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RESEARCH ARTICLE

A REPLACEMENT POLICY FOR BUFFER MANAGEMENT IN IPTV SERVICES

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Abstract— Replacement policy defines the enhancement factor in deciding the system performance. Many different policies have different effects on the system performance, but still there exist performance gap between processors and memory system. In the IPTV services it provides the various services to the user as per their request, the proposed policy is based on the no of hit count and miss count on the files on every access. The replacement is based on the most recently accessed. It performs well compared to other replacement policies like LRU, LFU, and FIFO etc.

Key Terms: - Replacement policy; Internet Protocol Television; Least Recently Used; Least Recently Used

I. INTRODUCTION

IPTV (Internet Protocol Television) is a method of distributing television content over broadband that enables a more customized and interactive user experience. IPTV will mean a fundamental change in viewing habits. Viewers will be able to watch what they want, when they want to. Interactive TV services will be a key differentiator for the multitude of IPTV offerings that are emerging. This interactivity can also be used to provide targeted advertising, one-to-one marketing that could include instantaneous end-user feedback and other services coupled to programming such as online shopping (for articles actually shown in the program), gaming, etc. The two way nature of these networks enable Video on Demand (VoD) and network digital video recording (NDRV), which are two of the most popular differentiators provided by IPTV systems over the traditional unidirectional broadcast system where programming is pushed to the consumer rather than pulled when required. In order to preserve bandwidth over the final link to the house, IPTV systems are designed to deliver only the requested channel to the STB. Note there could be several programs (or channels) delivered to different IP addresses in the same home (i.e. separate STB’s or other IP enabled receivers).

II. RELATED WORKS

A Generalized Interval Caching Policy for Mixed Interactive and Long Video Environments (1996) proposed the **Interval Caching (IC)** scheme maintains only the data in the interval between two successive requests such that the following request can be serviced directly from the buffer cache without I/O operations. IC aims to maximize the number of concurrent streams serviced from the memory buffer. With a given buffer space, therefore, IC sorts the intervals by the increasing order of space requirements and caches from the shortest interval A Hybrid Caching Strategy for Streaming Media Files (2001) proposed the **two level caching architecture** for the streaming objects at the proxy servers.

They deployed the interval caching scheme at the buffer cache layer and the LFU at the disk cache layer. They showed that this two level caching scheme performs better than previous approaches A Hybrid Buffer Cache Management Scheme for VOD Server (2002) proposed the presented the **HBM (Hybrid Buffer cache Management**) scheme for VOD servers. HBM detects the access pattern of each multimedia file and then employs the interval caching or LRU algorithm appropriately for file accesses**.** Popularity-Aware Interval Caching for Multimedia Streaming Servers (2003) proposed the **PIC (Popularity aware Interval Caching)** scheme that extends IC by considering different popularity of multimedia objects.

It estimates the popularity of multimedia objects based on the request intervals of each object and exploits the estimated popularity in predicting future request times. PIC extends IC by including predicted intervals in the candidates of caching. Pre-emptive but Safe Interval Caching for Real-time Multimedia System (2003) showed that improving the hit ratio alone is not sufficient to guarantee the hiccup-free service and efficient disk bandwidth utilization in multimedia systems proposed a new caching scheme namely **PSIC (Pre-emptive but Safe Interval Caching)** scheme that provides services with saved disk bandwidth. Caching and Scheduling in NAD-Based Multimedia Servers (2004) proposed the **DIC (Distributed Interval Caching)** scheme which utilizes the on-disk buffers for caching intervals between successive streams for the network attached disk (NAD) architecture.

New Stream Caching Schemes for Multimedia Systems (2005) proposed the **ISC (Iteration Set Caching)** that evolves from the interval caching that dynamically changes the ordering of caching blocks to support variable bit rates. Buffer Management for Heterogeneous Resolution Display in Home VOD Services (2006) proposed the **PRIC (Popularity and streaming Rate aware Interval Caching)** scheme it is a generalized version of PIC to support heterogeneous resolution display in home VOD services. It extends the PIC by considering the different streaming rate of video objects to provide QoS to the heterogeneous appliances. Block Level Buffer Management for Video Streaming Services in ITPV Environments (2010) recently proposed the **B-PIC (Block Level Popularity aware Interval Caching)** scheme retains the prefix blocks of popular objects in the memory buffer even though time progresses and caches the prefix of popular objects before they are actually requested. It reduces the start-up delay of popular object.

In OPT (Optimal) algorithm is an offline replacement algorithm. This algorithm assumes that the entire access sequence is available ahead of time and, therefore cannot be used online. LRU (Least Recently Used) has been used widely for buffer cache management .When the cache is full; it replaces the block that is the least recently used. It is designed to take advantage of the temporal locality exhibited in accesses. MRU (Most Recently Used) MRU replaces the most recently used block. It was designed to deal with situations like sequential scans. LFU (Least Frequently Used) replaces the block that is least frequently used. The frequency of a block is its reference count. FBR (Frequency Based Replacement) algorithm .It considers both recency and frequency to capture the benefit of both LRU and LFU.

It does not increment reference counts in the new section and replaces least frequent blocks in the old section. LRU-k (Least Kth-to-last Reference) algorithm. It replaces the block with the least recent Kth-to-last access. When K is large, it discriminates the frequent and infrequent blocks. When K is small, it removes cold blocks quickly. LFRU (Least Frequently Recently Used) algorithm was used to cover a spectrum of replacement algorithms that include LRU at one end and LFU at the other end. It replaces the blocks that are the least frequently used and not recently used. 2Q (Two queue) the algorithm utilizes one FIFO queue and two LRU lists. On re-reference its likely to be referenced again. LIRS (Low Inter-Reference Recency Set) algorithm. It uses Inter-Reference Recency (IRR) history instead of just access recency for making a replacement decision. Blocks with smaller IRR values are favoured than those with larger IRR values.

III. PROPOSED REPLACEMENT POLICY

The algorithm proceeds as follows the system contain two parts main cache unit and prefetch unit. The sizes of both the units are fixed. Buffers main cache unit and prefetch unit hold the cached and prefetched data. The size of the whole system is a constant. Each block in the main cache unit has two counters miss and hit. The miss counter gives the total number of non-references to the block and the hit count gives the total number of references to the block while it is resident in the cache. The following are the steps taken on an access to a block. Each block is identified by its block address.

1. If the block is in main cache its hit count is incremented.

2. If the block is in prefetch unit it is brought into the main cache unit. The placement/replacement strategy is as follows. If there are empty slots in the main cache, the block is placed in it Else, the block with the maximum miss count percentage i.e. (miss count / (miss count + hit count))*100 and which is not the most recently accessed is replaced. The hit count of the block is set to one and it is marked as the most recently accessed block.

3. If the block is not in prefetch and main cache, it is fetched from the disk to the main cache. The Replacement policy is same as described in step 2.The hit count of the block is set to one and the Miss count of

the block is set to zero. The next sequential block is fetched into the prefetch unit. The proposed algorithm ensures the following.

1. The number of misses for any two blocks is not the same. This is because blocks are fetched at distinct units of time. While a block is fetched, its hit count is set to one. The incrementing of the miss count takes place when the block is not referenced. Suppose there are two blocks a and b. Let them be fetched at time *t1* and *t*2 respectively. Let *t1* < *t2*. Then assuming there was only one reference to the miss count of a is t2 – *t1*- 1. The miss count of b will start after *t2.*

2. The proposed algorithm differs from LFU. In Least frequently used, the block that was referenced minimum number of times is replaced. In the proposed algorithm, the block could have maximum number of hits and also misses. Hence it could be replaced though it is most frequently used within the time span of its arrival and current interval.

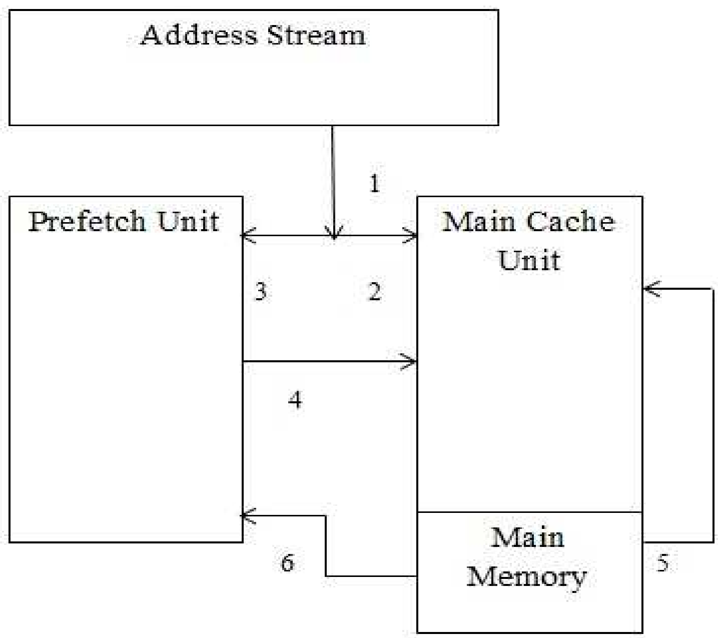

Figure 1. Organization of buffer and cache steps to fetch an address

For example suppose there is a request for blocks 1, 7, 3, 1, 3, 3, 7, 7, 3, 3, 7, 1. The following table gives the statistics for this address trace. Let there be a request for block number 8. According to LFU, block number 1 will be replaced. According to the proposed algorithm, block number 1 has the highest miss count percentage but it is the most recently accessed. Hence second block with maximum miss count percentage ,that is block number 3, will be replaced where miss count percentage is calculated by the formula: ((miss count)/(miss count + hit count))*100.

The table 3.1 shows the comparison of the proposed algorithm with the LFU algorithm and based on the miss count and which is not the most recently accessed is chosen for replacement.

S.NO	Block No.	Miss count	Hit count	% Miss count
1	1	10	4	71.42
2	3	9	5	64.28
3	7	8	6	57.14

Table 3.1: Comparison of proposed algorithm with LFU algorithm

3. The proposed algorithm differs from first in first out (FIFO) algorithm. In FIFO, the block that is fetched first is replaced first irrespective of its last time of reference. In the proposed algorithm if the block is the most recently accessed, it is not replaced.

4. The proposed algorithm differs from LRU. In LRU, the least recently used block is placed. In the proposed algorithm it could be the case that the LRU block has lesser misses than others. Hence it won't be replaced in this case.

5. The proposed algorithm differs from MRU. In MRU, the most recently used block is replaced. This is not the case in the proposed algorithm.

IV. **IPTV SERVICES**

IPTV brings together the television, internet and telephone. Much like cable or satellite television, IPTV uses a set-top box (STB) that allows viewers to watch hundreds of channels and order movies through video-on-demand (VOD). IPTV uses broadband ADSL, the same technology that delivers high-speed Internet to the computer. This opens the door to much more interactivity and the potential for thousands, as opposed to hundreds, of channels. The table below shows various IPTV services that are provided to the users.

Video on Demand (VOD)

Video communication is now one of the most important aspects of our lives. Videos are not only for entertainment, but also for education, and information. In particular, video on demand (VOD) has emerged as a base technology for many important new applications such as home entertainment, news on demand, digital libraries, distance learning and electronic commerce, to name but a few. A typical VOD service allows remote users to play back any video from a large collection stored on one or more servers. In response to a service request, a server delivers the specified video to the user in an isochronous data stream. The unit of server capacity required to support the playback of one server stream is referred to as a channel. The number of such channels is determined by the server bandwidth. In its simplest form, delivery of a video stream requires a dedicated channel for each video session. This approach is excessively expensive and nonsalable. To conserve server bandwidth, several users can share a channel simultaneously using multicast.

Personal Video Recorder

Many IPTV set top boxes will incorporate a Personal Video Recorder (PVR) that will allow programmes and interactive content to be recorded. Viewers will be able to watch one programme while recording another. They'll also be able to use interactive services or video on demand while recording in the background. While watching linear TV programming, viewers will be able to pause and rewind live television. The PVR will be programmed via the Electronic Programme Guide. Intelligent series linking will allow programme episodes to be recorded based on preferences, first-runs, repeats, or all occurrences.

Music on Demand

With IPTV, viewers will be able listen and download their favourite songs. They can request for the latest songs that has been released. The ability to listen and download the songs according the needs of the users and can enjoy the service. The large collection of songs ranging from old to new and popular songs too will be available to the users.

Advertising

Interactive advertising will extend traditional linear advertising. It will allow advertisers to give product information in the form of an on-screen interactive brochure. This will re-enforce the brand messages and encourage viewer involvement with the product. It will also allow a direct element to be added to any TV campaign, with responses being captured from viewers.

Communication Services

The two-way nature of an IPTV connection makes it ideal for providing person-to-person communication services. Instant messaging services will allow viewers to 'chat' via text messages while continuing to watch TV. Video conferencing over television will allow virtual family gatherings when family members are spread across the world. Services will be used both as stand-alone applications, and as add-ons to programming. Friends will be able to chat while watching a programme 'together' in different locations. Phone-in shows will be able to display callers, linked directly from their home.

V. CONCLUSION

A new replacement policy has been proposed .The algorithm uses two unit's main cache unit and prefetch unit in the memory. The algorithm is based on the number of hit counts and number of miss counts on every block that is referenced and non-referenced on every access. The most recently accessed block is not chosen for replacement. The block with maximum miss count that is not the most recently accessed is used for replacement in case of conflict. The algorithm performs well compared to the LFU, LRU, FIFO and MRU replacement algorithms.

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