertech.com/>. [Online; accessed 20-Sept-2011].
- [12] L. Brenna, A. Demers, J. Gehrke, M. Hong, J. Ossher, B. Panda, M. Riedewald, M. Thatte and W. White, "Cayuga: a high-performance event processing engine", in *SIGMOD '07 Proceedings of the 2007 ACM SIGMOD international conference on Management of data*, New York, NY, USA, 2007, pp. 1100-1102.
- [13] L. Neumeyer, B. Robbins, A. Nair and A. Kesari, "S4: Distributed Stream Computing Platform", in *ICDMW '10 Proceedings of the 2010 IEEE International Conference on Data Mining Workshops*, IEEE Computer Society Washington, DC, USA, 2010, pp. 170-177.
- [14] T.P.K. Dahanayakage, et al. "Wihidum - Distributed Complex Event Processing", Final Year Project-2013, Department of Computer Science and Engineering, University of Moratuwa. December 5, 2013.
- [15] M. RN Mendes, P.Bizarro, and P.Marques. A performance study of event processing systems. In *Performance Evaluation and Benchmarking*, pp. 221-236. Springer, 2009.
- [16] N. Schultz-Moller, M. Migliavacca and P. Pietzuch, "Distributed complex event processing with query rewriting", in *DEBS '09 Proceedings of the Third ACM International Conference on Distributed Event-Based Systems*, ACM New York, NY, USA, 2009.
- [17] L. Dysert, "Developing a Parametric Model for Estimating Process Control Costs", <http://www.costengineering.eu/>, 2001. [Online]. Available: http://www.costengineering.eu/images/papers/Developing_a_Parametric_Model_for_Estimating_Process_Control_Costs.pdf. [Accessed: 01- Mar- 2016].
- [18] M. Liu, E. Rundensteiner, D. Dougherty, C. Gupta, S. Wang, I. Ari and A. Mehta, "High-performance nested CEP query processing over event streams", in *Data Engineering (ICDE), 2011 IEEE 27th International Conference*, 2011, pp. 123 - 134.
- [19] W. A. Higashino, C. Eichler, M. A. M. Capretz, T. Monteil, M. B. F. D. Toledo and P. Stolf, "Query Analyzer and Manager for Complex Event Processing as a Service," *WETICE Conference (WETICE), 2014 IEEE 23rd International*, Parma, 2014, pp. 107-109. doi: 10.1109/WETICE.2014.53

- [20] Y. Ahmad, B. Berg, U. Cetintemel, M. Humphrey, J. Hwang, A. Jhingran, A. Maskey, O. Papaemmanouil, A. Rasin, N. Tatbul, W. Xing, Y. Xing and S. Zdonik, "Distributed operation in the Borealis stream processing engine", in *SIGMOD '05 Proceedings of the 2005 ACM SIGMOD international conference on Management of data*, ACM New York, NY, USA, 2005, pp. 882-884.
- [21] D. Abadi, D. Carney, U. Cetintemel, M. Cherniack, C. Convey, S. Lee, M. Stonebraker, N. Tatbul and S. Zdonik, "Aurora: a new model and architecture for data stream management", in *The VLDB Journal — The International Journal on Very Large Data Bases archive Volume 12 Issue 2, August 2003*, Springer-Verlag New York, Inc. Secaucus, NJ, USA, 2003, pp. 120-139.
- [22] S. Zdonik, M. Stonebraker, M. Cherniack, U. Cetintemel, M. Balazinska, and H. Balakrishnan. "The Aurora and Medusa Projects". *IEEE Data Engineering Bulletin*, 26(1), March 2003.
- [23] Y.Xing,S.Zdonik, and J.Hwang. "Dynamic load distribution in the borealis stream processor."*Data Engineering, 2005.ICDE 2005.Proceedings.21st International Conference on.IEEE*, 2005.
- [24] N. Schultz-Moller, *Distributed Detection of Event Patterns*, Advanced Computing of Imperial College London, 2008.
- [25] S. Ravindra and M. Dayarathna, "[Article] Distributed Scaling of WSO2 Complex Event Processor | WSO2 Inc", *Wso2.com*, 2016. [Online]. Available: <http://wso2.com/library/articles/2015/12/article-distributed-scaling-of-wso2-complex-event-processor/>. [Accessed: 01- Mar- 2016].
- [26] "Complex Event Processor | WSO2 Inc", *Wso2.com*, 2016. [Online]. Available: <http://wso2.com/products/complex-event-processor/>. [Accessed: 01- Mar- 2016].
- [27] Y. Mei and S. Madden, *ZStream: A Cost-based Query Processor for Adaptively Detecting Composite Events*, 1st ed. Providence, Rhode Island, USA: ACM 978-1-60558-551, 2009.
- [28] K. Cao, R. LI, and F. Wang. "The Research on CEP Based on Query Rewriting for CPS." *International Journal of Modeling and Optimization. pp.Vol. 3, No. 6*, 2013.
- [29] J. Calbimonte, J. Mora, and O. Corcho. "Query Rewriting in RDF Stream Processing."
- [30] Hettige Randika, Surangika Ranathunga, GATHIKA: A Dynamic Query Distribution Mechanism For Complex Event Processing Systems, Proceedings of International Conference on Advances in ICT for Emerging Regions, Colombo, LK, 2018