A REAL TIME TRAFFIC ENGINEERING SCHEME FOR BROADBAND CONVERGENCE NETWORK(BCN)

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Abstract: Recently, Broadband Convergence Network (BcN), a Korean version of Next Generation Network (NGN), was introduced to guarantee pre-defined QoS for high speed multimedia service. The BcN is considering charging users for premium services. For the BcN to be successfully diffused, however, a practical traffic engineering (TE) tool is required because the BcN is composed of many kinds of subnetworks, and real time feedback (traffic control) would be mandatory for the premium service. In the paper, a new TE scheme for BcN, Rule Based Capture(RBC)/User Satisfaction Parameter(USP), is proposed to resolve the latent problems of the BcN TE. The USP is designed to be admitted by many BcN subnetworks as a common intermediate description of service quality instead of conventional QoS parameters. The RBC is introduced to settle the real time TE issue against the vast accumulation of traffic monitoring data. The pilot RBC/USP is implemented on the Linux platform and its performance is investigated. We found that the average traffic log size is reduced to 0.058% for FTP, and 2.39% for streaming service by using the RBC/USP.

1 INTRODUCTION

Be advised that papers in a technically unsuitable form will be returned for retyping. After returned the manuscript must be appropriately modified. The Broadband Convergence Network (BcN) was introduced to provide high speed multimedia service in Korea [1]-[6]. The BcN's aim is to provide a premium service by charging users according to agreed QoS. Most of the BcN users are expected to use multimedia traffic, so it is presumed that the traffic analysis (or traffic monitoring) data is also growing dramatically. The vast accumulated log data would make it hard to be examined in time to control the traffic, thereby the user might not be satisfied by the non real time feedback [7][8].

In order for the BcN to be successfully diffused to public, while competing with the traditional (best effort) Internet, it should provide differentiated QoS provisioning and accepted charging schemes. The QoS-based charging system however requires a practical traffic monitoring mechanism because quality measurement and respective charging rely on accurate, fast and manageable traffic monitoring scheme.

The key requirements of the profitable TE for BCN are as follows:

1) practical and commonly acceptable QoS measurement
2) real time feedback mechanism
3) handling vast amounts of traffic analysis data

In the paper, Rule Based Capture(RBC)/ User Satisfaction Parameter (USP) scheme is suggested to fulfill the key requirements of the BcN TE. The USP is designed to be used across all subnetworks composing the BcN. By using the USP, user satisfaction is examined in a short time to meet the real time requirement of the TE. The RBC algorithm is introduced to continuously delete unnecessary data which has been already used to measure the user satisfaction i.e., the USP level. The RBC is expected to prevent the vast accumulation of traffic analysis (log) data.

The proposed RBC/USP is implemented on the Linux platform and its performance is investigated. We compared the average sizes of the log files for the cases of adopting the RBC/USP and of conventional traffic monitoring.

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Following the introduction, key requirements of the BcN TE is investigated in Section 2. The operation of the RBC/USP scheme is described in Section 3, and its operation and performance are investigated in Section 4. Conclusion follows in Section 5.

2 KEY REQUIREMENTS OF REAL TIME TE FOR BCN

2.1 Practical and Commonly Acceptable QoS Measurement

Conventional QoS measurements are expressed mostly in numerical value, such as delay, bandwidth, or error rates. The numerical value is convenient for representing network status or service statistics, but it is hard to express appropriately the level of user satisfaction because a collection of numerical values of QoS parameters is hard to interpret[7]-[13]. Furthermore, cascading the QoS parameters through many subnetworks to measure the Quality of Experience(QoE) would be more complex to interpret. To alleviate this problem, a nonnumeric satisfaction measurement scheme, the USP is suggested in the paper.
It is noted that BcN is composed of various subnetworks such as conventional (best-effort) Internet, Multi Protocol Label Switching(MPLS), wireless LAN, and telephone network. For successful commercialization of the BcN, an acceptable quality measurement scheme that can be used commonly in the heterogeneous BcN subnetwork is required, and the USP is suggested for this purpose.

2.2 Real Time Feedback Mechanism

The meaning of “real time” here is that traffic can be controlled while the service is being provided. For example, if you are not satisfied with the quality of a streaming service, you may pay more to increase the video quality during the streaming service. On the contrary, if you are fully satisfied with a service then you may not need a premium service, and want to pay less. In some situations, moreover, just the best effort Internet would be sufficient for the user. Therefore, BcN TE should provide wide range of options from free service to premium service with instantaneous (real time) feedback. It is noted that conventional feedback or claiming based on the Service Level Agreement (SLA) would be possible only after the service is ended.

3 RBC/USP ALGORITHM

3.1 Basic Operations

The rationale of the RBC/USP algorithm is that the traffic analysis data which was already used successfully in calculating the quality measurement (i.e., the USP) is thrown away. The operation of the RBC/USP TE algorithm is shown in Fig. 1.

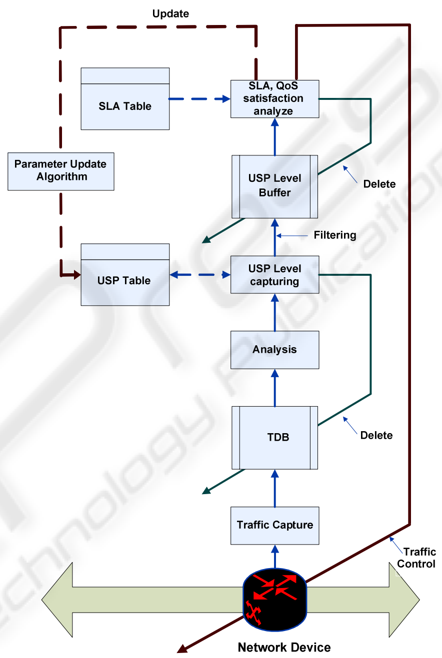

Figure 1: Operation of RBC/USP TE algorithm for BCN.

The captured data is first saved at the Traffic Data Buffer (TDB), and is analyzed at flow basis to extract some QoS parameters to calculate the USP level. The USP level is obtained from a pre-defined combination of typical QoS parameters, such as bandwidth and delay. The extracted USP level is then compared with the current USP levels of the service (or a flow) in order to update the USP Table. The USP Table contains all the service quality information of a user.

The extracted USP level is saved at the USP Level Buffer, which is a temporary buffer used for current service analysis. The service fulfillment is then checked referring to the SLA Table. If the captured data is from a new flow then the USP Table is updated with the new level of USP for each service (or flow). If the service satisfies the SLA, the corresponding captured data is removed from the TDB. By continuously throwing away the used traffic monitoring data, the accumulation problem can be avoided. When the service does not satisfy the SLA, a traffic control signal is sent immediately to the related network devices (e.g., the routers). The handling of the signal may depend on the SLA.

3.2 USP Levels

The USP level represents the service quality with a nonnumeric level such as A, B, C, or D. For example, if e-mail is defined to have two levels (e.g., A and B), 'A' may represent "good", and 'B' a "bad"service quality. The USP levels can be extracted from a few typical QoS parameters. For example, with streaming service, the combination of: bandwidth of larger than 50Mbps, delay of less than 20ms, jitter of less than 20ms will be graded to be 'A' level. Other examples of USP levels are given in Table 1 (the numerical values of QoS parameters are given arbitrarily by authors). The choice of key QoS parameters and their values which will be used for calculating USP level should be defined via heuristic evaluations.

Table 1: Mapping of USP level and QoS parameters.

Application	USP level	bandwidth (bps)	delay	jitter
E-mail	A	> 1M	< 500ms	< 100ms
	B	> 100K	< 3s	< 1s
Streaming	A	> 50M	< 20ms	< 20ms
	B	> 10M	< 50ms	< 20ms
	C	> 2M	< 100ms	< 20ms
	D	> 1M	< 100ms	< 50ms
	E	> 500K	< 200ms	< 100ms
WWW	A	> 10M	< 100ms	< 50ms
	B	> 1M	< 200ms	< 100ms
	C	> 100K	< 300ms	< 100ms
FTP	A	> 10M	< 100ms	< 50ms
	B	> 1M	< 200ms	< 100ms
	C	> 100K	< 300ms	< 100ms
Telnet /Rlogin	A	> 500K	< 200ms	< 100ms
	B	> 100K	< 300ms	< 100ms

4 CONCLUSIONS

In the paper, a simple but practical TE scheme for high speed networks such as BcN is proposed. The RBC/USP algorithm is expected to overcome the latent problems of BcN: providing acceptable QoS agreement among vendors, real time feedback, and accumulation of traffic analysis data. The RBC solves the problem of massive accumulation of QoS parameters, and the adoption of USP simplifies the QoS negotiation among the heterogenous subnetworks taking part in the end-to-end BcN service. The USP can play an intermediary role of service relay between service providers.

The RBC/USP was implemented in the Linux platform and its performance is investigated. We found that the average log size is reduced to 0.058% for FTP, and 2.39% for streaming service by using RBC/USP. The reduction of the log data means not only practical usability of the algorithm, but also it is expected to provide commonly acceptable end-to-end QoS description. By simulations, we found that the RBC/USP can be a good candidate of a real time TE methodology for the emerging BcN.

Further study includes reasonable defining of practical USP levels which can simply reflect service requirements of users as well as network service providers.

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