BROADCASTASIA2004 INTERNATIONAL CONFERENCE PAPER: ADDRESSABLE ADVERTISING ON DIGITAL TELEVISION

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ABSTRACT

Advertising on digital television will undergo significant changes within the next 5 years. The traditional models for advertising on television are challenged by the multiplication of channels and the explosion of VoD content brought by digital television that fragments the audience. They are also threatened by PVRs, where the viewer can easily skip ads.

We believe that addressable advertising, where specific video ads are targeted to specific audiences will become central to advertising on digital television within the next 5 years. In this paper, we are demonstrating that advertisers will be ready to pay premium rates to cable operators who can demonstrate increased efficiency of their advertising network through targeting. We also describe the impact of deploying addressable advertising on the infrastructure and operation of a digital television network.

Looking into the very near future, we describe how other forms of advertising, including telescoping and interactive advertising will complement addressability on digital television networks.

Table of Content

INTRODUCTION

Advertising on digital television will undergo significant changes within the next 5 years.

In 1965, 34 % of US adult TV viewers could name a brand advertised in the show they just watched. In 2000, the ratio had gone down to 9 %. Television advertising costs are increasing, while its efficiency is decreasing. At the same time, the traditional models for advertising on digital TV networks are challenged by the multiplication of channels and the explosion of VoD content brought by digital television that fragments the audience. They are also threatened by PVRs, where the viewer can easily skip ads. These factors could combine and hurt advertising revenues for the entire Television industry, including network operators.

On the other hand other factors create new opportunities for digital TV network operators to significantly boost their advertising revenues.

In particular, we believe that addressable advertising, where specific video ads are targeted to specific audiences will become central to advertising on digital television within the next 5 years. If advertising is tailored to the taste of the audience, viewers will be less inclined to skip commercials. In addition, advertisers will be ready to pay premium rates to network operators who can demonstrate increased efficiency of their advertising network through targeting.

Finally, it is our conviction that the two-way infrastructure of digital TV networks gives operators unique abilities in measuring the effectiveness of advertising on their networks.

In this paper, we will first compare different forms of addressable advertising, and demonstrate the superiority of home addressable advertising. We will show that network operators can expect one of the highest ROI from home addressable advertising amongst all the services they can offer to their digital subscribers. Then we will study the impact of introducing home addressable advertising on the digital TV plant, and suggest how the capability can be deployed with minimal cost by leveraging recent evolutions in digital TV network infrastructure. We will look in particular at the trafficking and digital program insertion (DPI) infrastructure. Finally, we will suggest strategies to optimize the amount of bandwidth dedicated to home addressable ads.

DIFFERENT CATEGORIES OF ADDRESSABLE ADVERTISING

In this section, we will see that digital infrastructure technology offers multiple options for targeting to digital TV network operators. These options include thematic addressability, geographic addressability and home addressability. We will give an overview of how these three techniques work and why home addressable advertising represents the most effective strategy for advertising.

Thematic Targeting

Audio and video compression technologies introduced with digital television have multiplied the number of channels an operator can offer to its subscribers. As a consequence, digital TV carries increasingly specialized channels that reach very specific audiences. Advertisers can increase their chance of reaching a certain audience by buying ad space on channels that cater to the audience they want to reach. For example, golf balls manufacturers will want to buy airtime on the Golf Channel.

This technique offers the advantage that it does not require any modification, either to the digital TV network infrastructure, or to the way ad space is bought today. On the other hand, this strategy offers significant limitations. First of all, it only allows reaching a portion of the target market for a particular product. For example, some golf players do not watch the Golf Channel. Secondly, the markets for most products do not closely match the target audience of any niche channel.

Geographic Addressability

As network operators reduce the number of households per node, households in these nodes become more homogeneous from a demographic standpoint. Geographic addressability is a specialized form of local advertising insertion. As a consequence, the impact of deploying geographic addressability on a digital TV network that is already equipped for ad insertion is minimal. Unlike home addressability, geographic targeting can even be introduced on analog channels.

On the other hand, the efficiency of geographic targeting is limited, depending on the factors used for targeting. Populations in a node can be rather homogeneous as far as ethnicity and revenue bracket. Other factors such as age, however, vary greatly in a node.

In general, it is a widely held misconception that geographic splits of commercials used by one marketer can deliver a large proportion of the value of home addressable commercials. The marketer is trying to reach the group that will have the largest ROI, typically detectable based on buying patterns and brand attitudes. The further one gets from buying patterns and brand attitudes in trying to throw a different sort of rope around a group containing as many "ROI positives" as possible, the more false positives (non targets reached) and the more misses (real targets not reached). Because where people live does predetermine neither their buying patterns nor brand attitudes, geographic targeting (zones, nodes, or even specific blocks) can never achieve the precision the marketer desires. In other terms, the efficiency of geographic addressability diminishes rapidly as the number of households in the node increases.

Which is not to say that geographic addressability has not been a step in the right direction. The value of geographic addressability may be inferred from the size of the premium which marketers have been willing to pay for geographic targeting, which has generally been in the range of a 10% to 20% premium. As we shall see, the fungible "premium" for home addressable ads is far higher than this, because the buyer side knows that "premium" to actually be a savings to them.

Home Addressability

In the home addressable advertising model, multiple household profiles are offered to advertisers within the same ad slot. For example, within the same slot, one advertiser may buy space to broadcast an ad targeted at young couples expecting children while another advertiser may buy space on the same slot to reach dog owners. During the slot, young couple will see one ad while dog owners will see another ad. Addressable advertising maximizes the digital TV network operators' revenue, since it can charge higher CPM to reach a more targeted audience.

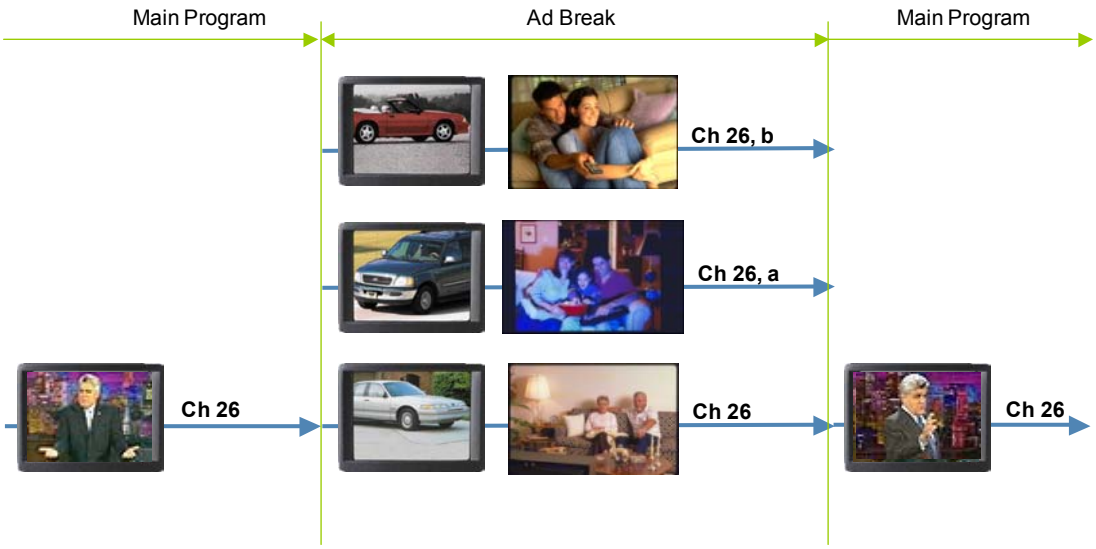

Figure 1 Three home-targeted ads inserted on Channel 26 to match three different household profiles

Because of its requirement to use additional bandwidth in order to broadcast multiple versions of an ad at the same time, home addressability is limited to channels in the digital tier, so that digital video compression can be used to minimize the extra bandwidth cost. As we will see later in this paper however, home addressability is only marginally more complex to deploy than geographic addressability. The impact of home addressability on the infrastructure of channels that are already in the digital tier and enabled for local ad insertion is minimal.

On the other hand, contrary to geographic addressability, home addressability can be used to target homes based on any collectable data, including factors that are known to vary greatly within a node, such as age and number of children.

THE VALUE OF HOME ADDRESSABLE ADVERTISING

The business value of addressable commercials rests on the growing sophistication of marketers in understanding the Return On Investment (ROI) implications of spending their advertising money to reach the mass audience versus specific target groups.

It is a misconception held by junior marketers and those outside the business, that demographics are the essence of targeting. In fact, demographics are surrogates used to increase the chances of hitting the true target, which involves not demographics but buyergraphics (a term coined by Arbitron). For example, the buyergraphic that a typical car advertiser may be really trying to reach might be homes that have bought or leased a car new in the past 3 years. Because they are buying TV programs out of a Nielsen book that does not show that column, but does show "Adults 25-54", based on other information correlating the real target group versus that surrogate demographic target, the buyer will use A2554 as the buying column. However, the buyer's superiors know that 40% of the target group is missed entirely by this action (40% of the buyergraphic target is not in the surrogate target) and that 70% of the surrogate target consists of buyergraphic non-targets. The action is not ideal, but it is the best that can be done under the circumstances. This is still the situation in the U.S. today, where $60 billion is spent annually on television advertising.

The evolution of targeting has taken a couple of great leaps in the past 40 years. In the 60s, Brand Rating Index (BRI) popularized the footrule that in a typical product category, 20% of the users represent about 80% of the volume, and thus the era of targeting heavy users was born. In the 80s,

supermarket checkout counter barcode scanner data became widely available and led to the learning that for a typical brand, 8% of the most profitable customers accounted for 60% of the profits. This ushered in the era of retention marketing, consumer loyalty programs, Consumer Relationship Management (CRM), and the concept of Consumer Lifetime Value (CLV). In the latest Master Model from the ARF, it is finally made explicit that targets ought to be defined and media selected so as to maximize impact against those consumers where there will be the greatest economic difference made from before to after. The metrics of marketing will soon fully plug into the CFO's spreadsheet. We believe that one of the mechanisms of this further evolution will be home addressable commercials.

The idea of addressable commercials was first spelled out in 1979. Within a year the idea was being tested in a research context by ERIM in France and IRI in the US. The idea is to deliver different commercials to different homes watching the same program, so as to deliver that commercial to each viewer that has the greatest chance of making a positive economic difference. With a return research feedback loop to prove ROI, spots of that kind could be sold for far more than the buckshot and unaccountable spots that today generate about six trillion mostly wasted impressions through US television each year. Thus marketers would benefit and so would the sellers of addressable commercials. The consumer also benefits because he/she sees fewer irrelevant spots. The overall economy could even benefit since marketing is about 20% of the top line of any company, is known to be largely wasted today, and any savings that move a sizeable chunk of that amount to the bottom line can have substantial macroeconomic impact if such movement occurs across an entire sector of the economy.

The first quantification of the value of addressable commercials came in 1997 in an analysis of Scarborough's Spring study of that year in Seattle conducted by Next Century Media for the Addressable Advertising Coalition, a non-profit group containing all of the top 20 agencies as well as many top advertisers, cable companies, set top box manufacturers, and others. Scarborough is a syndicated database used by marketers and media to analyze buyergraphics by media exposure in local markets across the US. That analysis found that with 12 advertisers splitting up a TV program's audience, the average advertiser could receive about twice as many impressions against his/her targets at the same cost as before, while the seller would simultaneously also receive about twice as much money for the same 30 seconds as before.

The second bit of evidence came a year later when Next Century Media (NCM) released the results of the Atlanta study, where 500 digital set top boxes had been measured second by second by a software client, and NCM had collected questionnaires and matched external database data against the 500 homes to determine their targeting value to each of the top advertisers participating in the study. Analysis indicated that, with 62 advertiser campaigns to optimize simultaneously, the average advertiser could receive 2.7 times the number of impressions against its true targets, while the network operator could charge three times as much money for the same 30 seconds aggregately across all advertisers buying impressions within that spot.

In the most recent analysis, addressable commercials were actually implemented, whereas in these latter first two cases the analysis was of a "what if" nature. The third study was done by OpenTV's ACTV Division using their SpotOn system, a feeder channel implementation that is the only known operational system to deliver addressable commercials today on regular TV channels. The study involved 11,500 set top boxes in the Denver market in a suburb called Aurora, CO. That study is still being analyzed as of this writing and there will be further data released by Comcast in the near future. An initial table from that study indicates that with four advertisers; with targeting characteristics of homes inferred from zip+4 averages; with requirement for one advertiser to buy all of the impressions in a spot and to allocate them across that advertiser's own commercials (versus multiple advertisers sharing the impressions in one spot, which is more efficient); SpotOn

increased the yield of target rating points (TRP) to the buyer side +84% while increasing revenue to the seller side by 18%. In actual practice the network operator would take a larger increase for himself/herself while still providing the buyer side with sufficient economic reason to use addressable commercials over regular commercials.

The Crux Analysis – Flash Report

Aug. 18-24, 2003, 5000 Homes in Aurora CO, zip+4 Targets

Avg. Of 4 Advertisers	Without SpotON (ROS)	With SpotOn	Difference
TV Spend ($20 CPM Targets, $10 CPM Waste)	$4.76	$5.60	+18%
Target Reach	3.9%	8.6%	+121%
TRP	7.7	14.2	+84%
Reallocatable Point Spread			66 points (84 minus 18)

Table 1 Use of Empirical Data To Prove Value of Addressable Commercials (1)

The further analyses of the Aurora data will involve actual household level buyergraphics targeting, testing of multiple advertiser allocations of impressions within a spot, and assumption of more advertisers, to determine the full matrix of variables determining the exact degree of economic leverage to buyer and seller side in the addressable advertising equation. What is clear at this point is that there is a simultaneous advantage to both buyer and seller in the use of addressable commercials. The superiority of home addressability over other forms of addressability, including thematic targeting and geographic addressability, is also clearly established because of its ability to deliver any buyergraphics. It is expected based upon the prior two studies that the additional analyses in Aurora involving more advertisers, multiple advertisers per spot, more precise targeting, and the use of an optimizer will result in an increase in the yield to both buyer and seller.

The real question – since the use of addressable commercials does not involve significant capital expenditure but it does involve use of scarce resource, namely bandwidth to carry the simultaneous alternative commercials via feeder channels – is "How does the Return On Bandwidth (ROB) of addressable commercials relate to the ROB of other common uses of network bandwidth?"

To establish a framework for answering that question, OpenTV engineers created the following set of estimates based on Kagan data and inputs from cable operators. A similar computation could be put together for other types of digital TV networks, including satellite, FTTH and DSL. This indicates that the average ROB across all uses of cable plant is 16 cents per Hertz per subscriber per month. High-speed access and VOD are the leaders in high ROB at an estimated 36 cents and 34 cents respectively.

Use of Bandwidth	MHz	Revenue Per Sub Per Month	Note	Return Per Hertz ("Revehertz") $/Hz/Month
Basic	432	$36.61	1	$0.08
Pay	36	$5.78		$0.16
Digital Tier	120	$13.27	2	$0.11
High-speed Access	18	$6.40		$0.36
Cable-To-Business	6	$1.17		$0.20
Digital music, Nav Guides, TV Internet Access, ISP, etc.	6	$0.01		$0.00
Home Shopping Commissions	12	$0.34		$0.03
Telephony	12	$3.54		$0.30
Digital Cable VOD/SVOD	30	$10.29	2	$0.34
Nondigital cable PPV/NVOD/Adult	30	$1.92	3	$0.06
Satellite PPV/NVOD/Adult	42	$6.72	4	$0.16
Average (Unweighted)				$0.16

Table 2 Estimated Typical Cable Operator Return On Bandwidth (2)

1- $32.85 subscriber fees + $3.76 advertising

2- Of digital subs = 26.6 million

3- Of Nondigital cable subs = 43.9 million

4- Of Satellite subs = 20.4 million

All other stats are against total cable subs = 70.5 million

What about home addressable ads? Assume a cable operator used 6MHz for feeder channels to make 6 basic cable channels addressable (we will see later in this paper that this is a very conservative estimate for bandwidth allocation), and those 6 cable channels averaged a half rating point in audience size across the whole broadcast month, 24 hours per day. Assume further that each of these channels currently sells out 90% of its locally-insertable spot inventory consisting of four spots per hour per channel, at an average $15 CPM, and that addressable commercials can lift the effective CPM to $35 leaving the sellthrough rate at 90%. A $15 CPM equates to 1.5 cents per exposure, and a $35 CPM equates to 3.5 cents per exposure. $35 CPM to reach one's true targets is conservative if for example the system allows an advertiser to target the 8% of his/her customers who account for 60% of profits. The average advertiser today buying mass audience at a $10 CPM

is actually paying $120 to reach his/her own brand's customers (assuming average brand has 8% penetration), and to reach the 8% of the brand's buyers who account for 60% of the brand's profits, the advertiser is actually paying a CPM of $1440 today. This is close to the $1,500, which is the average CPM of direct mail, a medium which has of late been growing in advertising revenues faster than television as a result of advertiser interest in targeting.

Assuming a lift only to $35 CPM, the increment is 2 cents for each spot in inventory on those 6 channels (less 10% not sold). 6 channels times 4 spots per hour times 24 hours times 30.5 days per month=17,568 spots, factored down 10%=15,811 spots. Only one in 200 of these spots is exposed in the average household (this is what "a half rating point" means, that exposure is 0.5% or 1 in 200). Thus the average subscriber home gets 79 of these spots, and 2 cents for each of these=$1.58. This took 6MHz of feeder channels to achieve, thus we divide by 6 to get ROB on a per-Hertz basis. That calculates to 26.352 cents as the addressable commercial predicted ROB on the same basis as in the table above, per sub, per Hz, per month. This is not as good as High-speed Access or VOD but 65% higher than the current average use of cable bandwidth ROB. We anticipate that the real ROB for addressable commercials will actually be far higher than this as a result of multiple advertisers per spot, more advertisers on the system making it more efficient, and better (household-level) buyergraphic targeting. Finally, we will see later in the paper techniques aimed at optimizing the amount of bandwidth dedicated to home addressable ads and therefore further improving the ROB for home addressable advertising.

END-TO-END NETWORK ARCHITECTURE FOR THE DELIVERY OF HOME ADDRESSABLE ADVERTISING

The overall network infrastructure will have to change in order to support home addressable advertising. Some of these changes will be specific to home addressable advertising. Much of the infrastructure that is currently put in place by network operators to support digital TV, VoD, Digital Program Insertion and network PVRs can, however, be reused to deploy addressable advertising.

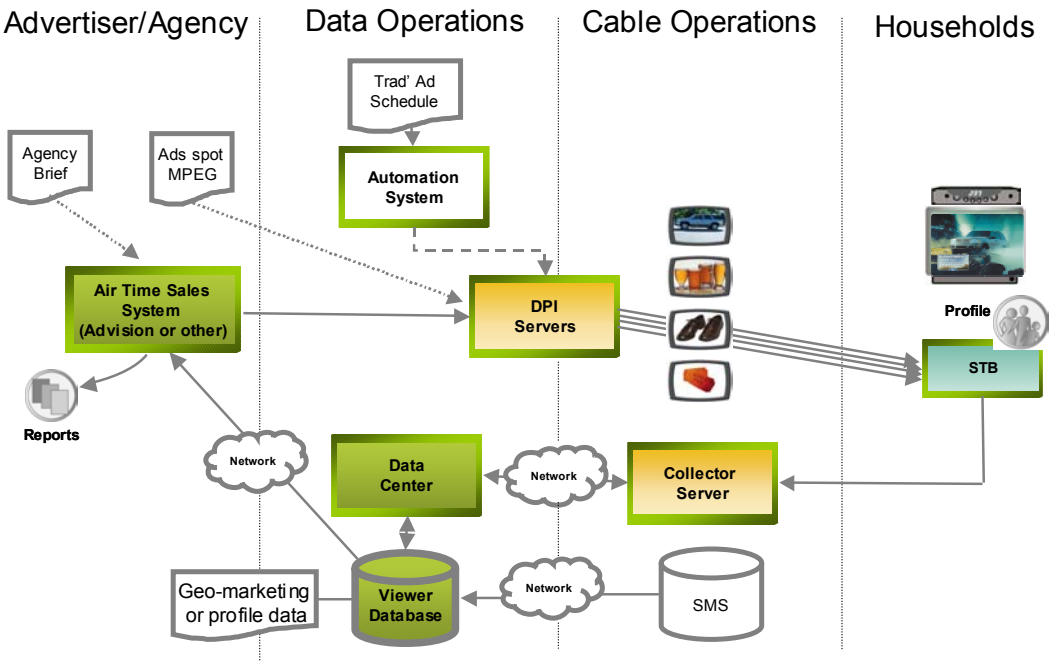

Figure 2 End to end infrastructure diagram for the delivery of home addressable ads on a digital TV network.

In order to get an overview of the infrastructure of a digital network operator enabled for home addressable advertising, let us follow the flow of a home addressable ad.

Ad agencies prepare the ads. Multiple copies of the ad will have to be created to reach different audiences. In addition, metadata needs to be generated to indicate the target audience for each ad copy. We expect that in the future, the format of the metadata will be standardized, so that it can be created once by advertisers and then deployed on all TV networks.

Network operators sales team manage their inventory and sell ad slots using trafficking software. The purpose of the trafficking software is to optimize usage of the ad slot inventory, and eventually schedule insertion of individual ads (in this case multiple copies targeted to different audiences) in the main program of individual channels. While not a requirement to deploy home addressable advertising, we will see in the next section how next generation trafficking systems can help maximize the overall ad efficiency across the complete inventory and, therefore, boost network operators revenue.

In order to enable frame accurate insertion of digital ads, with the current generation of Digital Program Insertion (DPI) splicers, special encoding hardware has to be used to encode the main program as well as the local ads. In the future, we expect DPI splicers to be able to splice any combination of legal ISO/IEC 13818 MPEG-2 streams coming from any encoder.

Ad copies, targeting metadata as well as schedules are then transmitted to the digital ad servers. The same existing content propagation methods and infrastructure can be used to download traditional and addressable ads into the digital ad servers. Just as for traditional local ad insertion, DPI servers can be located and cascaded in multiple points of insertion in the network plant, from superhead-ends to local head-ends. One of the following sections will describe in more detail the minor enhancement to current DPI servers required to support home addressable advertising. In the DPI

servers, automation systems, audio cues or digital cues (such as SCTE DVS 253) can then be used to trigger the insertion of specific ad copies on specific channels at specific times.

The existing monitoring system can be used to monitor the good health of the DPI slicers as well as to log local ads insertions. These logs are sent back to the operator's back-office for billing advertisers. Progress in the reliability of DPI, helped by the replacement of audio cues with DVS 253 compliant digital cues (which reduce the risk of missing cues but also, because they rely on program unique Ids, rather than static scheduled, to make sure that the right ad is inserted on the right program), will benefit all categories of local ads, including home addressable.

DPI servers insert addressable copies as a legal ISO/IEC 13818 MPEG-2 stream. The stream includes a PMT that describes the position of the audio and video for the addressable copy ads in the transport stream. It also includes the metadata that maps each ad copy to a specific profile. Finally, splice points are inserted in the stream to notify the receiver of the start or the end of a particular addressable ad spot.

The fact that addressable enabled channels are carried as legal ISO/IEC 13818 MPEG-2 streams means that no special hardware is required in the receiver to decode these streams. In other terms, the tens of millions of digital TV receivers deployed in Asia can be enabled to receive home addressable advertising as long as the right firmware has been downloaded (typically out of band over the air if the receivers are already in the field). The receiver monitors splice points on the channel the viewer is currently viewing. If a splice point is detected, indicating the beginning of an addressable ad, the receiver extracts the targeting metadata from the stream, compares it with the profile stored in the receiver and retrieves from the PMT of the channel the data required to tune to the specific addressable ad copy that matches the profile, all this without any viewer intervention. When a splice point is detected, indicating the end of an addressable ad, the receiver retrieves from the PMT of the channel the data required to tune back to the main program.

Data can be stored in the receiver to log which ads have been viewed. While it is not necessary to have a two-way OOB data connection in order to perform home addressable advertising functions, where available, the OOB return path can be used to send the clickstream logs to the network operator's back office for data mining. While not required, we have seen in a previous section the importance of accurate audience measurement in order to assess fully the value of home addressable advertising. Audience measurement and reporting will become increasingly important to demonstrate the effectiveness of targeting in order to claim higher CPMs. Industry organizations, such as the ITA (Interactive Television Association), are identifying standardized metrics to measure the effectiveness of addressable advertising. This work is being done as part of project called IAG (Interactive Advertising Guidelines) 2.0 facilitated by Forrester and Josh Bernoff and includes the participation of many of the key advertising organizations including; ANA, AAAA, Ad-ID, CAB, and ARF as well as many universities including; UCLA, Ball State University, Georgia Tech University, The University of Georgia and USC.

In addition to the return channel, the OOB channel can also used to send profiles to the STB. The database that is used to create profiles can be populated from a number of sources including:

Network operator questionnaire filled out when the service is turned on.

Public records

Third-party information gathering services

Feedback from previous ad selections

Voluntary surveys

TRAFFICKING HOME ADDRESSABLE ADS

In the area of ad trafficking, tools that are used support ad sales and inventory management will have to evolve. In particular, while traditional traffic systems can be used for the management of home addressable ad inventory, it is our feeling that next generation Traffic Systems will be required to fully monetize the network operators local avail inventory with home addressable ads. In particular, in order to match advertisers bids for specific audience profiles, Traffic Systems will have to become much more flexible and dynamic in their ability to manage inventory based on complex rules.

Traffic management, and its interaction with the systems that deliver ads to television viewers, has changed very little in the past 25 years. Next generation traffic systems have improved the processes of representing and communicating an advertiser's requirements regarding the programming into which their ads should be placed and have made the information driving the sales process much more accessible. Current traffic systems are faster, more user friendly, and better integrated with an MSO's broader information systems. But, the nature of the ads and the systems that deliver them remain as they have been since the days of tape decks and VT100 terminals.

In present implementations, the traffic system produces a daily schedule for each TV network in a headend. The schedule is delivered to the ad insertion system as a sequence of fully qualified playback commands in a fixed column, ASCII text file. Such schedules define the exact sequence of ad spots to be played at completely specified time periods (Figure 2). The ads themselves are simple 30 or 60 second video spots that are inserted exactly as scheduled when an anticipated cue tone is detected. There is no allowance for the (very common) possibilities of program variation, time shifting, cue tone failure, or content discrepancy. The DPI servers click through the schedule from midnight to midnight and log their success or failure in a similar ASCII file that is sent to and verified by the traffic system the following day.

```
REM Schedule for ESPN, EAST Zone
00:00 00:10 :30         Al's Used Cars
00:00 00:10 :30         Pizza Hut
00:30 00:45 :60         Eastside Honda
01:00 01:10 :30         Joe's Lunch
01:00 01:10 :30         HBO Promo

                ...

23:00 23:10 :30         Dove Soap
23:00 23:10 :30         TriState Ford
```

Figure 3 Traditional Traffic Interface File

It is worth noting that such methods are far behind the capabilities of even current technology. As we move to the next generation of addressable television advertising, the challenge to traffic systems should be to dramatically improve this interaction and to drive the technology and it's ability to sell advertising to it's full potential.

Next generation of traffic systems must be more dynamic and highly integrated with the emerging addressing and insertion technologies. Ad space (inventory) must be used as flexibly as possible so

as to maximize the revenue that it produces for the network operator. This will require a dramatic increase in computing power, which can only be delivered effectively by a distributed system. It will no longer be practical for a single machine to produce all of the possible variations of ad "schedules" that would address viewers by their profiles.

The new delivery systems will need to be much more intelligent and capable of working with an abstract description of the advertiser's campaign requirements. Moving this intelligence out to the "insertion point" will make the new systems far more dynamic and able to react to targeting and real-time events. These insertion points may be a traditional headend, a neighborhood (node), or an individual set-top box (in the case of PVR based home addressable advertising). The functions of the traffic system will be distributed outward from a central facility that processes orders and other user interactions, produces descriptions of the programming and targeting objectives for individual or classes of insertion points, and interacts with the intelligent delivery systems to ensure that the campaigns are running as planned (Figure 3).

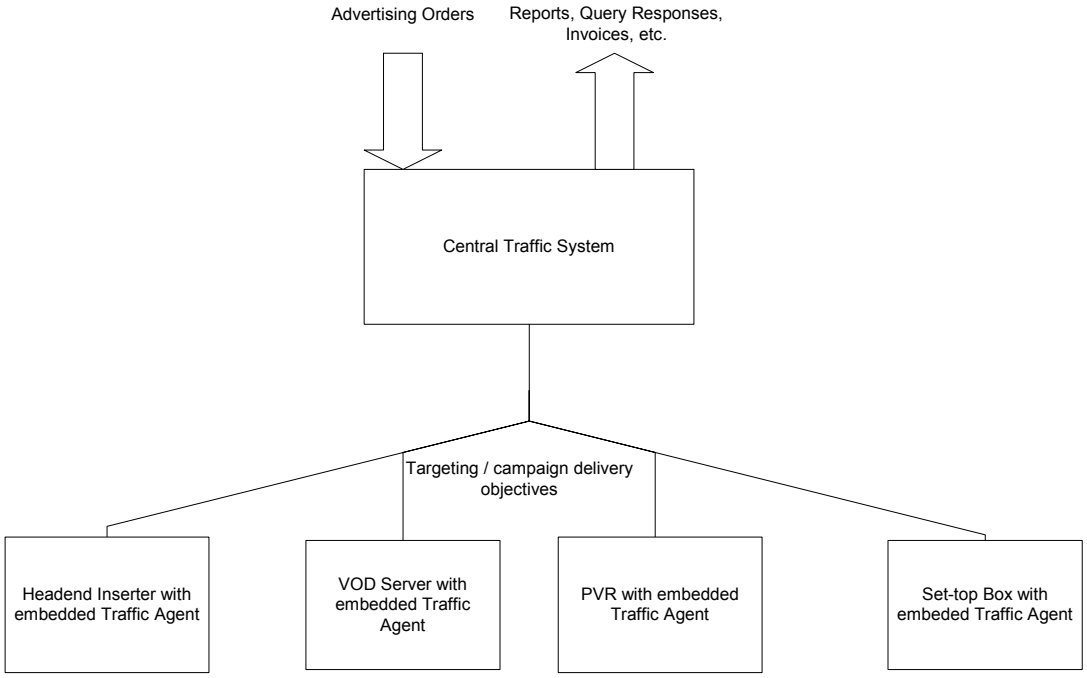

Figure 4 Next Generation Distributed Traffic System

Such a distributed system makes appropriate use of the computing resources within each component. The Central Traffic System processes sales orders and provides the necessary user interfaces for reporting, queries, billing and other "back-office" functions. The Embedded Traffic Agents produce a "schedule" for each break comprising the optimal set of ad spots to play such that the viewer profile is satisfied and the revenue generated for the media network is maximized. Each Traffic Agent bases it's decisions on the history of ad spots previously inserted during a time period, the changes to the contracted ad campaigns, the profile of the viewer, and real-time events occurring within the media stream. Because of the real-time nature of this method, the system is able to target viewers and react to events, conditions and viewer interactions in ways that are not possible in the current technology.

INSERTING HOME ADDRESSABLE ADS IN THE HEAD-END

It is our view that DPI equipment, which is currently deployed to support the insertion of a single ad copy into a digital program, will be enhanced to support home addressable advertising. DPI equipment will become capable of inserting multiple ad copies as well as tables mapping household profiles to ad copies.

The Society of Cable Telecommunications Engineers ("SCTE") has adopted various Digital Program Insertion (DPI) standards for providing advertising in a digital system. Two of these standards are of particular relevance to home addressable advertising. The first of these standards is SCTE 35 2001 (hereinafter, "DVS253"), which is entitled "Digital Program Insertion Cueing Message for Cable", and was first issued on September 27, 1999. The second SCTE standard is SCTE 30 2001 (hereinafter, "DVS380"), which is entitled "Digital Program Insertion Splicing API", and was adopted on January 18, 2001.

When an insertion opportunity is signaled by the arrival of a DVS253 trigger in the network stream, the ad sever references the schedule to determine what ad set to play and when to play it. The ad splicer communicates with the ad server through the DVS380 standard interface to tell the splicer when to spice the ads into the network feed. The ad server and splicer also embed targeting metadata in the stream. The embedded metadata carries ad targeting and splice timing information to insure a frame accurate splice into the correct ad at the set top box based on a preloaded STB profile.

In order to function properly within a home addressable advertising system, the ad server has the following functionality:

Output a Single Program Transport Stream (SPTS) containing targeted ad sets to the ad splicer.

Output targeting metadata files, for example in the DVS380 TEC descriptor format.

The ad splicer forms the heart of a digital ad insertion solution for the home addressable advertising system. The splicer adds value to the home addressable system by allowing high quality network feeds to be replaced with multiple lower bit-rate advertisements that are then selected on a receiver-by-receiver basis to support home addressable advertising.

The ad splicer must meet certain requirements that are not normally considered with traditional splicing solutions that handle splicing out one video program with one other video program. The ad splicer must be capable of taking a single video feed and splicing in multiple video feeds, and correspondingly, taking multiple video feeds and splicing back to a single video feed. It must do this in such a fashion that, regardless of which of the multiple video feeds a downstream decoder is currently presenting, the splice will be invisible to the viewer.

In order to support home addressable advertising properly, the ad splicer must typically support the following functionality:

Input a Multiple Program Transport Stream (MPTS) at 27 Mbps.

Output a Multiple Program Transport Stream at 27 Mbps.

Be capable of stripping a Single Program Transport Stream (SPTS) from the input Multiple Program Transport Stream (MPTS); replace it with a SPTS at the same bit rate from the ad server, and present the resulting transport stream to the output (insert a digital ad set into a digital multiplex).

Receive ad insertion scheduling data and TEC descriptors containing targeting metadata via a DVS380 interface.

Ensure that home addressable ad splice points are transmitted through the system.

Ensure that all splicing operations are performed on GOP boundaries, and the PTS/PCR and PID re-stamping is performed properly.

Recreate PMT information so that the STB is always presented a valid PMT containing all of the services defined correctly including during enhanced ads.

Finally, it should be noted that in addition to DPI servers, PVRs can also be used to support addressable advertising. We expect that the same infrastructure that is being put in place to distribute entertainment content in the background into PVRs hard drives to support pushed VoD will also be used to distribute home addressable ad copies.

MANAGING BANDWIDTH ALLOCATION FOR HOME ADDRESSABLE ADS

Addressable advertising uses more bandwidth than traditional DPI, since multiple ad copies need to be broadcast simultaneously. The evolution of the network infrastructure will, however, help absorb the increased demand on bandwidth. We expect analog television to be gradually switched off networks, which will free up spectrum previously occupied by analog channels. Note that, as channels migrate to digital, they become eligible for addressable advertising, creating additional addressable advertising revenue potential. One of the previous sections in this document has already demonstrated how home addressable advertising brings one of the highest ratios of revenue/bandwidth amongst the services digital network operators can offer to their subscribers.

In addition, we expect operators to significantly decrease the number of households per node, to the point where broadcast on demand becomes possible. In this scenario, as the number of viewers per node is reduced, the number of channels that are not watched on a node increases. Bandwidth that would normally be assigned to these channels can then dynamically be recycled and reused for revenue generating applications such as home addressable advertising. Eventually, as operators put in place the infrastructure for network PVRs, the bandwidth overhead related to home addressable advertising would disappear.

Nevertheless, we have recognized strategies to optimize the amount of bandwidth dedicated to home addressable advertising even in the current digital network infrastructure. The most bandwidth efficient method we have identified depends on the stochastic properties the aggregated intervals so that a small additional bandwidth (say 1/8 of a digital carrier) is used for carrying the home addressable spots for several network channels (say 7 digital networks). The system will work well provided that multiple networks are not simultaneously broadcasting home addressable ads.

Modeling

There is anecdotal evidence from the Aurora trial that OpenTV's ACTV Division using their SpotOn system conducted for Comcast that a minority of local avails does suffer from collisions. Gathering empirical evidence is both time consuming and difficult to incorporate into scheduling and planning algorithms. Furthermore, well-constructed and validated models can provide insights that are useful when evaluating features and options for the system and product over time.

The nature of the local avails collision problem lends itself to modeling with well-known methods. We have defined two models, one that is slightly optimistic and one that is slightly pessimistic.

All models require a number of assumptions, and these models are no different. The assumptions are:

Local avail commercial breaks are randomly and uniformly distributed among the available commercial minutes.

There is no correlation between the scheduling of local avails on one network versus another network.

All local avail intervals are 1 minute.

All networks have the same number commercial minutes and local avails/hour.

There is no variation in local avails commercial time and total commercial time by day-part.

Model 1: Bernoulli Trials

This model assumes that all networks within the multiplex have synchronous commercial intervals. For example, if all networks have 12 minutes of commercials, they also all run them from 00:00-02:59, 15:00-16:59, 30:00-31:59, and 45:00-46:59. Within those 12 minutes, they all allocate local avail ad breaks in 1-minute intervals, uniformly distributed over the available 12 minutes. A collision is said to occur when 2 or more of the networks schedule a local avail for the same 1-minute interval.

The probability of collision is equal to *(1-Probability of no collision)*. To generalize, we assume that there are N minutes of commercials in the hour, there are M local avail intervals lasting 1 minute with in the N intervals, x% of the local avails are home addressable ads. There are L networks in the multiplex. Then, k is the number of the networks with a scheduled local avail in any one interval is a Bernoulli Trial. In any one interval a spot is a home addressable local avail with probability $p=xM/N$ and is a normal add with probably $q= 1-p$. The probability density function of k, p(k) is known in closed form as:

$$p(k)=C^{L}_{k}\,p^{k}q^{(1-k)}$$

This model is slightly optimistic since it assumes synchronicity between commercial spots. Jitter in the arrival time of the commercials will result in collisions for small fractions (say seconds) of a commercial which will preclude a second home addressable ad from airing because the DPI resource will still be busy with a previous spot.

Model 2: Poisson Points

A Poisson Point model makes no assumptions about synchronous time slots for commercial time. Rather it considers an interval of time that is the union of the all commercial intervals for the L networks and the start of the commercial intervals being distributed as Poisson Points within that interval. We need only consider the Poisson Points associated with home addressable local avails. We can then evaluate the probably that there are k points within a 1 minute interval. There is an approximate solution to this problem assuming that the interval is much smaller than the total time line (which is true for our case where 1 minute is much less than the 1440 minutes in 24 hours). The probably of a collision of k channels is given by:

$$p(k) = e^{-(p/N)} (p/N)^k / k!$$

This model is slightly pessimistic since it does not differentiate between local avails within a same channel that obviously cannot collide with each other. This error in the model becomes less important as L gets larger.

Results

The model is quite useful in looking at sensitivity versus success in selling home addressable ads. As an example, the following graph (Figure 3) is for a system with 7 networks + 1 home addressable feeder stream being carried on a 6 MHz carrier. There are 12 minutes of advertisements/hour and 2 of those minutes are local avails. The graph shows the fraction of local avail intervals that will suffer a collision as a function of the % of the local avails that are home addressable ads. For example, if 30% of the local avail ads are home addressable, then 4% of those ads intervals will suffer a collision, or alternatively 2% of the adds will need to be rescheduled and made-good, or can not be charged for.

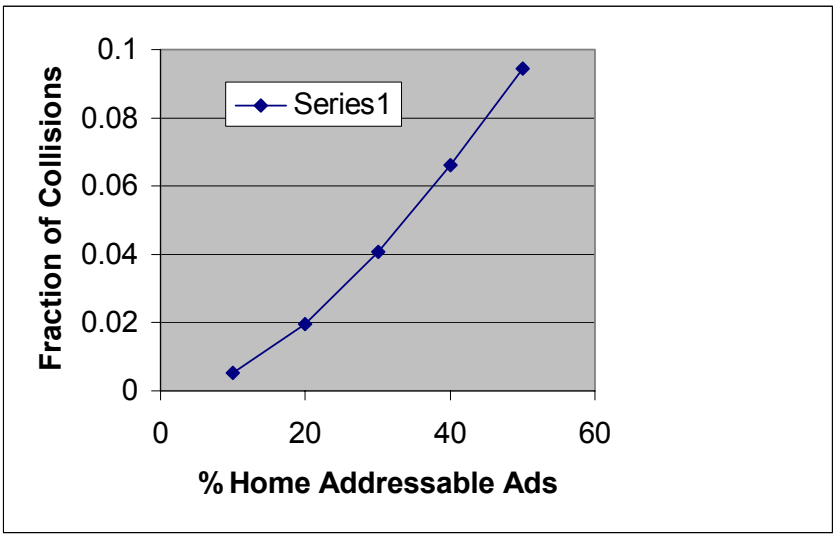

Figure 5 %age of home addressable ads versus collisions

The model exposes the non-linear nature of the onset of collisions, and provides some insight into when the system will need to be scaled. For example, when the inflexion point is reached, the digital TV network operator will reconfiguring the network with 6 networks serviced by 2 home addressable ads augmentation streams instead of 7 networks with only 1 home addressable ads augmentation stream.

CONCLUSION

As a conclusion, we believe that home addressable advertising will play a significant role in increasing the advertising revenues of digital TV network operators in Asia. Home addressable advertising is the only form of addressable advertising that can reach any buyergraphics. A number of trials have demonstrated that home addressable advertising increase the efficiency of advertising, the price advertisers are ready to pay for advertising and the revenue operators can generate from their inventory.

Even conservative estimates show that home addressable advertising offers the highest ROI on bandwidth after high-speed data access and VoD. Furthermore, in addition to being profitable to the buyer and the seller, home addressable advertising is desirable because it maximizes the satisfaction for the subscriber, who gets to see more ads she is really interested in.

Obstacles to the deployment of home addressable advertising on a large scale are rapidly disappearing. Channels are gradually shifting to the digital tier in an effort by the network operators to recover bandwidth. The number of homes per node is diminishing, freeing up bandwidth for new services such as home addressable advertising. The amount of additional bandwidth required for home addressable ads can be reduced by sharing feeder channels for multiple addressable enhanced channels. The bandwidth overhead will vanish once broadcast on demand and PVRs are deployed. Head-end infrastructure is becoming ready to support home addressable advertising. Trafficking system vendors are adding the capability of supporting home addressable advertising to their products. DPI equipment is replacing analog servers to insert local avails. We predict that the added features required to support home addressable advertising will quickly become part of the feature set offered by DPI servers.

Looking into the very near future, other forms of advertising will complement addressability on digital TV networks. VoD and PVRs will give network operators the opportunity to deliver telescoping advertising, where viewers will be able to jump from short spots to long form advertising. We also expect home addressable commercials to be inserted in VoD and PVR sessions.

The effectiveness of addressable advertising will be further enhanced by the ability to deliver interactive advertising, where viewers directly engage with the advertising message (requesting product samples, completing surveys, entering contests, etc…). For example, young couple with children households will see a home addressable ad for van that will offer them a test drive at the closest car dealer. They will only have to press one button on their remote control to respond to the offer.

Compared with its analog predecessor, the digital TV network operator enjoys considerable advantages. The network infrastructure can scale to offer virtually unlimited bandwidth per household. In addition, where applicable, the two-way nature of the network and its always-on return path, combined with the DPI, VoD, nPVR and PVR infrastructure offers the most versatile platform to support new forms of revenue generating interactive and addressable advertising.

REFERENCES

1. OpenTV Research, Comcast, August 18-24, 2003, Aurora CO

2. Kagan, *Media Trends 2002*, page 294; and Kagan, *The State of Digital TV 2002*, pages 149-151