A Survey on Integration and Migration of Heterogeneous Computers

Priya Badarinath[1]
Dept of CSE, PES Institute of Technology, Bangalore.
priyab@pes.edu

Dr Ajeet A.C[2],
Dept of CSE RL Jalappa Institute of Technology, Bangalore.
ajeetac@rediffmail.com

Dheeraj D.
Dept of CSE, REVA ITM, Bangalore.

Abstract-Legacy Computers are a backbone of organization's information flow and main stream for maintaining organization's business information. Many organizations still relay on a number of legacy systems and still maintain them to fulfil their daily operations. But these legacy systems cannot afford to accommodate today's emerging business needs and technology. So, business professionals need to recognize the limitations of these legacy systems and identify the best action for dealing with these legacy systems. In this paper we present various ways of integrating the legacy system by considering its platform, hardware, software, performance and functionalities. We also try to give a brief survey on various techniques that are used for migration.

Keywords : Legacy System, SOA, Cloud, Integration.

1. Introduction

Computers today are used for a wide range of applications [1] viz education, entertainment, business, service providers, web infrastructure etc, that play a major role in day to day activity. Most of the applications are designed using a database system [2]. These database systems can be constantly accessed by querying the database. Personal Computers today are designed with a great speed of execution up to 8GB and a very vast internal memory of up to 2 to 5TB and have a very high computational power. A computational power [3] actually describes the performance of the computer. Few parameters of the computer performance includes - low response time, high throughput, less utilization of resources, fast, high bandwidth, response time, etc... Because of these parameters, end users, organization and business professionals tend to opt for high end super computer so that any task can be executed quickly. Due to this reason lower end machines, also called as legacy computers are getting unused in the recent days.

A legacy system [4] is also defined as an "outdated" computer system having software, hardware, peripherals and a programming language running upon it. They are typically the backbone of any organization's information flow and a main road

for business information. They are very critical and failure can have a very huge impact on business. It is defined as "any information system that significantly resists modification and evolution" [9]. They can also be associated with the processes that are no longer being used or applied to current contents. Legacy system need not be defined by age. It can be due to vendor's incapability or system's incapability that are often a concern during a software upgradation. Legacy information systems [5] are the backbone for information flow for an industry which is the main walkthrough for consolidating business information. If one of them stops working the business halts. *Legacy software* [6] is software that is installed either yesterday or even a decade ago that is running on a critical business process. From the business perspective, industry / organizations need to respond rapidly to the market opportunities. Neither the old nor the new technologies should come with a solution that results in a complete, dynamic, flexible, cost effective qualities that are needed to deliver to customers. Thus there is a need for a platform that can actually extend existing assessment by offering some advantage to new services. One such bridge is Service Oriented Architecture.

Service oriented architecture (SOA) [7] provides a standard framework for flexible and adaptive system that is widely being used currently. They are the collection of services. These services communicate with each other. Communication can be either data exchange or may involve two or more services coordinating some activity, though a SOA is not a new concept.

Organizations spend money on software systems and get a return on money they spent; the software's must be useable for many years [11]. Life time of the software depends; but many soft ware's remains in use for more than a decade. Few organizations still relay on software that are more than 20 years old. These soft wares are business critical i.e. the organizations still relay on these software's. Any failures in services cause a big damage to the organization.

2. Issues With Heterogeneous Systems

A legacy system faces many problems in market from the business perspective. Based on the

aging, limited functionality [8] and usability most of the legacy system has been in place since a decade.

i) Increasing Maintenance and Staffing costs – As the demand on Organization budget is increasing, most of the staffs should have to spend more money on legacy systems. Since legacy system are responsible for business transactions and capabilities that represent the core needs of organization, proper care of them is very critical. Maintaining the original code in the legacy system is also an important challenge as the original programmer may have resigned from the organization. Regardless of money being spent, the maintenance cost of legacy application is responsible for eating up large Organization budget.

ii)Limited functionality leads to limited innovation and limited growth – Legacy system cannot meet high expectations that are needed for today's industry standard since today's industries demand instant and easy access of information. This results in poor impact on organization staffs and customers. Legacy systems have limited efficiency for both IT and Business: For Engineers, major time is spent on coding and programming to maintain the legacy data to meet the user's demands. This results in morale and high turnover. Also in business perspective, since the interfaces are very hard and functionality is limited, the productivity is very poor and limited. This results in the users spending more time in deciphering the system or changing the system or completing tasks manually.

iii). Data driven and no access to business content- Since most of the applications are developed using programming languages, it is difficult to access business information on legacy system. Even though IT staffs / engineers are willing to design a solution for monitoring business processes, legacy system may not be able to handle new or fresh processes i.e. the information contained in legacy system may be valid and relevant but architecture of legacy system is not supported by business growth.

iv).Replacing – not a valid solution - Since legacy systems has many negative impacts and challenges, users may be tempted to replace the old system and buy a new system. But this is not a right choice. Replacement can lead to the following issues: More risk, prohibited cost, limited business age, delivery speed. Also the question of reusability is unanswered since the business applications are not intended to solve problems in multiple department but rather they can just solve one problem within one functional area of the organization. Since the data present in legacy systems can be of a decade or more, extracting the data and finding a way for new replacement may not be an easy task and requires extensive custom coding.

There are various solutions that are being proposed to address these issues [10] – re-development that rewrites the existing application, migration, that moves the legacy system to a flexible environment and wrapping which wraps the current components to new thus retaining the systems data and functionality.

As the demand for high end super computer is drastically increasing, it's computing techniques, hardware and software, high end resources are getting increased day by day. Legacy system are becoming of no use as people these days try to replace the legacy systems with a new system. Because of these, the resources present in the legacy system with respect to hardware, software, processor, functionality are getting wasted. People opt to buy new machine with high processing speed and large memory and large computational power rather than retaining the old ones.

3. Recent developments

Since there is a drastic growth taking place in data processing, visualization, storage, speed of network, mobility, access of real time data[11], legacy systems need to integrated to these changes in technology for business organization to maintain their advantages which developers could not predict at the time of development.

In the recent development, with the invade of the current technology, legacy system happens becomes unfit after a certain days. There are various ways or approaches that have been presented during past decades that proposes the integration and migration of legacy systems to various distributed architectures, including client server architecture [12],[13], distributed architecture[14][15], web based and service oriented architectures[16][17][18].

Most of the Legacy machine is written using 3rd generation programming languages [11] like Pascal, basic, COBOL, C etc... Thus a rapid change of technology is pushing the modernization of legacy system in many ways.

One of the positively proved solutions for modernization of integration and migration is the legacy system wrapping [19] which can subdivided into wrapping presentation modules, data and its functionalities. Wrapping is also called black box modernization which provides a new interface for legacy components thereby removing the mismatches [20] between the interface by a software artefact and the interfaces required by current integration practises.

A Service oriented architecture is one of the

current technologies where [21] describes the SOA as a system that can be divided into various sub systems based on its functionalities which are interoperable in the process of business in an organization. *[22] describes to reuse the legacy systems as components in SOA by opening the ir functionality as services.* Also further to reuse the legacy system [23], evaluating its assets is also a very important context of migrating the system.

Also a few researches discuss the migration of legacy systems into SOA such as black box [24], wrapping methodology [25], reengineering approach [26] and multi-tier architecture [27] strategies. Data base re-engineering is also efficiently matured enough to apply for migration.

Ontology Works also provides ontology and bridges that maps data from legacy information systems to the ontology [28]. Also further, Data mirror [29] techniques also provides an engine for the bidirectional transformation of the data exchange and integration.

Several authors also [30] propose various steps in software modernization where legacy code can be transformed to new languages and new environments. They suggest – removing anomalies, restricting, extracting business rules that are needed to be transformed and managing the reusable components.

There are also clustering algorithms that target two specific views [32], layered view called horizontal view and a feature based view called vertical view which were proposed and implemented. Preliminary results have shown the views are comprehensible and may be helpful in restructuring and migration process.

There is also another technique for modernization of called screen scrapping [31]

4. Integration and Migration process tools and techniques

Various authors discusses about various ways in which integrating a heterogeneous system can be achieved. Integration is not just the integrating the of the data, but also the functionality of legacy computers. Functionality can be with respect to increasing the resource power, processor utilization, migration of data... After integration is achieved, finally, performance evaluation also plays a very major role. During the integration, migration also plays a vital. One possible solution to perform integrating is using big data [20]. Big data needs to be integrated into legacy system by using forward

engineering, reverse engineering, administration of data and system integration.

5. Conclusion

This paper concedes with various review analysis that are carried on migrating and integrating the legacy system. This paper describes various ideas and thoughts that are expressed by various authors during the carry of the experiments and analysis. The primary reason – data can continue to grow, data is found in many sources, and traditional data do not meet the current requirement. Impact of the legacy system complexity addresses the following two issues – operational and technical complexity

6. Future Scope

This is an open research in the field of computer and information system engineering. There are many issue that come across during the process of integration and migrations – Understanding of a legacy system which includes understanding of its application, System understanding, data understanding, Resources understanding, Also development of a target system which includes a few re constructing techniques like Business computing, Design of any real time data migration engine, reuse methods**.**

7. References:

[1]. Juan Cain, "Research on application of computer database technology in information management", Published in:Woprkshop on Advanced Research and Technology in Industry Applications (WARTIA), Sept- 2014.

[2]. Ganesh Chandra Deka, " A Survey of Cloud Database Systems", Published in: IT Professional (Volume:16 , Issue: 2), Page : 50 – 57, April 2014.

[3]. L. Bautista Gomez ; Argonne Nat. Lab., Argonne, IL, USA ; F. Cappello ; L. Carro ; N. DeBardeleben, " GPGPUs: How to combine high computational power with high reliability', Published in: 2014 Design, Automation & Test in Europe Conference & Exhibition (DATE) , pg 1-9, March 2014.

[4]. G. Salvatierra, C. Mateos, M. Crasso, A. Zunino and M. Campo, "Legacy System Migration Approaches", published in IEEE Latin American Transactions, Vol. 11, No. 2, MARCH 2013.

[5]. Richard Wise , Lindsey Sheppard ,John Huggins , Douglas Broadwell, "A methodology and heuristics for re-architecting a legacy system", Published in 9th Annual IEEE International Systems Conference (SysCon), Page 382-389, 2015

[6]. Alexander Bergmayr , Hugo Brunelière , Javier Luis Cánovas Izquierdo , Jesús Gorroñogo, " Migrating Legacy Software to the Cloud with ARTIST ", Published in: 17th European conference on Software Maintenance and Reengineering (CSMR), Page : 465 – 468 , 2013

[7]. Madiha Waris ,Shoab Ahmad Khan ,Muhammad Zaman Fakhar, " Factors effecting service oriented architecture implementation", Published in: Science and Information Conference (SAI), 2013

[8]. Helton Emanuel Reis Santana , Glauco de Fígueiredo Carneiro, "A Decision Process to Migrate Legacy Systems to SOA ", Published in:11th International Conference on Information Technology: New Generations (ITNG), Page : 243-248 , 2014.

[9] M. Brodie and M. Stonebraker, Migrating Legacy Systems:Gateways, Interfaces and the Incremental Approach

, MorganKaufmann, San Francisco, 1995

[10]Jesús Bisbal, Deirdre Lawless, Bing Wu and Jane Grimson, "Legacy Information Systems: Issues and Directions", IEEE software, September / October 1999.

[11] Ian Somervillie, "Software Engineering", 9th Edition, Pearson Publication.

[12]J. G. Butler "Mainframe to Client/Server Migration". Computer Technology Research Corp.,Charleston, South Caroline, 1996.

[13]G. Canfora, A. Cimitile, A. De Lucia, and G. A. Di Lucca "Decomposing Legacy Programs: A First Step Towards Migrating to Client-Server Platforms" Journal of Systems and Software, vol. 54, 2000, pp. 99-110.

[14]M. Rahgozar and F. Oroumchian. "An effective strategy for legacy systems evolution". Journal of Software Maintenance: Research and Practice; vol. 15, 2003, pp. 325- 344

[15]H. M. Sneed. "Wrapping Legacy COBOL Programs behind an XML-Interface", Proc. Of Working Conference on Reverse Engineering, IEEE CS Press, 2001, pp. 189-197.

[16] L. Aversano, G. Canfora, A. Cimitile, A. De Lucia, "Migrating Legacy Systems to the Web: an Experience Report", Proc. of European Conference on Software Maintenance and Reengineering, Lisbon, Portugal, IEEE CS Press, 2001, pp. 148-157.

[17] L. Aversano, G. Canfora, A. De Lucia "Migrating Legacy System to the Web: a Business Process Reengineering Oriented Approach", Advances in Software Maintenance Management: Technologies and Solutions, M. Polo editor, Idea Group Publishing, USA, 2003, pp. 151-18 1.

[18] T. Bodhuin, E. Guardabascio, and M. Tortorella. "Migration of non-decomposable software systems to the web using screen proxies", Proc. of Working Conference on

Reverse Engineering, Victoria, BC, Canada, IEEE CS Press, 2003, pp.165- 174

[19]M. Y OSHIOKA , T. S UDO , A. Y OSHIKAWA AND K. S AKATA , Legacy System Integration Technology for Legacy Application Utilization from Distributed

Object Environment, Hitachi Review, 47 (6) , pp. 284–290, 1998.

[20] Sanjay Jha, Meena Jha, Liam O'Brein, Marilyn Wells, "Integrating Legacy System into Big Data Solutions: Time to make the Change", Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE), Nadi, 2014.

[21] T. Erl, Service-Oriented Architecture Concept, Technology and De- sign. Upper Saddle River: Pearson Inc, 2005

[22]. G. Lewis, E. Morris, and D. Smith, "Analyzing the reuse potential of migrating legacy components to a service-oriented architecture," in Proceedings of 10th European Conference on Software Maintenance and Reengineering (CSMR). IEEE, 2006, pp. 15–23.

[23] V. K. Reddy, A. Dubey, S. Lakshmanan, S. Sukumaran, and R. Siso- dia, "Evaluating legacy assets in the context of migration to soa," Software Quality Control, vol. 17, pp. 51–63, 2009.

[24] B. Zhang, L. Bao, R. Zhou, S. Hu, and P. Chen, "A black-box strategy to migrate gui-based legacy systems to web services," in Proceedings of the 2008 IEEE International Symposium on Service- Oriented System Engineering. IEEE, 2008, pp. 25–31.

[25] G. Canfora, A. R. Fasolino, G. Frattolillo, and P. Tramontana, "Migrating interactive legacy systems to web services," in Proceedings of the Conference on Software Maintenance and Reengineering. IEEE, 2006, pp. 24–36.

[26] Z. Zhang and H. Yang, "Incubating services in legacy systems for architectural migration," in Proceedings of the 11th Asia-Pacific Software Engineering Conference. IEEE, 2004, pp. 196–203.

[27] M. Sheikh, H. Aboalsamh, and A. Albarrak, "Service oriented architecture adoption management roadmap," in Proceedings of 7th

International Conference on Digital Content, Multimedia Technology and its Applications. IEEE, 2011, pp. 119–124.

[28] Ontology Works, Integration of Legacy Information Systems, Technical Report, Ontology Works, 2002.

[29]. DataMirror, Managing Your Data the XML Way: Data Transformation, Exchange and Integration, 2001.

[30]. B. Erricson-Connor, "Truth and Consequences", ZJournal, pp. 38-43, August/September 2003.

[31] D. F. Carr, "Web-Enabling Legacy Data When Resources Are Tight", Internet World August 10,1998.

[32]   #G. E. Boussaidi, A. B. Belle, S. Vaucher and H. Mili, "Reconstructing architectural views from Legacy Systems", 19th Working Conference on Reverse Engineering, Kingston, Jamaica, 2012,

pp. 345-354.