How Well Does Addressable Targeting Work on Television?

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***Abstract*—Television has traditionally been a broadcast medium in which specific viewers have not been able to be targeted with advertising. We ask the question: How well would one-to-one targeting work on television? In particular what kind of lift is possible from one-to-one compared to current methods which target programs?**

I. Introduction

TELEVISION is very different to online advertising. In online advertising it is possible to deliver ads to individual persons. In television, advertisements are embedded in a single high definition video stream and broadcast using over-the-air terrestrial transmission towers, satellite, and cable. The single channel signal transmission enables high bandwidth and so very high quality TV signal. However this introduces limitations for advertisers since they cannot target individuals.

But what if television could turn into a one-to-one medium? Specific ads could be targeted based on an individual's interests and propensities. In the Television advertising industry this is referred to as *Addressable Targeting*, and refers to delivering an ad to a specific household, which then sits on the Set Top Box and triggers based on specific conditions.

Addressable has been touted by many as the next evolution in television advertising. Paul Guyardo, Chief Revenue Officer of DirecTV, was quoted as saying *"Never before have advertisers had that level of precision when it came to a 30-second commercial."* [1], [15]. Wired Magazine even declared *"This will be the year of "addressable" TV advertising*." [11].

Despite the hype, addressable campaigns are rare, and the technology to support them is not uniformly available. There are a patch-work of pilot efforts underway. Dish and DirecTV announced addressable capabilities using the Invidi Set Top Box. Cablevision is capable of addressable advertising on 3.5 million Motorola, Cisco and Pace Set Top Boxes in the New York market. Comcast has announced addressable capabilities that work on Video On Demand (not Linear TV) ad spots, using BlackArrow and their X1 Set Top Box [3]. Although addressable campaigns are rare, this is an area of extreme interest for the television industry.

II. Contribution

This paper will ask the question of how well would Addressable Targeting work on television. We make three contributions:

1. We introduce an Addressable Targeting Algorithm that is technically feasible for current cable operators to implement using current TV technology.
2. We measure the lift possible from Addressable Targeting by measuring Set Top Box Buyers reached per viewer targeted.
3. We compare Addressable Targeting's lift performance against two other TV algorithms including the standard Target Rating Point method used in most television campaigns today.

We find that Addressable Targeting can be effective; however economic factors need to be addressed to support widespread adoption.

III. Previous Work

A. Field Tests

A handful of Addressable Targeting field tests have been reported in advertising literature [2]. The first generally regarded test of addressable TV was conducted between 2006 – 2008 by Comcast Spotlight and Starcom MediaVest Group. 8,000 households in Huntsville, Alabama were delivered ads from OpenTV. The study found that people viewing addressable TV ads had a tune-away that was about $1/3^{rd}$ lower than non-addressable ads [4].

A second study involved Comcast, Walmart, Walgreens and Starcom MediaVest Group, using Invidi Set Top Boxes from January – June 2009. The test ran in Baltimore and included 60,000 households. The study concluded that households were 32% less likely to change channels during the ad break [7], [14].

Despite these reports, there is little documentation on the methodologies, size of target, and creative mix, and so it is difficult to draw conclusions from the above studies.

IV. The TV Ad Targeting Problem

A. Television Media

The conventional TV targeting problem is to select a segment of time on television to insert an ad, which runs during a television program, and which meets certain criteria. TV advertising is similar to contextual advertising online – in contextual advertising, sites are being targeted; in television advertising, programs and commercial pods within those programs are being targeted.

In terms of what is buyable, we can define a "spot" M_i as follows:

$$M_i \in S \times P \times D \times H \times T \times G \times POD \times POS \times L$$

where *S* is Station (cable and broadcast), *P* is Program, *D* is Day-Of-Week, *H* is Hour-Of-Day, *T* is Calendar-Time, *G* is Geography (national, Direct Marketing Area local broadcast footprint or cable zone), *POD* is the Ad-Pod (the break number during a TV program), *POS* is the Pod-Position (the sequence order within a pod), and *L* is Media-Length (30 second, 60 second and others).

B. Addressable Television Media

In contrast to conventional TV inventory, Addressable TV inventory is an ad insertion designed to target a particular inventory which is a household or device $M_{i,addr} \in HH$. Current addressable TV systems often have the ad cached on the viewer's Set Top Box, and when they watch television, they overlay the ad over a standard television spot sometimes referred to as a local break which is inventory for which cable providers have access. Some addressable systems place the ad in places other than standard advertising pods, such as on navigation screens or as a pre-roll to video on demand content. We won't attempt to model those placement differences in this paper, and note that conventional ads could be sold into these positions also. We will instead focus on the ability of each method to reach probable buyers.

C. Objective

In this paper we will be focusing on the potential value per impression that is achievable with different targeting methods. Therefore, we will assume no fatigue, and will also not consider the media's price per thousand impressions $CPM(M_i)$. Our problem therefore becomes finding the TV media with the best value per impression *tratio* or *tr*.

$$M_i\text{: } \mathbf{max}\ tr(M_i)$$

V. TV Ad Targeting Algorithms

There are various ways to target ads on television. We will describe two important methods that work on conventional TV media assets. The first is Target Rating Points (TRPs), a standard method of targeting which has been used for at least 50 years [8], [9], [12], [13]. The second is a Set Top Box Buyer targeting technique described in [5]. Both methods work by measuring the match between the audience demographics and the target demographics.

A. Target Rating Points on Age-Gender (TRP):

Age-gender Target Rating Points (TRPs) are arguably the most widely used form of targeting. This form of targeting defines a TRP as the number of persons who match the advertiser's target demographics τ divided by total viewing persons $\#Q$.

$$tr(P, M_i) = 100 \cdot \frac{\tau(M_i, P)}{\#Q(M_i)}$$

Where $Q(M_i)$ is a set of viewers who are watching TV media instance M_i and where this viewing activity recorded by Nielsen panel. Let # be the cardinality of a set, $\#r_T$ be persons that match on all demographics.

For example 50% means that 50% of the people are a match to the desired demographics.

Age-gender TRPs are defined using standard Nielsen Market Breaks – gender=male|female, age=18-24, 25-34, 35-44, 45-54, 55-64, 65+. This is an important benchmark algorithm as it is used by most current television advertisers.

B. High Dimensional Demographic Buyer Targeting (M32):

High-dimensional targeting is a recently reported method [5] which uses Set Top Box data to calculate the demographic match across 3,500 variables between the ad product buyer and each media asset. We define the demographic match between an ad product and media to be as follows:

$$tr(\bar{P}, \bar{M}_i) = \frac{\bar{P} \cdot \bar{M}_i}{|\bar{P}| \cdot |\bar{M}_i|}$$

where $\bar{P}$ is a vector of buyer demographics and $\bar{M}$ a vector of media demographics. A problem with TRPs is that when using a large number of demographics, the number of people in-target becomes vanishingly small; this method does not suffer from the same problem and so can arguably bring more variables to bear to the targeting problem. In the subsequent analyses we will refer to this algorithm as M32.

VI. Addressable Targeting Algorithms

Addressable Targeting differs from conventional TV media targeting in that it is scoring *cable subscribers* rather than programs. The objective is to score the cable subscriber population for targeting based on similarity to a buying target population (Figure 1).

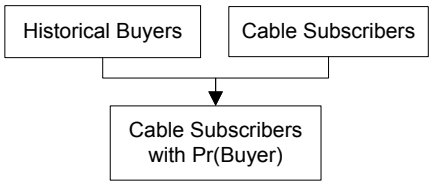

Figure 1: Inputs and outputs

C. Individual Targeting using Media Similarity (VAddr)

A first approach might be to decompose buyer households into a vector of network-program viewing propensities. We find the set of programs watched by buyers and then devices which have highly similar program viewing profiles. These devices would be the ones to target with ads. This may be a good option for non-US TV Cable Operators because they can use their own Set Top Box viewing data to drive the match without any third party data being required.

D. Individual Targeting using Demographic Similarity (Addr)

Another method would be to use third-party demographics. We enrich each of the historical buyers with demographics, and then generate a target demographic profile. We can then match that demographic profile to cable subscribers and report the top matching subscribers (Figure 2).

An important property of this method is that the underlying mechanics of the targeting algorithm – demographic matching - are exactly the same between M32 and Addr (see Figure 2). The only difference is that in the former the demographics are an average for a group and in the latter the demographics are for one person. Therefore this is a good test for how much gain can be achieved just by going from the level of media audience buckets, to individuals, holding the algorithm constant.

In the subsequent sections of this paper we will be using this algorithm (Addr) for our comparisons.

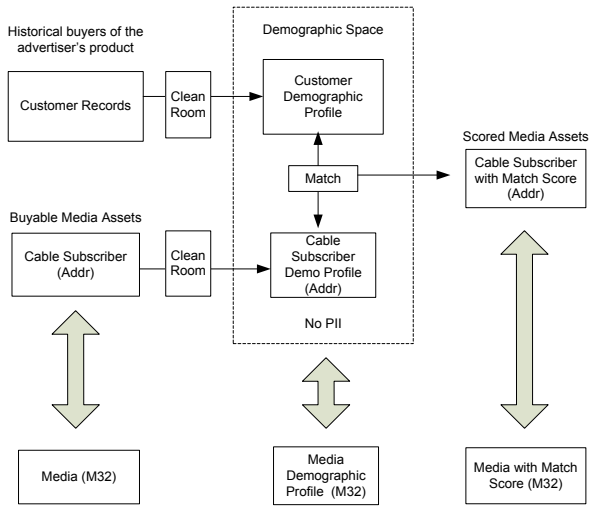

Figure 2: The Addressable Targeting Algorithm Process. The only difference between Algorithm M32 [5] and Algorithm Addr (this paper) is that the former targets individual demographics and the latter targets media demographics. This will make it possible to isolate the gain that is possible from going from programs to household addressable.

VII. Live TV Advertiser Addressable Targeting

In order to test Algorithm Addr, we used a television advertiser who had run over 4,165 airings and was selling a life insurance product. Their demographics are shown in Figure 3: the customers tended to be 60+, retired, low income, rural, and likely to own a compact car.

We next scored a cable subscriber population to find persons who match the advertiser's demographics. After scoring we noted that higher tratio (*tr*) persons produced higher revenue as measured by the Advertiser (Figure 4).

Demographic=Value	Customer Pct	Index Vs Avg
Discretionary Income=Lower Discretionary Income (15-29)	4%	6.80
Health - Cholesterol Focus=True	15%	4.17
Ethnicity=African American	23%	3.97
Young Men's Apparel=True	3%	3.62
Personicx Classic=Downtown Dwellers	4%	3.52
Personicx Classic=Rural Everlasting	4%	3.27
Personicx Classic=Thrifty Elders	3%	3.23
Prefers Shopping Online=10 Least Likely over Internet	20%	3.00
Compact Car - Most Likely to Own=01 Most likely to own	13%	2.70
Personicx Classic=Timeless Elders	2%	2.41
Personicx Classic=Still Truckin	2%	2.06
Household Income=Less than $15,000	18%	1.98
Income Range Premium=Less than $15K	4%	1.77
Infants and Toddler Apparel=True	5%	1.61
Occupation - Professional=Retired/Pensioner	21%	1.58
Personicx Classic=Rural Retirement	5%	1.52
Home Property Type=Mobile Home	5%	1.51

Figure 3: Demographics for Advertiser 110402. Variables are indexed compared to US population, so for example, 2.0 means that twice as many persons who have bought the advertiser's product have this trait than what we would expect if we collected a random sample of people from the US population.

A. Actual Buyers Per Million Reached

We define the quality of the buy as the number of product buyers per total audience who are in the media being purchased. For example, for TRP and M32, the quality of targeting will be measured by buyers in the audience of program divided by total viewers watching program. For Addressable Targeting, quality of targeting is measured by cable subscribers who are buyers divided by total subscribers who have been targeted. As discussed, this measure is free of considerations of fatigue or cost – the objective is to measure the lift due to targeting.

For analysis purposes we have used National cable and Broadcast media represented as network-day-hours during one week. There are approximately 35,000 buyable Networks-Day-Hours per week, for example CNN-Tues-8pm. Addressable scores individual cable subscribers and so the cardinality is equal to the cable subscriber universe. We used 350,000 cable subscribers.

B. Results

Figure 7 shows what kind of performance an advertiser could expect if they target different amounts of assets. For example, if they had a budget to target the best scoring 2% of the buyable assets, and were using Addressable Targeting, their lift would be 6.5x. The diagonal line shows the performance of a theoretical campaign in which assets are bought randomly. This shows that *Peak Lift* for addressable, M32 and TRP are 9.9x, 1.75x and 1.21x respectively. We can also say something about the consistency of lift. TRPs are nearly random in the first 15% of targetable assets (1.07x for 15%), which is a surprising result. In contrast, M32 and Addressable have more consistent lift (Figure 8). We can summarize targeting quality using Area Under the Curve (AUC) (Table 1), where, again, 0.50 would indicate random performance. For Addressable, M32 and TRPs respectively are 0.668, 0.579 and 0.529.

A key question for TV advertisers is how much higher is Addressable lift compared to what could be achieved by buying audiences in conventional TV programs and media prices. Figure 9 attempts to answer this question by showing the ratio between lift from Addressable, M32 and TRPs. When targeting the top 1% of addressable inventory, Addressable has an advantage of about 5x over conventional media assets. However target size is critical, and lift from Addressable decreases rapidly. At 10% of population, Addressable will only be slightly more performant than conventional TV media; at more than 32% of households, then Addressable Targeting will perform worse than the best conventional media targeting option.

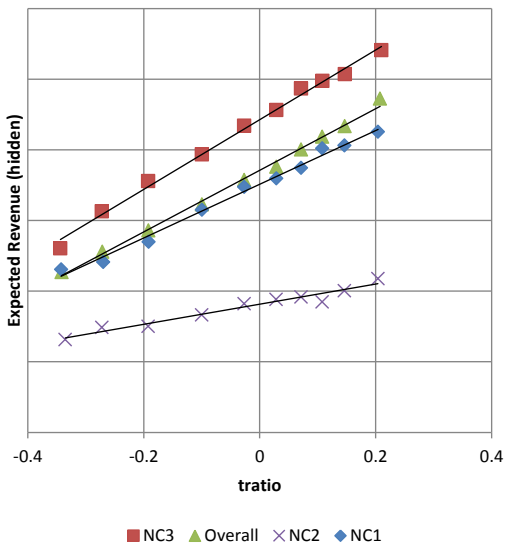

Figure 4: Addressable Targeting score (tratio as calculated by algorithm M32) versus Expected Revenue from customers. As targeting score increases, so does the expected revenue. Also shown in the diagram are three natural clusters (NC1,NC2,NC3) inferred using the k-means algorithm on the demographic data from each person. These are sub-populations: NC1 tend to be older males, NC3 older females, and NC2 tend to be younger persons. NC2 is less valuable, and this shows up as it is shifted lower than the other two. Clearly as the clusters increase their targeting score, the persons being targeted all become more valuable, and this relationship holds across clusters and overall population.

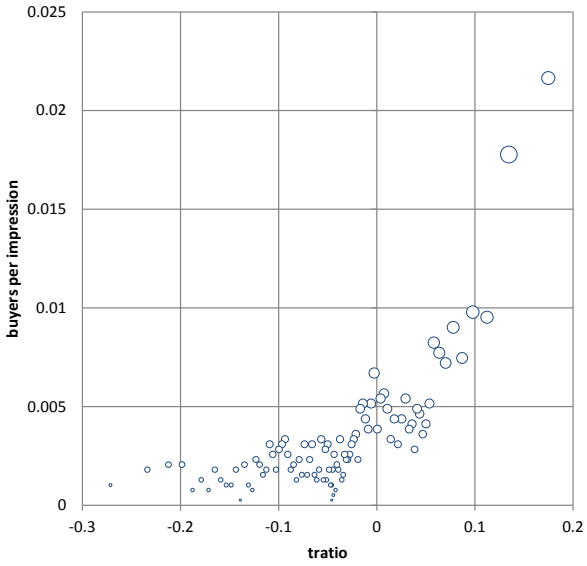

Figure 6: Addressable Targeting algorithm performance Buyers per Impression versus tratio as calculated using Algorithm M32. x-axis is tratio divided into 100 percentile buckets and y-axis is buyers per impression. Each circle represents the number of buyers in each bucket. tratio 0 indicates random performance, and negative worse than random. The flat region from tratio -0.3 to -0.05 and curvature is a common feature in television targeting curves that we have remarked on in previous work [5]; this shows that if ads are targeted at persons with a poor match then the ads can be largely ineffective.

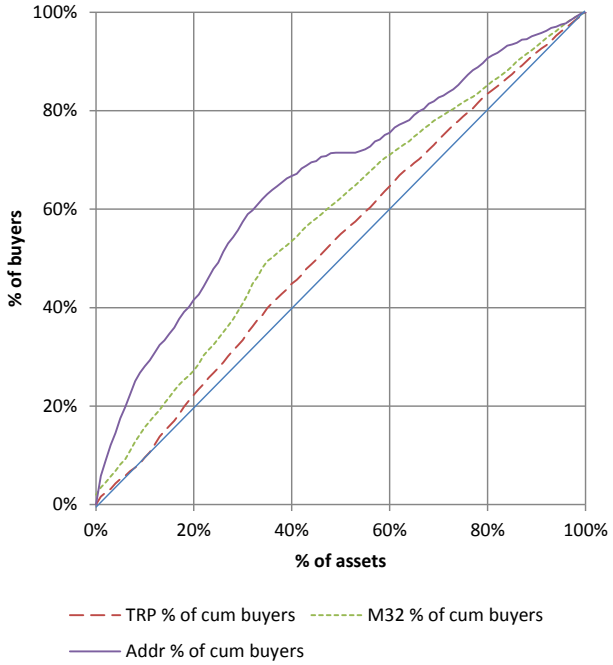

Figure 7: Cumulative distribution for buyers per asset from three different targeting algorithms.

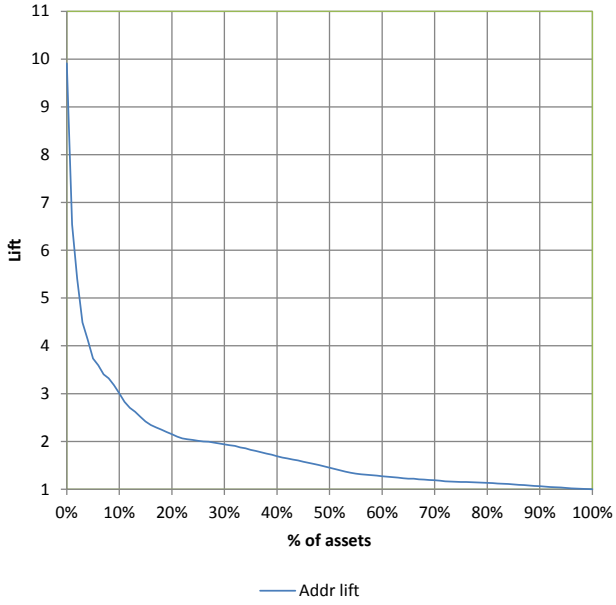

Figure 8: Addressable lift versus % of assets targeted, reported in percentiles.

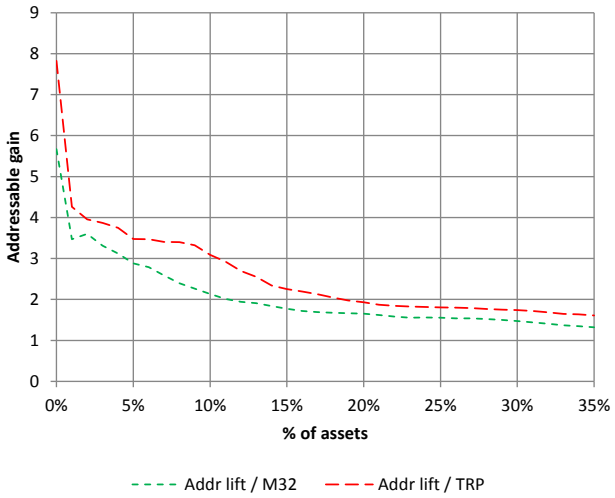

Figure 9: Buyers per impression ratio between Addressable lift and M32 or TRP lift. This shows the premium CPM that could be charged for an advertiser by the % of subscribers that they are targeting. For example, if they are targeting 10% of subscribers, the Publisher could charge 2 times their standard national CPM price.

Table 1: Performance for three different TV targeting algorithms

Measure	TRP	M32	Addr
AUC	0.529	0.579	0.668
R^2	0.242	0.532	0.499
Lift top 1%	1.266	1.749	9.912
Lift top 10%	0.957	1.403	3.177
Lift top 20%	1.111	1.317	2.195

Table 2: Lift versus % of Assets targeted

pctl	TRP lift	M32 lift	M32 /TRP	Addr lift	Addr /TRP	Addr /M32	Addr / Max M32
0%	1.27	1.75	38%	9.91	7.83	5.67	5.26
1%	1.53	1.88	23%	6.54	4.26	3.47	3.47
2%	1.37	1.50	10%	5.41	3.95	3.60	2.87
3%	1.16	1.36	17%	4.49	3.87	3.31	2.38
4%	1.10	1.32	20%	4.13	3.75	3.12	2.19
5%	1.07	1.30	21%	3.73	3.48	2.88	1.98
6%	1.04	1.29	24%	3.59	3.47	2.79	1.91
7%	1.00	1.31	32%	3.40	3.40	2.59	1.81
8%	0.98	1.39	42%	3.32	3.40	2.40	1.76
9%	0.96	1.40	47%	3.18	3.32	2.26	1.69
10%	0.97	1.41	45%	3.01	3.09	2.13	1.60
11%	0.97	1.40	45%	2.83	2.93	2.01	1.50
12%	1.00	1.39	39%	2.70	2.69	1.94	1.43
13%	1.03	1.37	34%	2.62	2.55	1.91	1.39
14%	1.07	1.37	27%	2.51	2.34	1.84	1.33
15%	1.07	1.36	27%	2.42	2.26	1.77	1.28
16%	1.07	1.36	27%	2.34	2.19	1.72	1.24
17%	1.08	1.35	26%	2.29	2.13	1.69	1.22
18%	1.10	1.34	22%	2.25	2.05	1.68	1.19
19%	1.11	1.32	19%	2.19	1.97	1.67	1.16
20%	1.11	1.30	17%	2.15	1.93	1.65	1.14
21%	1.12	1.29	15%	2.10	1.87	1.62	1.11
22%	1.12	1.30	17%	2.06	1.85	1.58	1.10
23%	1.12	1.31	17%	2.04	1.83	1.56	1.08
24%	1.12	1.30	16%	2.03	1.82	1.56	1.08
25%	1.11	1.30	16%	2.01	1.81	1.55	1.07
26%	1.11	1.30	17%	2.00	1.80	1.54	1.06
27%	1.11	1.30	16%	1.99	1.79	1.54	1.06
28%	1.12	1.30	16%	1.98	1.77	1.52	1.05
29%	1.12	1.30	17%	1.96	1.75	1.50	1.04
30%	1.11	1.32	18%	1.94	1.74	1.47	1.03
31%	1.12	1.33	19%	1.92	1.72	1.44	1.02
32%	1.13	1.35	20%	1.91	1.69	1.41	1.01
33%	1.14	1.37	20%	1.87	1.65	1.37	0.99
34%	1.13	1.37	21%	1.85	1.64	1.35	0.98
35%	1.13	1.38	22%	1.83	1.61	1.32	0.97

Table 3: Media prices compared to National June 2014.

TV Geographic Level	CPM	TVHHs	price /nat
National cable	6.6	114,000,000	1.0
Local Cable Interconnect	20	500,000	3.0
Zone	40	50,000	6.1
Addressable	120	1	18.2

VIII. The Economics of Addressable

Based on our analysis, we can draw some conclusions on Addressable systems.

A. *Expected Lift from Addressable*

The first conclusion is how much lift can addressable deliver? Lift estimates depend primarily on the size of the micro-target. Addressable lift can vary from about 5x gain to effectively no lift at all if the target is too large. Given the potential lift, it is curious that previous field tests only reported modest improvements of around 35% [7], [10], [14]. We suspect that this may be because those tests may have addressed a large – or perhaps all – of the population, and perhaps used the technology to route creative for the same product, rather than sending different product ads to different people.

B. *"Context Addressable" Ad Insertions*

Our second conclusion is that that Addressable Targeting and Buyer targeting should be combined to create a higher lift and a better television commercial experience. Set Top Boxes can't tell who is watching TV at any given time. Therefore, knowing that a young adult female is in a household is useful, but inserting the ad to the household with the female occupant, plus into Pod A for Vampire Diaries, is a more effective strategy for getting the ad in front of the intended target in the household, than addressable alone. In order to combine we will define our media inventory to be a combination of household and conventional media: $M_i' = M_i \times M_{i,addr.}$ We can then weight both Algorithms Addr and M32 in targeting the above media. An additional level of contextual advertising could even be to weight in the match between keywords of the program and of the advertiser's product [6].

C. *The Need for Improved Market Mechanisms*

Finally, Addressable Targeting needs improved market mechanisms that can cope with the need for advertisers to micro-target. When a cable operator sells x% addressable inventory to the advertiser they are left with (1-x%) inventory that is now left unsold. They need to look for ways to back-fill – either by providing it as a kind of local break to other advertisers, or by inserting Public Service Announcements (PSAs). For example, if networks were to sell 1% of targeted households, the increased value of the inventory mean that the publisher could charge a price per thousand impressions (CPM) up to 5x a conventional media asset price. However, this then leaves the publisher with 99% of their unsold, and for which they need to find another buyer lest they incur a 95% loss.

In order avoid this problem, publishers have created minimums on addressable households x% and minimums CPMs. Unfortunately, these minimums appear to make it impossible for advertisers to achieve their needed economics. One Addressable pilot that we investigated had a

requirement of 20% minimum number of targeted households, at $120 CPM. At 20% of households, according to Table 2, Addressable inventory is only a tiny 1.1 times more performant than standard network-program-dayparts. However the CPM being charged for addressable inventory is 18.2 times higher than standard national media prices (Table 2). Thus Addressable media is currently about 18 times less performant per dollar compared to a conventional media buy.

Two solutions might be possible:

1. Large agencies could buy addressable inventory and then allocate the inventory amongst their different clients. For example if they had 100 demographically diverse clients, they could ensure that each advertiser can use the inventory and has minimal overlap and competition for the same inventory. This capability seems to be something that the larger agencies could use to their advantage, as small agencies would not be able to afford to monetize the whole addressable spot.

2. Publishers could set up an exchange so that as addressable cable subscriber ad inventory is sold, the remainder can be easily purchased by other advertisers.

IX. Conclusion

Addressable Targeting today remains the province of research studies. If an effective market mechanism can be set up that would enable inventory to be purchased efficiently and continuously by multiple, simultaneous advertisers, we believe that Addressable would begin to live up to its considerable potential. Combined with Context addressable insertions, this offers the prospect of delivering relevant ads to the right consumer, during the right program and with the right context to be more effective than anything we've seen on television before.

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