A Tiering Architecture for Integrated Network Management System

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***Abstract*—Recently, the walls of wired and wireless networks are breaking down to bring the cluster environment of networks to a chaos, mainly due to the exponential gross of the wireless devices.**

For the network service providers are taking the burden of caring the enormous networks in a safe and efficient way, they are trying to acquire the excellent network management systems in order to provide the users the robust network services in such a complicated network environments where the size and the variety of the networks keep on increasing.

The ways to promote the performance of the network management systems can be categorized into serveral ways: increasing the hardware performance, improving the software performance, or adapting the advanced system architectures.

It's relatively well known that the single-tier architectures are inferior to the multi-tier architectures in most of the fields including the network management system architectures. But regarding the specific amount of the gains of taking multi-tiering architecture has not been well documented especially in network management area.

In this research, we present the explicit benefits by adapting the multi-tier architecture into network management system comparing to the single or lower tiering architectures.

I. Introduction

The requirements for qualities of the network services are rapidly rising but it is very hard to make a good profit by using the limited cost for the network service operation. This is the critical time for the network operators that cutting down the budget for the operation is the core key to make their businesses sustain through this harsh market situation.

When the network companies maintained enough budget for taking care of the networks, the architecture of the network management systems did not mean much to them, and there were some possible places for the simple architecture frameworks. For example, when the users want quick changes on the system functions, the simple architectures were preferred because it is flexible and easy to implement their requirements.

However, the silos inside the network domains became united and the various network management systems gathered into a single integrated system, the architectures start to become an important part needed a precise plan and strict implementation. The simple architectures lacking of multi-tiering concept might not efficient enough to cover today's rather complex networks.

Most of the researches that aimed to improve the quality of network management systems possibly agree on the efficiency of the multi-tiering (more than two-tiering) architectures. But the research about the measurable benefits of changing lowly tiering structure to highly tiering structure has still not presented to my knowledge.

This paper looks over the normal tiering concept and the NMS(Network Management System) applied tiering structure and will explain the 3-tier performance advantage after setting up 2 types of tiering structures.

II. Multi-tier Architecture

The basic meaning and structure about tiering is well introduced in references [1]. The research about tiering is currently into a ripe stage and [9] describes the research about the NMS architecture containing a 2-tier and 3-tier structure. In reference [6] there is a performance testing result of a computer system that has a 3-tier structure.

Not only the researches mentioned in the above that the NMS field that makes tiering its base NMS, most tiering architecture dealing with clients, assume the lowest tier one as the user terminal layer. Compared to that, applying tiering scheme to NMS, it gets all the information from the lower networks that are being monitored and the gateways used for scrambling that information corresponds to tier one.

The client interface at tier one which is used by the users and the one that is used by the network element show the significant different characteristics in some points.

- Users client has a limited amount of information that can be sent but the network client is almost unlimited.
- User client has a variety of data types but the network client has only text.
- User client has an output of un-regular in and out data when the network client not only outputs the un-regular, but also the regular data. (e.g. The 5minute status updates are regularly gathered whilst the SNMP Trap information is not.)

The multi-tier architecture helps NMS support the hardware system scalability and allows variety to the implementation at the various level of tiering intensities.

III. Related Works

In the early stages in 90's, most of the NMSs were made up of a 2-tier structure consisting of a business logic processing module and a data processing module. This brought a very easy features to take care of the flexibility need in the software development that expropriated a variety of network tasks.

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However, when upgrading or expanding a system it required having to change the whole system itself, so it brought up a lot of problems considering the need of todays NMSs, hence, there have been moves making up the architecture with the multi-tier.

In [2] an architecture was proposed for an end-to-end IPTV network. This architecture did not show where the DBMS should be, but has been developed by the 3-tiering structure.

In [4] the quick and flexible SOA based architecture was reported, bringing the SOAs basic philosophy to place and having a 3-tier structure.

In [5], an architecture that has three different types of NMSs grouped into EJB, is being proposed, and there are a 2-tier and 3-tier NMS architecture inside each type of NMS architecture.

[10] contains of the NGOSS based TM Forum architecture and signifies all the considerations in 2-tiers and in 3-tiers.

In [3], [8], [7], an architecture thats based on AIR(Active Information Resource) is composed of different types of NMS form. These systems can be seen as a 2-tier architecture containing of the Knowledge Base and the Knowledge Element bound together.

Like the research of the tiering based NMS architecture that this paper has gone through, most of the systems have a 3-tiering structure rather than a 2-tiering one. However it is difficult to find exactly how much the performance was upgraded by the addition of the tiers. If the math was more exact about the upgraded performance, it would be able to predict the future profits of multiple tiering, and would be the yardstick to measure the profit before the similar system is built.

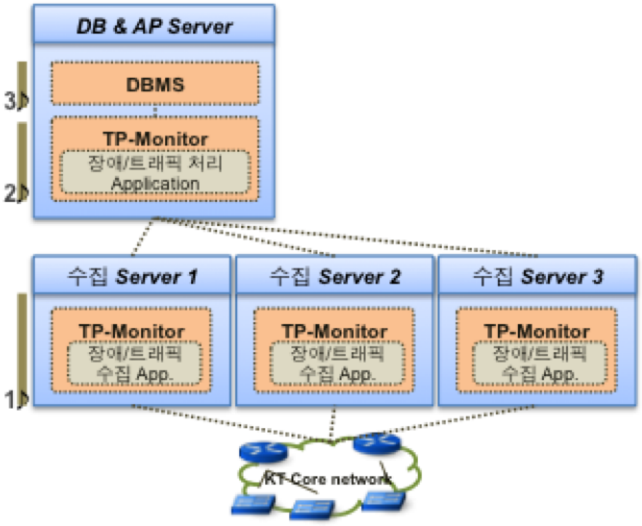

Fig. 1. *The basic multi-tier NMS architecture.*

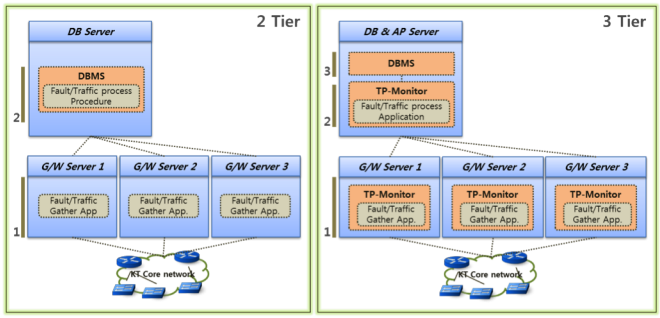

Fig. 2. *one tier and two tiers NMS architectures.*

IV. Multi-tier Architecture and Testing Environment

In general arguments, tiering architecture regards the user-side at the top most as the tier one. But, in NMS's perspective, the bottom part is regarded as the tier-one, e.g., network equipments and the information gathering gateways for which the NMSs always executing the monitoring activities. The basic multi-tier NMS architecture used in this work is shown in Figure 1

We made up a 2-tier environment and a 3-tier environment for the purpose of performance comparison. To make it fair, we use the same hardware the two different testings with different software configurations.

The 2-Tier environment consists of one DB server and three GW servers. It worked by getting the traffic data and the fault information coming from the GW server and putting them into the DB server. Then the DB server would constantly analyze the procedure with the data.

The 3-Tier environment has the same hardware as the 2-Ttier but the software has a Middleware, the TP-Monitor inside it besides the DB servers. In general, the DBMS and the TP-Monitor would be run in different servers, but for the purpose of fairness of the testing, they run in the same box.

The mechanism is to collect the bugs and traffic information from the GW and when it sends the collected data to the Ap server, which is TP-Monitor in this case, the AP server breaks it down, and then inputs it to the DB. The actual equipment was used to solve the ACL problem.

Figure 2 shows the tier-1 and tier-2 architectures used for the performance comparison.

- DB Server (DB & AP Server) : Sun Fire 3800 (2 CPU, 4G)
- G/W Server 1 3 : Sun Fire v880 (2CPU, 4G)
- DBMS : Oracle 9i
- TP-Monitor : Tmax 3.13
- Core network : 1,026 Equipments, 6,813 Interfaces

V. Comparison

To compare the problems and the efficiency of the network system in a 2-tier network and 3-tier network the ICMP ping messages were transferred back and forth, and the traffic was extracted every 5 minutes using a SNMP protocol.

The first experiment result after checking the performance were shown in Figure 3.

As explained above, the 2tier and 3tier environment have their differences in the way they handle the data. Due to this difference, when the number of applications used in

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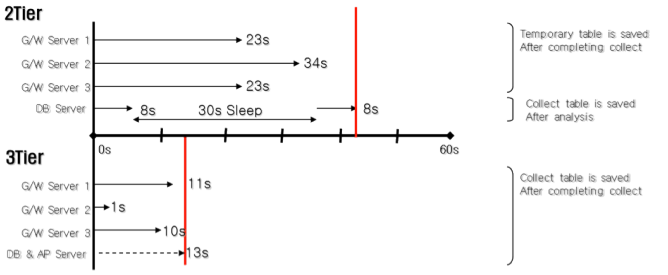

Fig. 3. *Ping testing comparison resuts.*

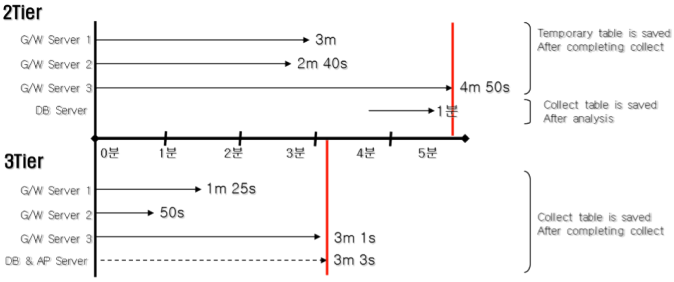

Fig. 4. *Periodic trasmission time comparision results (per 5 minutes).*

the collecting server the 2-Tier environment gets a boost of DB Sessions, whereas the 3-Tier environment TP-Monitors it, giving no effect to the DB Session.

As a result, the 3-Tier environment could run more applications then the 2-Tier environment and had a 3 times more faster bug detection.

Secondly, the results of the 5minute traffic data is show in Figure 4.

There was a similar result with the first experiment.

Note that in the environment of 2Tier there was a margin of increasing the due to the DB Session and the DB Connection time. The CPU usage percentage for the DB server and the GW server is as in Figure 5.

As the graph shows, the three tier architecture consumes much less CPU resources than the two tier architecture.

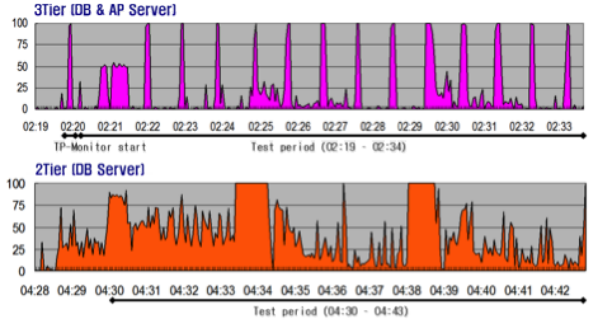

Fig. 5. *CPU usage for DB and gateway servers.*

VI. Conclusion

After the survey for the various NMS architectures, we found that multi-tier architecture has been dominating without in-depth consideration for the specific amount of gain.

Through this work, we found the NMS tiering is different from the general purpose tiering, mainly because they have different first-tiers at their bottom (e.g., NMS looking at the network elements vs. general purpose system looking at the human users at the first-tier).

As the network elements produces much more interactions than human users, the performance gain by the multi-tier architecture for NMS is greater. In the above experiments, we found that the three tiering environment had a much faster speed with less resources. The reason why three tiering architecture shows better performance is that it always runs to maintain proper number of DB session minimizing DBMS loads regardless the number of gateway processors in this scenario.

In the future research, we hope to find the performance difference between 2 Tier and 3Tier when there are more gateways, and more network equipment to take care of.

References

[1] Multitier architecture. http://en.wikipedia.org/wiki/Multitier_architecture, March 2013.

[2] Chung-Hua Hu, Yung-Yi Hsu, Chia-June Hong, Shun-Hsing Hsu, Yen-Cheng Lin, Chen-Min Hsu, and Tse-Han Fang. Home Network Management for IPTV Service Operations - A Service Provider Perspective. *2010 IEEE/IFIP Network Operations and Management Symposium Workshops*, pages 1–7, March 2010.

[3] Susumu Konno, Yukio Iwaya, Toru Abe, and Tetsuo Kinoshita. Design of network management support system based on active information resource. *Proceedings of the 18th International Conference on Advanced Information Networking and Application (AINA'04)*, 1:102–106, 2004.

[4] Venkatesan Krishnamoorthy, Naveen Krishnan Unni, and V Niranjan. Event-Driven Service-Oriented Architecture for an Agile and Scalable Network Management System. In *NWESP '05: Proceedings of the International Conference on Next Generation Web Services Practices*. IEEE Computer Society, August 2005.

[5] Hiroshi Matsuura and Naotaka Morita. EJB-based implementation of L1VPN NMS controlled by each customer. In *IM'09: Proceedings of the 11th IFIP/IEEE international conference on Symposium on Integrated Network Management*. IEEE Press, June 2009.

[6] David C. Roberts, David A. Grossman, Ophir Frieder, R. Bernstein, and E. Bisfiop. Performance testing of communication protocols for three-tier computing: results for ica and x window protocols. In *ICCCN*, pages 450–455, 1997.

[7] Kazuto Sasai, Gen Kitagata, and Tetsuo Kinoshita. Mutiagent Architecture of Knowledge based Network Management Support System. In *2010 International Conference on Broadband, Wireless Computing, Communication and Applications (BWCCA)*, pages 782–787. IEEE, 2010.

[8] Kazuto Sasai, Naoyuki Tanji, Yusuke Takahashi, Gen Kitagata, and Tetsuo Kinoshita. An Architecture of Extended Network Management System: Autonomous Cooperation between Knowledge Resource and Network Equipments. In *2010 IEEE/ACIS 9th International Conference on Computer and Information Science (ICIS)*, pages 617–622. IEEE, 2010.

[9] Jiahai Yang, Jianping Wu, and Yue You. A web-based, event-driven management architecture. In *Communications, 1999. APCC/OECC '99. Fifth Asia-Pacific Conference on ... and Fourth Optoelectronics and Communications Conference*, volume 2, pages 1214–1221 vol.2, 1999.

[10] Man Yi, Shang Jing, Song Junde, and Song Mei. CONSIDERATIONS FOR THE DEVELOPMENOTF LARGESCALE MOBILE NETWORKMANAGEMENSTYSTE. In *CCECE 2004- CCGEI 2004, Niagara Falls, May/mai 2004*. Electrical Engineering Department, Beijing UniversityofPost and Telecom, IEEE Computer Society, May 2004.

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