Minimizing Zapping Time in IPTV Based on User's Interest

Yu-Wei Chen and Tzu-Ting Chiu

***Abstract*—Internet Protocol Television (IPTV) is a system whichcombines internet, communication, multi-media and deliver digital signal to user end through internet. Due to the higher quality and its increasing content updated by providers, IPTV has been becoming more and more popular these years. Because of bandwidth limitation and lots of channels in IPTV, set-topbox cannot receive all contents simultaneously and it will cause zapping time while channel switching. In this paper, we propose CIRI is to lighten the zapping time problem. By channel reordering and preload policy, it can shorten seek distance and zapping time.**

***Index Terms*—IPTV, zapping time, waiting time, user behavior, set-top-box, preload**

I. Introduction

As mentioned above, IPTV is a system which offers television service delivered by platforms such as internet, communication, multimedia, and deliver digital signal to user end through internet. IPTV had been being paid more attention recent years. By development of internet, content providers join the service in cost lower than traditional cable TV. So the numbers of IPTV channels are growing quickly. There are several reasons why user wantsit.Two of them are: First, its quality increases than cable TV with delivering digital signal through internet. Second, the numbers of channels in IPTV are countless compared to traditional TV cables, user have more choices to watch.

In cable TV, all channels are simultaneously received by user end. No matter how user switches, the content is shown to user immediately with little zapping time that user even feels nothing [1]-[4]. On the contrary, IPTV receives channel content in set-top-box through internet. Limited by the bandwidth limitation and explosive contents, set-top-box cannot receive all channels at the same time. It generates zapping time about 0.9 – 70 seconds during channels switching [5], [6]. In [5], [7] we understand that the longer zapping time brings user more impatience. Thence how to lighten the zapping time in IPTV is now our most concerned problem.

Based on user's viewing habit, about 40%-44% of channel switching behaviors are not linear, and about 56%-60% of channels switching are linear. In linear switching events, 69%-72% of them are upward and 28%-31% are downward. IPTV combines several different sources and had lots of channels. But we can observe that, every user watches few specific channels only [1][8][9]. User often watches some specific types of channels and we know it before that user tends to switches channels by linear way. So channel switching often cost user much time that makes user lower satisfaction [5][7].

In this paper, we propose CIRI to lighten the zapping time problem. By channel reordering and preload policy, it shortens seek distance and zapping time.

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II. Related Works

There exist several approaches to shorten zapping time. First, use the preload policy to shorten zapping time. Second, increasing the I-frame can shorten the zapping time, too. Third, channel reordering, which is the approach used in this paper. And we will introduce about channel reordering in this section.

A. IPTV User'S Habit-Linear Switching Pattern

In the paper [1] and [12], they introduce about user behavior, which suggests 55%-72% switching are linear. And 60% of switching events are happened soon after the previous, means that user's focus is volatile and user must has to suffer the long seek distance when searching the channel what they want to watch by linear channel switching [1][8][12]. We can also know that most of channel switching events were happened on the hour [8][13]. By these two characteristics, to concentrate the channels which are high probability and same genres. Then user can find the channel by using the shorter seek distance.

B. IPTV User'S Behavior-Concentrative of User'S Interest

IPTV provided lots of channels, but the channels that every user can watch within a day are very limited. [8] proposes nearly 80% of viewers are watching top 10% of channels, reflects 80-20 rule and the problem that there are too much redundant channels existed in IPTV for every different users. Every user interest is different, due to this, respectively concentrated channels for every different user is a necessary task.

C. MRS and MFS

In [10] proposes MRS (Most Recently Selected) and MFS (Most Frequently Selected). In Fig. 1, MRS is channel reordering by the user's most recently watching history. And MFS is channel reordering by what are the channels that user watched most frequently. But there has the problem in these two ordering way. Most of family were shared on IPTV, the above two manners were reordered by the whole history in a family. So these manners cannot suit for all the members in the family who shared the same IPTV.

D. Frequency Interleaved Ordering

There has another ways to reorder channels. It is called Frequency Interleaved Ordering (FIO) [5]. FIO reordered the channels by channel's ranking, ranking from 1 to n in a circular way. Fig. 1 is ordering as sequential. We can see that in Fig. 2, ranking n is adjacent to ranking 1, but the probability of switching event happened between these two channels is very low. So put the high ranking channels adjacent to ranking 1 can help to shorten the seek distance. Reorder the channel from ranking 1, than ranking 2 and ranking 3 are adjacent of ranking 1, show in Fig. 3.

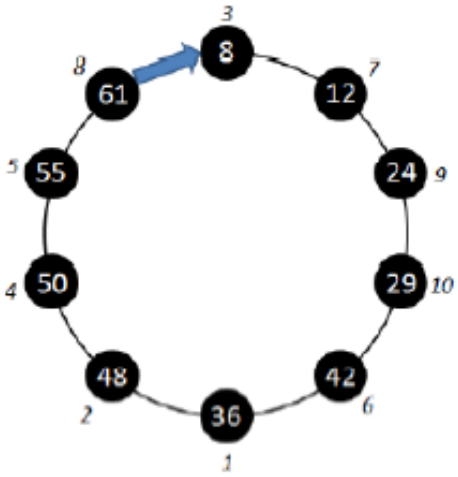

Fig. 1. Sequential ordering.

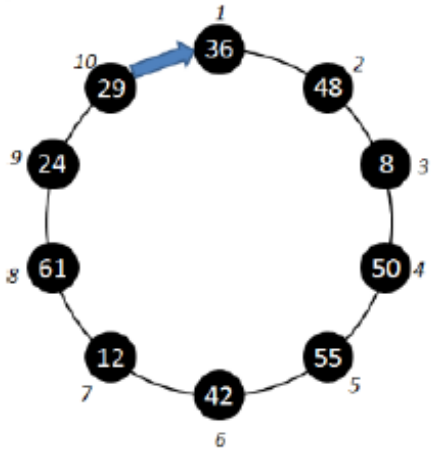

Fig. 2. MFS

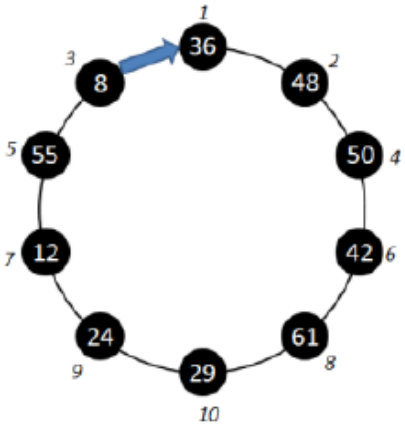

Fig. 3. Frequency Interleaved Ordering.

III. Channel Interleaved Reordering Based on User's Interest

User can only watch the IPTV by decoding the digital signal delivered by internet. It generates lots of time by the process of channel switching, receiving digital signal, and decoding. For this reason, let set-top-box to preload the signal not only the target channel but also the other channels, it can shorten the waiting time when user select these channels which was preloaded by set-top-box during channel switching.

By the restriction of bandwidth, set-top-box cannot receive all the channels in the IPTV. When user select the channel which was not preloaded by set-top-box, than set-top-box should restart the process including joining the new streaming, receiving signal, and decoding. The process above will generate lots of time additional, this is the problem what we wanted to solve.

A. The Point of Lighten Zapping Time to Consider

The number of channels in IPTV is much more than cable TV. Users are usually interested in only part of channels, so they usually need to suffer a long seek distance to find the target channels by linear channel selection. The rest of this paper will introduce the way to shorten the long seek distance which was generated by this problem. We design the CIRI method by consider three points:

- **User behavior-linear switching pattern**

Even though IPTV had provided lots of channel recommendation like hot button for users to select the channel what they like, but users usually are accustomed to use linear channel selection because they have used to use the traditional TV for a long time. There are about 55%-72% probability that they had using the linear switching pattern instead of using non-linear switching pattern [1][8][12]. So we also considered about this characteristic to design our pattern which can suit for not only short seek distance but also linear pattern.

- **Multiple users shared one IPTV**

The traditional patterns to lighten the long zapping time were only suit for single user, because the recommendation was generated by the single watching history on each IPTV and cannot suit more than one user. So we also considered about the condition that multiple users shared one set of IPTV.

- **User's interest and watching interval**

The channels in IPTV can be classified as several categories, and each category also contains several channels. User's interesting channels may changed by the time, like that user may be used to watch news in the morning, watch movie at dining time, or watch movie at evening. For this reason, we use this characteristic to design the pattern with user's interest.

B. The Point of Lighten Zapping Time to Consider

On the base of three characteristic above, we proposes the CIRI pattern to solve the problem what we discuss before: (1) More than one user have shared one IPTV. (2) User's interest may change by the time. (3) User may be used to linear switching pattern.First, we aim to the problem which user may be used to use linear switching pattern. We

let channels which are high probability of being watched to gather together. Therefore, users can surfing channels during these hot channels and don't have to pass through the channels which they don't want to watch at all. So users can select the target in a shorter seek distance.

In this part, we will introduce why we want to reorder the IPTV channels. In Fig. 3 and Fig. 4, user had switching the channel from channel 36 to channel 48. Fig. 3 is sort as original sequential, user need suffered 12 switching seek distance. However, Fig. 4 is reordering and we can find that the switching seek time is shorter than original sequential. By this instance we can know that the fine reordering policy is helpful for shorten switching seek distance even user is used.

Fig. 3. Channel original sequential ordering

Fig. 4. Channel frequency ordering

The formerly patterns which were reordering channels by the popularity ranking cannot suit for different users. Therefore, we design a pattern which can useful for different users by interesting classify. Fig. 5 illustrates reordering the channels by their ranking. To avoid that user may cannotbe used to changed number of channel after channel reordering. So we retain the channel number as usual and only change the sequential what they was ordered. For this reason, users can still change the channel by non-linear switching pattern when they don't want to change the channel by linear switching pattern.

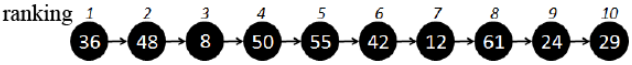

Fig. 5. Channel reordering by their ranking

C. The Genre Classify and Application

In this part, we want to introduce how to apply user's interest to our pattern. We told that user's interest may include different genres at each time interval during a day, therefore they will surfing the same genre at each time interval. For this reason, we design the pattern based on channel genres. CIRI clustereach genre in order to let user can surfing the genre he want but does not has to pass through other genre. For example, in Fig. 6, we classify the channels into six genres, including drama, news, integration, cartoons, movies, and entertainment. We will explain how to use these characteristics in the following part.

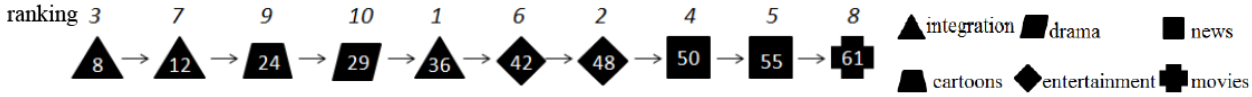

Fig. 6. Genre classify

D. CIRI Pattern

CIRI (Channel Interleaved Reordering based on user's Interest) applysZipf's law which is an empirical law formulated using mathematical statistics. And there are many types of data studied no matter in the physical or social sciences can be approximated with the Zipf distribution. Show in table 3.1, we can see that Zipf's distribution characteristics: when the probability of ranking 1 is *k*, ranking 2 will be *k/2* and ranking 3 will be *k/3* and so on ranking n will be *k/n*.

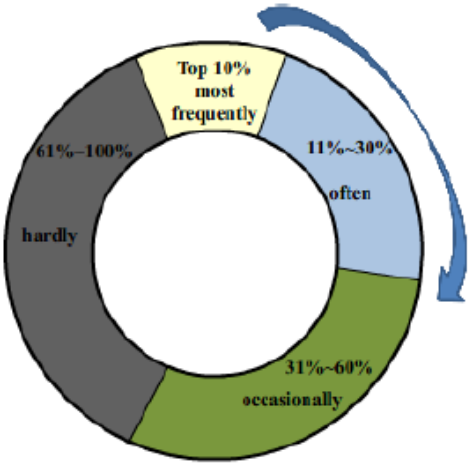

Fig. 7. Sequential frequency parts

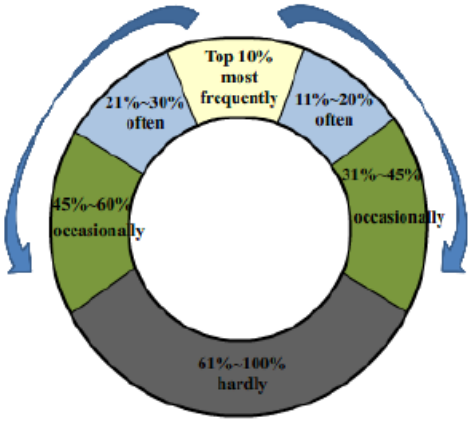

Fig. 8. Interleaved frequency part.

Therefore, we use this characteristic to design our pattern. We divide the channels into four frequency parts in accordance with their ranking. Top 10% of channels are assign to "most frequently watched", 11%~30% are assign to "often watched", 31%~60% are assign to "occasionally watched", and 61%~100% are assign to "hardly watched". And this distribution is according to Zipf's distribution characteristics. Hence, the channels will be arranged like what showed in Fig. 7. We also see that "most frequently watched" is adjacent to "hardly watched" in the Fig. 7. But the switching even happened between these two frequency parts is very hardly, for this reason, we adopt the interleaved pattern what we introduced before. The frequency parts will

be sorted as Fig. 8.

In this part, we are going to introduce how to solve the problem that user's interest may be different during one day. Users may watch the same genre on the same time of the day. Therefore, in the each frequency part what we classify before, we further cluster the channels by their genre and arrange by their ranking in the interleaved way. The result of channel reordering is showed in Fig. 9. Consequently, different users can surfer the channels during the genre what they had most interest.

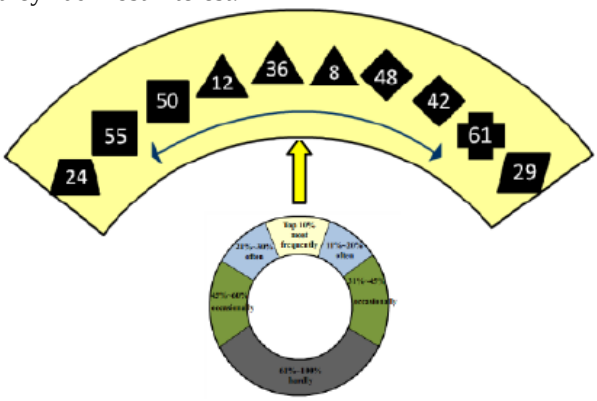

Fig. 9.CIRI reordering pattern

E. Preload pattern

CIRI is capable to effectively lighten the problem of long seek distance, and we will introduce the preload that can help to further lower the zapping time. User can watch the content immediately when switching to those channels which are been preloaded by set-to-box. Then which channels have the high priority to be preloaded? Users are tend to use the linear pattern to switching channel, therefore, we let set-top-box to preload the channels which are adjacent to the channel that user is watching.

The preload size is be limited by bandwidth, so to use the preload size effectively is one of the ways to lighten the zapping time. When user use the upward or downward to switching, then the probability that he/she push the same button to switching is very high. The traditional preload pattern was aim to the two side of adjacent channels of current channel. In this part, we are going to introduce our preload pattern what improve the previous. In the Fig. 10(a) is showed the traditional preload pattern. Channel A is current channel, than set-top-box will preload A-3, A-2, A-1, and A+1, A+2, A+3. In our pattern, by the time that user push the same button of upward, the preload target will be changed, too. Fig. 10(b) is time of T1 that user continuous uses upward, the preload target will be A-2, A-1, and A+1, A+2, A+3 and so on showed in Fig. 10(c) and Fig. 10(d). This pattern can effective to utilize the limited bandwidth of preloading.

Fig. 10. preload pattern

IV. Conclusion

We have proposed the CIRI andpreload pattern in this paper. Reordering channels by their ranking and classifying frequency parts are still matters of this research. And we design the genre classify for shorteningof channel switching seek distance. The prelaod pattern can utilize the bandwidth of preload in the more effectively way. By these two patterns, it is easier to lighten the long zapping time. In future researches, we will design a IPTV system in order to improve our pattern and make contribution to this field.

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