PHIZ: Discovering TVs Long Tail through a Channel - Centric Model

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personalization, search, user interface, virtual channel, show generation

The volume of content available through television has overwhelmed the original interface. While recommendation systems and search engines have changed how consumers discover and acquire books, music and movies over the web, the same model applied to television channels and shows can easily disrupt the television experience that viewers expect. We propose a network of mass customized television channels and call our hypothetical network **phiz**. Designed around the viewer's skills and expectations, phiz enhances their ability to navigate through the television space by delivering customized virtual channels and custom created shows. We present the design and prototype of the phiz search and discovery model that allows individual viewers to access unique content relevant to their interests while preserving the familiar television metaphor.

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Abstract
The volume of content available through television has overwhelmed the original interface. While recommendation systems and search engines have changed how consumers discover and acquire books, music and movies over the web, the same model applied to television channels and shows can easily disrupt the television experience that viewers expect. We propose a network of mass customized television channels and call our hypothetical network **phiz**. Designed around the viewer's skills and expectations, phiz enhances their ability to navigate through the television space by delivering customized virtual channels and custom created shows. We present the design and prototype of the phiz search and discovery model that allows individual viewers to access unique content relevant to their interests while preserving the familiar television metaphor.

Key Words
Personalization, search, user interface, virtual channel, show generation.

1. Introduction

As the web has exploded in popularity and size, information overload has become a dominant problem. Two main solutions have emerged: search and recommendation. Search engines, epitomized by Google, allow users to actively initiate a search, sifting through long lists of results and rephrasing search queries until they *find* what they want. Recommendation engines, with the Amazon book system perhaps the most famous, are more implicit and gently guide users toward related items based on the aggregated behavior of all users (social filtering). Search looks at the available textual content (the web page or metadata) to find items of interest. Recommendation engines use patterns of behavior to *discover* which items are most relevent.

The value of search has been dramatically shown by the success of Google. The value of discovery was recently highlighted in a Wired magazine article, The Long Tail (Anderson, et al 2004). Sorting a collection of media by decreasing popularity (sales, views, downloads) reveals a "long tail" at the end of the distribution (see Figure 1). This long tail is indicative of consumer interest in media beyond the big hits. Amazon has found that more than 50% of their book sales are in the part of the tail not stocked by physical book stores. Amazon's buyers use the site's recommendation system to locate these less broadly popular books.

Like the web, television has an information overload problem. With the increasing number of niche channels, specialty shows, archives of old shows, repositories of sub-show clips, and an explosion of individually created shorts, *finding* and *discovering* relevent content is a growing viewer problem. Clips (highlights, skits, individual news stories, interviews) are an emerging source of content at a smaller granularity than whole shows. The high volume of interesting clips will exacerbate the problem of video overload. As they have on the web, search and recommendation engines can help with the overload problem on television.

However, it is unclear how to apply search and recommendation technology to television, with its relatively passive viewer model and limited interaction through remote controls. A typical television viewer is unlikely to use a keyboard to search for content. The common electronic program guide (EPG), a form of linear search,

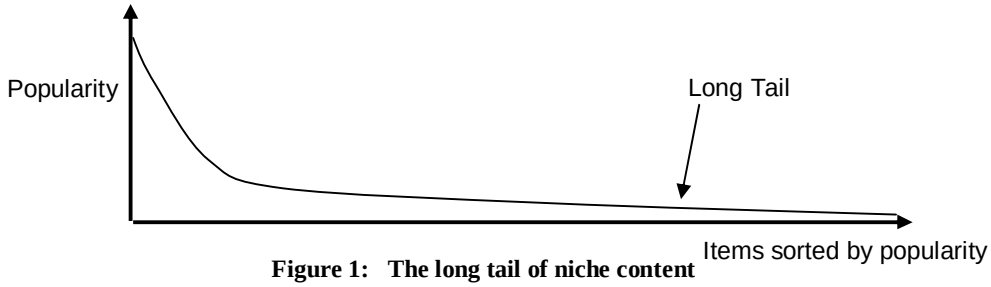

Figure 1: The long tail of niche content

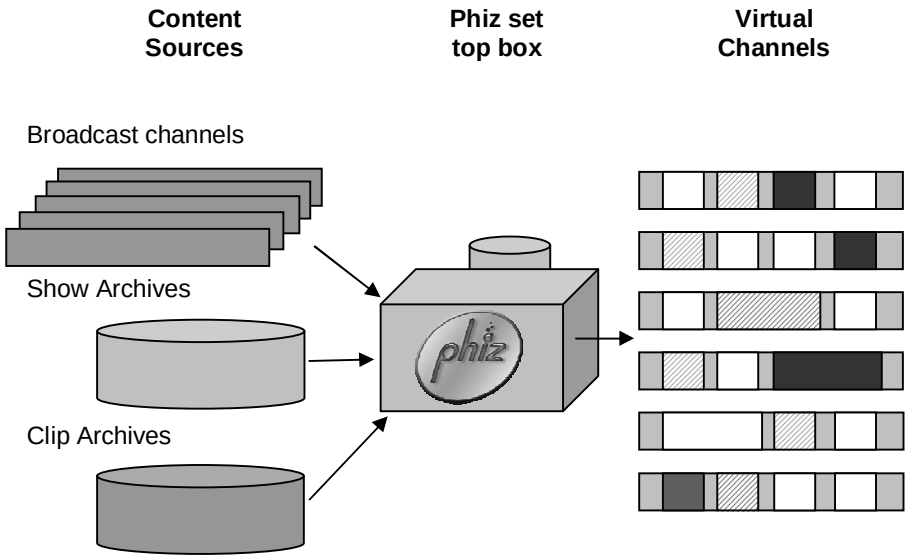

Figure 2: Content flow within the phiz

breaks the passive model of television and is a tedious distraction to someone who just wants to sit down to be entertained. The normal web interface to a recommendation system provides the user with multiple links to choose from using a mouse, not an easy interaction to support with a remote control.

Even more problematic is how to take advantage of video clips. These clips are not available to viewers today except as segments of full length shows. To get to a specific sport highlight or news item, the viewer must tediously scan through longer shows. While search and recommendation engines may be able to find these clips, some method of presenting them to viewers is also needed.

Our primary problem, then, is to give television viewers the power to *find* programs they want (through search) and to *discover* new programs (through recommendations), without compromising the passive television experience. Furthermore, we need to deal with multiple levels of granularity, down to individual video clips, and present all of this content to the viewer in a familiar way.

2. Our Solution

Our solution is based on existing notions of virtual channels (Chorianopoulos 2003) and custom created shows (Maybury 2001, Hass et al 2002). Virtual channels aggregate recorded, downloaded, and custom created shows. Custom shows aggregate video clips. Virtual channels and custom shows are created locally in a set top box with a hard disk. Viewers can watch their virtual channels when convenient, much like any digital video recorder (DVR) such as Tivo. Virtual channels extend the DVR model, providing not just an organizational and interface model, but also encapsulating important search and recommendation functions. Virtual channels represent the micro-niche tastes of small groups of viewers that populate the long tail. Virtual channels show content related by some "theme" such as a genre (news, reality, makeover, entertainment), a specific director (Hitchcock movies and television shows), or what my friends are watching lately.

Recommendation engines are used to discover relevent virtual channels, as well as shows within a channel (including custom created shows). Channels and custom shows encapsulate predefined searches. Custom created shows give access to individual clips. We simplify viewer interaction, requiring a small number of buttons on a remote control and do not require the use of an electronic program guide, on screen menus, mouse, or keyboard.

We created a fictional network of custom virtual channels called **phiz** to help us explore, design, and communicate these ideas. A high level view of content flow within the phiz network is shown in Figure 2.

The architecture of phiz is broken into several separate modules, allowing us to plug in different sub-systems based on our experiments with the system and as we target different environments.

There are 5 primary components for the client-side portion of the phiz system, as illustrated in Figure 3:

Model: Stores application state, video metadata, as well as the video itself. Manages disk space, including policies for when to delete shows, etc.

View: The rendering system in charge of handling the video, onscreen overlays (e.g. an information bar along the bottom and the channel logo "bug")

Control: Separate module that collects user input, for example the remote control device or web based control.

Select: Based on channel definition and user behaviour, decide what shows to record, download, or create.

Fetch: Given a desired list of shows, use the appropriate technique to record them from broadcast tv, download from an archive, or "synthesize" a custom show from clips and templates.

Our goal is to design a system that is as easy to understand and use as possible, grounded on viewer habits formed over long periods of time by the television industry. Familiar concepts from broadcast television include channels, shows, advertisements, and remote controls. To keep our solution broad, we have chosen to leverage these concepts with minimal change.

With today's television, shows are delivered through channels that are defined to optimize advertising sales. Network programmers perform a search function, deciding which shows will be in their lineup. Viewers discover television content using advertising (television, radio, print), promotions on talk shows, reviews by critics, as well as word of mouth. Viewers also perform search through print (television guides), web (sites such as http://www.zap2it.com), and set top box features (electronic program guides: EPGs). Clips are created during the production process, but not available to viewers.

We have adopted the notion of the virtual channel as a basic metaphor in our system. In contrast to normal television channels that optimize ad sales, virtual channels are defined narrowly to better target viewer tastes throughout the long tail. Virtual channels integrate standard shows from broadcast channels and internet archives, as well as custom shows created for individuals. Virtual channels in the phiz network represent both search (to limit the kind of content within the channel) and discovery (by using a method to select the most relevent content to present).

Custom shows have been adopted to allow access to video clips. A custom show represents a search through clip archives based on viewer preferences. Relevent clips are then automatically edited together to form a coherent show. The phiz custom show technology is applicable to a subset of television genres, including news, sports, and in depth shows on celebrities.

The rest of this paper examines in more detail how search and recommendation engines are utilized in our design to help viewers find the shows they like and discover new shows to enjoy. We will look at

- How to discover virtual channels that are likely to have appropriate content
- How virtual channels search for content, use recommendation engines to tune the channel to individual preferences, and help viewers discover interesting new content
- How custom shows help to discover clips and present them to the viewer without complex

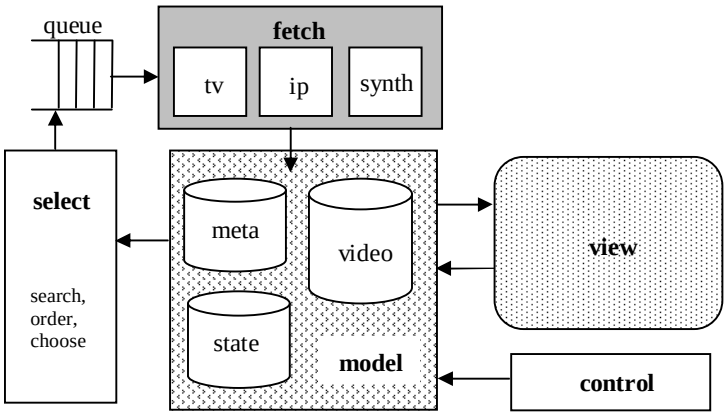

Figure 3: Client side architecture for phiz

```
<channel name="news">
 <filter from="epg">
  <and>
   <or>
     <get field="genre" match="news" />
     <get field="title" match="daily show" />
   </or>
   <miss field="genre" match="sports" />
   <miss field="genre" match="entertainment" />
   <miss field="genre" match="newsmagazine" />
  </and>
 </filter>
</channel>
```

Figure 4: XML search through EPG for a news

menus

3. Channel Discovery

We assume for the purposes of design that there will be thousands of virtual channels. Each channel delivers to the viewer a set of related video content. The insight of the long tail implies a huge population of such micro-niche channels. Virtual channels are the coarsest granularity of content in the phiz network.

The phiz custom network design only uses recommendation to help viewers discover interesting channels. Building on the channel metaphor and living within the passive television model, we chose to concentrate channel discovery in a special "channel preview" channel.

Input to our channel discovery recommendation system is the set of channels currently in the viewer's (or household's) virtual channel lineup and how much each is watched. We can gather viewing statistics as a form of "voting" for each channel. A typical recommendation system (Resnick 1997) uses these votes in an algorithm to find related items based on voting behavior from some population. Typically, votes from one person, say Alice, are used to find other individuals with similar tastes. We then use these similar individuals as a theoretical model of how Alice would react. We then rate other possible items (virtual channels) in terms of relevency to Alice based on the votes by the similar individuals.

On the web, a typical discovery user interface would list multiple related items on the same page, as Amazon does for related books. The high display resolution and ability to click anywhere makes spacial layout of recommendations a natural solution. Television is much more limited. Since no direct pointing is possible with a remote, the typical approach is to use a menu, navigated with arrows or selected with numeric keys. Menu readability and navigation limitations mean that the number of options does not scale very high without adding complexity (hierarchy, multiple pages, scrolling, etc.).

On traditional television, the natural mechanism is a linear time layout of content, with only one thing on the screen at a time. Advertisements for new shows or products, interspersed within and between content, is the standard discovery mechanism on television. If well done, relevent, and not too repetitive, advertisements are entertaining as well as useful.

Our phiz "channel preview" channel is a linear presentation of the recommendation results, presenting a relevency ordered list of virtual channel "previews" (advertisements) in sequential time. While a preview is playing, a single button click on the remote, a '+' key perhaps, indicates interest in the current virtual channel being previewed, causing it to be added to the channel lineup.

This design requires each virtual channel to have a video preview available. Some channels might have high quality previews because they are designed by professionals. Previews could be generated based on text metadata about a virtual channel.

Alternative designs for presenting channel previews are certainly possible. One obvious design would put channel previews within one of the existing virtual channels. For example, if you have a gardening channel in your lineup, you might automatically see channel previews for an English

gardening channel or a channel on landscaping, all intermixed with the regular shows within the gardening channel. We chose the separate preview channel design to separate out the addition of a new channel, since that was a significant event.

4. Show Discovery

Once a channel has been added to a viewer's lineup, it must be populated with shows. The preview channel uses a recommendation engine to select relevent channel previews. Within a regular channel we first apply a search to select a subset of all possible shows (establishing a "theme" for the channel) before sorting those shows to select a subset (tuning the channel to the viewer's tastes).

The type of search that defines the theme for a phiz channel is extensible. Initially we are investigating four types:

- Manual: list of shows similar to a "video blog" created manually by an individual
- Group: automatically collected from shows watched by a group (buddy list, family)
- Private: privately authored content shared by group of people (extended family, club)
- Mechanical: generated list based on searching show metadata, see Figure 4 for an example of a news channel search based on EPG metadata

Limited set top box disk space and limited viewing time imply that not all selected shows can or should be put into the channel. Ordering the results of the channel search provides a mechanism to select a subset of shows. We envision several types of show ordering, including:

- Time: most recent first
- Popularity: most popular first
- Relevency: use a recommendation engine as within the preview channel and sort using relevence scores

The *mechanical* search with *relevency* ordering type of channel is the most similar to automatic search and recommendation systems on the web. The *manual* and *group* searches, paired with *time* or *popularity* ordering, leverage social interactions to discover shows. A *private* search channel can be used to discover content created by friends or family.

The *relevency* sort method is tuned using either implicit or explicit feedback. Implicit feedback is gleaned from watching behavior: watching the whole show is a positive vote, continually skipping the show is a negative vote. Explicit feedback uses remote control buttons (such as Tivo's thumbs up/down mechanism).

One primary difference in our use of recommendation engines for relevency is to apply a separate engine for each channel, rather than a single engine for the entire system. We do this for two main reasons (both of which need to be tested):

- We hypothesize that by limiting the engine to only those shows that are appropriate to the channel, we can get better recommendations
- We also hypothesize that multiple people within a household will tend to watch disparate channels, naturally segmenting their feedback and providing a way to have their different tastes supported without requiring them to "login" to their remote (or other such non-TV behavior)

When previews for shows are available, a small portion of the available disk space can be dedicated to previewing shows that cannot be fully kept on the disk. Clicking on the '+' remote control button while a preview is playing votes positively for that content, providing explicit feedback.

Virtual channel definitions can be created by professionals, organizations, or individuals. Along with the search and ordering methods, defining a channel involves creating preview video, short channel identification video, and specifying a set of policies, such as how and when to remove old content and get new content, how often to allow reruns, etc.

5. Clip Discovery

Video clips, such as sports highlights, individual news reports, or interviews, are potentially entertaining but are spread through many long shows. Our design utilizes custom created shows to present interesting short clips for select genres, specifically news, sports, and celebrity shows. The design challenge is to discover which clip sources are interesting and then to search for appropriate clips within the passive television metaphor we have chosen.

Our model of custom created shows parallels the most common method utilized on the web to create custom pages: the template. A typical mass customized web page is created using a template language such as Java Server Pages (java) (as one example). A template is usually a fairly simple language with embedded database queries or commands that insert user specific data into a predefined layout. We can use the same technique

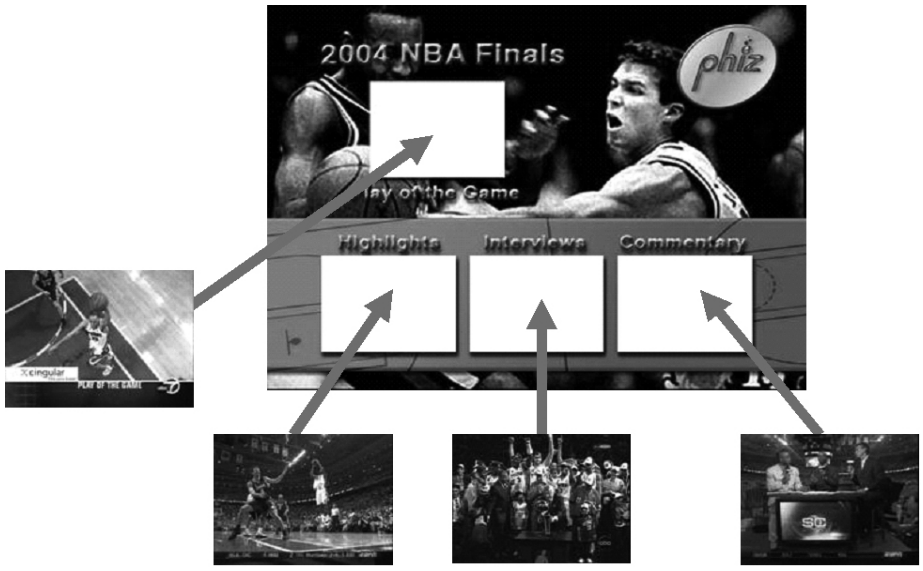

Figure 5: Constructing a custom sports show from clips

for video: create a predefined show layout, search for video clips based on the viewer's preferences, and then automatically integrate the video template with the clips.

We have designed three such shows:

- News: invert the typical news show (one editorial policy, a few personalities, many news stories) and construct a comparative show concentrating on a single story with coverage from many news sources. Viewer preferences include the subject and the list of news sources preferred.
- Sports: construct a sporting event summary show with highlights, post game interviews, and analysis. Viewer preferences include the team and/or event, play-by-play preferences, and preferred analysts. Figure 5 shows schematically how a sporting event show is created.
- Celebrity: gather interviews, news items, still photos, music, movie trailers, music videos, etc. related to a favorite celebrity and create an in depth look at media not yet seen by the viewer. The show can be customized by selecting the celebrity, a preferred editing style and set of news sources.

A custom show generated using this template mechanism encapsulates search through clip and other media archives, and then edits together the result into a high production value television show. Our current design relies on web access to the clip archives, presumably based on a business relationship. If the right techniques were available, clips could be extracted from broadcast shows instead.

Setting preferences for these custom shows uses the same techniques used for channel and show discovery. Within a channel, previews of news topics, sport teams or events, or celebrities can be selected by the viewer and will then cause a custom show to be created. Other previews of news sources, sports play-by-play and analysts, and gossip sources can be selected to customize the shows.

6. Related Work

Recommendation engines have been around for many years. (Resnick 1997) cites (Goldberg et al 1992) as one of the first recommendation engines (circa 1992) and they coined the phrase "collaborative filtering." For a good taxonomy see (Montaner et al 2003). (Ardissono et al 2004) presents several articles that use recommendation techniques for generating personal EPGs. These models integrate various preference gathering and recommendation modules, and the results are used to augment an EPG. We apply preference-informed recommendation engines towards the selection of content both for the preview channel and for the shows and previews within a given channel. Thus we integrate the search and discovery into the channel-viewing model rather than through a separate EPG interface.

The channel model is a common model for media organization and we have seen it in radio, television and even weblog RSS feeds. We leverage the same

model as the Virtual Channels model proposed by (Chorianopoulos 2003). The tenet with Virtual Channels is that "...a virtual channel is a model that aids the organization and dynamic presentation of digital television programming from a combination of live broadcasts, prerecorded content and Internet resources at each set-top box." We extend this in that we use a new, virtual preview channel to represent the new content (recommendation) and to provide a mechanism to opt in to available virtual channels (through explicit viewer selection).

In addition to the creation of virtual channels, we also describe creating custom shows made up from clips or segments from various sources. Related work in (Ardissono et al 2004) such as PersonalCasting (Maybury 2001) and Media Augmentation (Dimitrova et al 2004) does a similar aggregation for news broadcasts, attempting to identify and present related news clips. These works illustrate the potential for automatically segmenting and recombining video to meet personal preferences.

7. Current State and Future Work

We have mocked up our design for the preview channel, several regular channels, and three custom shows. This mockup includes our relatively passive "preview"-based model for adding channels, discovering shows, and personalizing custom shows.

We have prototyped the channel and show presentation system including channel navigation controls, show skipping controls, and preview selection. Since all content is stored on disk, the viewer can both move between channels (conceptually "up" and "down") and skip forward and backward within the channel ("left" and "right") similar to a DVD chapter skip. While watching a preview, the viewer can select a '+' button to provide explicit feedback. Depending on the preview this may add a new channel, vote for a show, add a show to a manually created channel, or select an option for a custom show.

Our prototype includes early versions of mechanical search, a simple recommendation system with explicit and implicit feedback and a simple custom show template system. We are actively completing the integration and extension of these modules as well as gathering informal viewer feedback.

Simultaneously we are embarking on a study to understand how viewers perceive channels, mentally organize their favorite shows, and discover new media. We will be gathering more formal feedback on our prototype at the same time.

8. Conclusions

We have designed a custom television network (phiz) that attempts to impose the smallest possible interaction load on the viewer while creating a mass customized television experience. Our design builds on well entrenched metaphors from standard broadcast television, including channels, shows, advertisements, and simple remote controls.

We employ two techniques from the web, search and recommendation, to help viewers find and discover television content relevent to their interests. Virtual channels and custom shows encapsulate search through show and clip metadata. Recommendation engines are used to select shows and previews (advertisements) for content. Other people are leveraged as highly trusted content recommenders. Implicit and explicit feedback is used to tune the system to viewer preferences and to help the viewer explore the long tail of television content.

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