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TV RATINGS MEASUREMENT IN A DIGITAL WORLD

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Abstract

Last year approximately $45 Billion dollars exchanged hands between programmers/ networks operators and the advertisers. The value of a particular 30 second commercial is directly related to the total number and demographics of the viewers that were tuned to and likely saw the programming segment that contained the ad. And in the US, one company, Nielsen Media Research, has had the primary task of independently measuring and reporting TV viewing statistics continuously since television broadcasting began more than 50 years ago. The Nielsen ratings has become the currency of the TV industry.

The core technology used to measure TV viewing has been based on determining what frequency/channel the home TVs, cable settop or satellite receivers are tuned to using direct RF frequency measurement of the tuner's local oscillator, or indirect channel segregates such as, reading LED or on-screen channel indicators, or a number of other channel determination based technologies. However, the adoption of digital transmission technologies plus new digital based consumer electronics equipment in the home are creating new challenges to frequency/ channel based TV measurement technology. Multiplexed program distribution, time-shifted viewing, xVOD, IPTV, and home wireless video networks are blurring the traditional concept of "channel" and are causing a Global obsoleteness of all channel based TV measurement technologies requiring totally new TV measurement techniques to be developed and rapidly deployed.

This paper will provide a brief historical TV measurement technology overview; detail the current measurement technology and issues caused by various digital over-the-air, cable, and satellite distribution techniques as well as the plethora of new digital consumer electronic devices. The paper will also describe the new Universal Metering Initiative (UMI) technology that is being deployed by Nielsen to measure all analog or digital over-the-air, cable-TV, and satellite viewing, including capability for all forms of time-shifted viewing.

IMPORTANCE OF TV RATINGS MEASUREMENT TECHNOLOGY

The extraordinary success of television, including the proliferation of broadcast and cable networks, TV stations, program suppliers, and the tens of billions of dollars in annual advertising expenditures and cable programming fees necessary to fuel this growth has had an invaluable tool-- an independent measurement system which directly samples the viewing audience and reports the information back to the marketplace on a daily basis. This information—the Nielsen ratings—is the currency of television. This year, more than $45 billion exchanged hands in the TV industry based on this currency.

While nearly everyone has heard of Nielsen ratings, few recognize the enormity of the task or the complexity of the overall measurement technology system. But now that the US and the rest of the World are shifting to a digital based TV system a totally new "digital friendly" Universal Metering Initiative (UMI) using active and passive audio (A/P) technology and new Nielsen Audio and Video Encoders (NAVE) must be rapidly deployed.

The new A/P system will work equally well on analog or digital channels, including HDTV and time-shifted viewing. The new NAVE real-time encoder encode both the audio and the VBI just before over-the-air transmission or network distribution with an assigned constant source ID code and a time/date stamp about every two seconds in the active program audio using a patented technique that makes the codes non-auditable to the ear but easily detected by in-home monitor equipment and Monitor Plus sites. The NAVE encoder also encodes the standard AMOL codes that are necessary with the older measurement technology during the transition period and with the new system until a new all digital metadata standard is adopted and used by the industry.

The new audio encoding technology is very robust and will withstand almost any normal "bad practice" that would still produce a reasonable picture and audio to the home.

The new A/P system has for the first time in a TV measurement redundant measurement technologies in case of failure or operator error of the primary active audio encoding system. The new system will automatically default to the redundant passive signature mode.

The TV technical community will want to become knowledgeable about Nielsen's new Universal Metering Initiative A/P system-- But first, some TV measurement basics to better understand TV measurement requirements and why a new system is necessary in the digital TV World.

TV Ratings 101

In its simplest form, TV ratings require detailed measurement data of two equally important broad areas-- what is being viewed and the demographic detail of who is in the audience. While a full treatise on TV measurement definitions and methodically issues is beyond the scope of this paper a few basics are necessary in order to understand the current analog based system and why a completely new digital friendly system must be rapidly deployed. Four sections are presented as background information: Definitions; Sampling; Privacy, and; The Nielsen TV Diary (The Diary section comes later in the paper.)

Definitions

Universal Estimate (U.E.) Total persons or homes in a given population, e.g., TV households in the US.

Rating Percentage (Average Audience) The percentage of the Universal Estimate

(U.E.) viewing a TV program during the average minute:

$$\text{Rating \%} = \frac{\text{Audience}}{\text{Universal Estimate}}$$

Share Percentage of TV sets (or persons viewing) tuned to a program:

$$\text{Share} = \frac{\text{Rating}}{\text{HUT}}$$

HUT Number of homes using TV

PUT Number of persons using TV

Total U.S. Rating (%) Average audience of total U.S. households

Reach Number of different homes/people exposed at least once to a program or commercial. Also referred to as Cume.

Average Frequency.Average number of times a home or person is exposed to a program or a commercial.

Average Audience Projection/Impression
The audience expressed in numeric rather than percentage form:

Average Audience = Rating X Universal Estimate

Gross Average Audience (GAA Rating)
Sum of the percent of households tuning (or persons viewing) during the average minute of each telecast of the program, including repeat telecasts during the report interval.

Gross Rating Points (GRPs) Sum of all ratings for a program in a schedule.

Cost per Thousand (CPM) The cost to expose a commercial/ program to 1,000 people or homes:

$$\text{CMP} = \frac{\text{Media Cost}}{\text{Impressions}} \times 1{,}000$$

Hawthorne Effect Even the tiniest of inadvertent change to the overall measurement environment introduced by either the measurement equipment itself or just the impact of respondents knowing that they are being measured can cause bias or errors in the collected data. (For this reason, using "doctored remotes" or exchanging the household TV with similar pre-metered TVs is not a acceptable option.)

Source Detection/ Reporting In today's more competitive TV industry a program/ network can arrive and be viewed in the home from several alternative sources: direct-off-air reception; cable-tv; satellite, or perhaps the internet or telco based delivery options in the future. In addition, in order to accurately measure HUT nearly everything connected to the TV that could generate video must also be identified and reported, including video games, VCRs, PVRs, and DVD players.

Automated Measurement of line-up (AMOL)
A defacto Nielsen industry standard of inserted codes in the VBI for the purpose of electronically identifying the source and real-time/date stamp of its transmission.

Monitor Plus Sites (M+) Nielsen maintained monitoring sites in 354 of the largest cites across the US and Canada. These sites collect and store 24/7 all audio and one frame per second of video from nearly all TV stations and cable/satellite networks. The stored audio and video are used (and augmented by stations line-ups) as the "as transmitted" data base and used extensively with both the current People Meter/ Mark-II and new Universal (Digital) Metering Initiative A/P system.

Designated Market Areas (DMAs) There are currently 210 individual "local" DMA markets defined by Nielsen. TV viewing behavior can vary between local markets, especially in early morning and late night viewing patterns.

Sampling An accurate, projectable TV measurement system depends on a random audience sample that is representative of viewers as a whole. It is important that the random group mirror the behavior and characteristics of the overall population not only at the aggregate total level, but also within each of the narrower defined demographic breakdowns important to programmers and advertisers. By using random probability samples, Nielsen can project the viewing in its samples to the entire population and sub-classifications of viewers.

This process can be quite complex in terms of practicable implementation. It starts by using the US Census Bureau's decennial (updated annually) census counts of all housing units in the nation. Using this data Nielsen randomly selects more than 6000 small geographic areas (blocks in urban areas and their equivalent in rural areas) and dispatches surveyors to each area to enumerate and list housing units. Housing units are then randomly selected within each sample area. This process ensures that each household in the population has a known chance to be selected.

Once a household is selected it is important to the sample quality that they agree to participate and stay as a sample household for the research period (one week for diaries; two years for People Meter and Local People Meters). While the overall process defines "alternates," any deviation from the true initially randomly selected households detracts from the sample quality. "I don't watch enough TV for Nielsen," or "I only watch…" are two often heard reasons selected viewers feel they shouldn't participate. But inclusion of all randomly selected households/viewers is essential to have accurate projectable data.

The homes are first contacted by phone. (Nielsen is exempted from the "Do Not Call" restrictions) and follow-up with letters and person-to-person contact as necessary, including using callers and field staff with special language/ dialect skills to properly communicate and put the person at ease. This is especially true in the case of some minorities or non-citizens who might be initially unfamiliar with Nielsen and the importance of this research to them and others with similar background that they will now represent in the sample. There is a very small monthly payment that is not tied to their amount of viewing.

Privacy

Privacy of viewing data is of utmost concern to all involved, especially to the sample households. Nielsen's privacy record and privacy controls are unparalleled and surveys continue to show extremely high levels of public trust of Nielsen and its processes. Beginning with the first contact, it is explained how the viewing data is collected and that a particular household's/ person's viewing data is combined with the aggregate with no individual or household identity. All of Nielsen's and industry TV viewing, including demographic breakdowns is derived from data processed from various aggregate buckets of data. The household members sign a release allowing Nielsen to use their viewing data in this way. This process adds to ensuring that all data collected meets state and federal privacy laws and regulations.

Households are also requested to maintain a low profile that they are a Nielsen sample household while they are actively in the program. This is to avoid any unlikely targeting of the household by media players of mailings or incentives that might influence the household's viewing/ reporting data.

People Meter

The heart of today's National TV measurement system is the People Meter, an electronic metering technology that measures both programs viewed and logs who is in the home viewing audience. The People Meter is actually a combination of a People Meter which logs who is viewing and a Mark-II companion device that measures which channel is being tuned.

The People Meter is a small relatively flat profile unit with a row of red and green LED indicator lights visible to the TV viewers which is used to log in/out who is in the room watching TV. The People Meter and its wireless remote has simple single buttons for inputting which family members are in the room viewing. There are also provisions for logging in visitors and their demographic data (age & M/F). The When the TV is turned-on all LEDs begin flashing signaling the viewer(s) to log-in which family members are viewing. Any family member can log in all others viewing. Periodically and after channel changes the LEDs will begin flashing for an up-date on which family members are still viewing.

The People Meter is placed so the LEDs are visible while watching TV, generally right on the TV or the cable settop, during installation and is usually the only visible sign of Nielsen's measurement equipment after installation. Because of the possible Hawthorne effect resulting from the current People Meter, various stealth people meter alternative technologies are being developed that would require less or no involvement by the household viewers to maintain accurate audience data. A detailed discussion of these technologies is beyond the scope of this paper but include: Infrared, RF tags, Voice Print/ Recognition, as well as others.

Currently there are People Meters installed in about 5000 randomly selected households across the US-- and the number of National Sample metered homes will begin to increase to more than 10,000 starting this year.

Sample households agree to be a Nielsen sample household for a two year term and to allow Nielsen engineers come to their home and install People Meters and its associated Mark-II measurement equipment on every TV, and its associated peripheral devices in the house, including even small portable rabbit ear TVs on the kitchen counter or in the garage workshop. These installs can take up to two days and require that all Nielsen measurement equipment and associated wiring be completely hidden/ out-of-sight in order to minimize any long lasting Hawthorne effect. No data collected from a newly installed Nielsen sample household is used for the first thirty days to allow the impact and newness of the installation and being a Nielsen sample household dissipate. Research has shown that normal pre-installation viewing returns well within that period.

MARK-II

The companion measurement device installed in a National People Meter sample household is the Mark-II. The Mark-II was first engineered in 1978 and has remained the work-horse of measuring what program/channel is tuned for over 25 years! Indeed, it is hard the imagine a device

performing such a complex task still accomplishing its basic goal after so many years in such a dynamic industry. Its strength is its basic simplicity, and the forward thinking of its original designers. The Mark-II while having a power-supply, UART, dial-up telephone modem, and modest memory and processing capability- has survived so well because its visionary designers embraced a designed concept of supporting up to eight additional external specialized data collecting probes. Additionally, two Mark-IIs can be daisy-chained together for up to sixteen probes, if necessary. More than 120 specialized Mark-II probes have been designed over the years to allow for measurement of virtually every TV and peripheral device such as, VCRs, DVDs, dual decks, video games, etc.

Full installation of a People Meter/ Mark-II in a typical sample household can take a full day and some homes with higher than average number of TV sets and/or peripheral equipment can take two full days. Obviously, a Nielsen service call must be scheduled anytime the household decides to move their equipment, add a new TV viewing location, or add any new component to their viewing systems..

The Local People Meter (LPM)

The Local People Meter is a new Nielsen initiative to deploy essentially the same National People Meter technology within separate sample of homes starting in the largest of the Nielsen DMA local markets. It will use the People Meter to collect audience viewing data and the Mark-II technology to measure TV-tuning data.

The Nielsen TV Diary

Mainly to address cost, diary measurement is used to collect viewing information from sample homes in every TV market in the US. Each year more than 2 million paper diaries from households across the country are processed for the sweeps ratings periods. The standard November, February, May, and July sweep months larger markets include; October, January, and March, as well.)

In approximately 50 large local markets, not using the Local People Meter, Nielsen uses the Mark-II device to collect just set-tuning information on a daily basis. This daily household tuning data is cost effectively augmented at least four times a year with demographic viewing data which is collected from another sample of households which maintain a paper-viewing diary for one week. Each household member in the sample is asked to write down what programs and channels they watched over the course of that one week. Then the diary and the Mark-II set tuning information from the separate samples are merged to produce the standard “sweep” reports.

TECHNICALLY DIFFICUILT HOMES (TDs)

Despite the enormous flexibility of the People Meter/ Mark-II and its various probes, sometimes a home is encountered that has a new TV or peripheral device that does not yet have technical measurement solution. If even only one device can not be properly measured, the household is declared “Technically Difficult” and no data from the household can be accepted.

TDs would generally occur when new to the market devices with either very different circuitry or functionality are purchased and brought home. Obviously, systematic elimination "early adopter" households from the overall viewing database would possibly introduce a bias in the data if not addressed. Accordingly, close ties are maintained with program distributors, consumer electronics manufacturers, and regulators to gain early awareness and prototypes of new products that may challenge existing measurement solutions. Over the years Nielsen has maintained the percentage of Technology Difficult households to less than .5%.

Digital Challenges to the Current System

Even without the impact of digital TV, in recent years the friendly "cat & mouse" game of staying ahead of the challenges of measuring TV viewing and all the peripheral CE equipment (DVDs, Dual Deck devices) began to take on a significantly more complex, intrusive, and costly posture. The trend of CE equipment becoming smaller, multi-purposed, and feature rich as resulted in a general CE trend toward massive multi-purpose LSI silicon device-on-a-chip designs where access to critical TV measurement taps/ test points is not longer available.

Development of special Nielsen software, reverse engineering, or ASIC solution development is very expensive, especially for the very small number of homes it would likely be used. Solutions for some new CE equipment are approaching in excess of $500K each with no upper end in-site. Further, while most new CE devices, regardless of popularity takes years after introduction to reach a penetration level sufficient to cause any impact with the Nielsen sample data thereby providing reasonable development time for a solution.

But today both cable and satellite TV industries are capable and have inadvertently downloaded Global software up-dates to all settop boxes in their local system or network that suddenly changed their channel line-ups or various internal settop settings enough to suddenly cause a market wide incompatibility with the current Mark-II measurement technology.

As taxing as this trend has become, digital TV will over time completely break the current measurement channel-based system. It's not that plain digital TV breaks the measurement system, its what the new digital TV domain supports as standard operating practice at the distribution and consumer level that breaks the system over time and forces a new system. The two primary causes are:

Multiplexed Program Transmission

The current measurement systems used almost universally are based on a core channel/ frequency determination measurement strategy. But in digital TV the FCC and economics encourages several separate content streams (programs) be multiplexed and transmitted over one frequency/channel. When the current measurement system is attached to a digital TV tuner tuned to a multiplexed channel it simply knows the channel, not which of the four or five multiplexed programs is actually being viewed. Accordingly, channel based measurement systems are not longer deterministic is a digital TV World where multiplexed program distribution will be commonplace.

Time-Shifted Viewing

And the second of the "one-two" digital TV punch is the meteoric raise time-shifting capabilities in the home either as a feature of

a stand-alone TiVO type CE device, built-in to an up-graded cable or satellite box, or as a virtual time-shift capability supported by the cable headend server. Indeed, it is cable's unique ability to significantly accelerate deployment of time-shift capability in certain markets that has resulted in a corresponding acceleration of Nielsen new digital friendly Universal Metering Initiative and especially its ability to measure time-shifted viewing.

UNIVERSAL METERING INITIATIVE

More that seven years ago Nielsen accessed the direction of the TV industry and consumer electronics and determined that a completely new metering system would be necessary to address the capabilities and needs of a more digital empowered and completive TV industry. A complete and through review of all measurement technology options was considered. In addition to all the previously discussed concerns/ issues, Nielsen also was aware that significant segments of the industry desire Nielsen to develop the ability to measure "out-of-home" viewing.

Active/ Passive (A/P)

The result was the development of a totally new concept in TV measurement that relies primarily on audio to determine programs viewed. However, because of the reliability needs, a patented active and passive audio system (A/P) that supports a unique and first time redundancy in TV measurement was developed. The A/P system relies on active encoding using the Nielsen patented psychoacoustic masking technology that "actively" encodes a special code into the program audio in such a way that it conceals itself from normal hearing, yet easily detected by special monitoring/ decoding equipment in the home or Monitor Plus sites. Since the encoded data is in the active audio of the program it automatically rides along wherever the program and its audio goes. It is very robust and can survive almost any "bad practice" until the content itself is nearly un-viewable.

The "back-up" redundant passive signature system does not add anything to the program audio. It simply uses the program audio itself to generate a corresponding thin data stream signature that is unique to that program audio. At the Nielsen Monitor Plus sites master signatures are generated as needed using a special algorithm and stored 24/7 for any TV station or cable/ satellite network, as needed. In the home, the A/P TV measurement equipment is connected internally to the TV audio line-level out and active codes containing its source ID and time/date stamps about every two seconds during the viewing are collected from all viewed programming. If the viewed programming is not properly NAVE encoded for whatever reason, the A/P home monitoring equipment automatically begins to generate and store its thin stream of passive signatures derived from the unidentified audio using the same algorithm as used at the Monitor Plus sites for a match when all viewing and audience data is forwarded to the central operations facility by dial-up modem later at night.

Nielsen Audio and Video Encoder (NAVE)

The NAVE encoder is a critical part of the new TV measurement system. Its purpose is to automatically insert a source ID and time/date stamp undetectable to the human 3hearing into the program audio. It also inserts the current AMOL VBI format source

and time/date stamp information to add in the transition period where both the current AMOL dependant and the new A/P system must be supported. The Nave encoder will on average insert a full psychoacoustic audio masked source ID and time/date stamp code about every two seconds.

It is important that station and network engineering community understand the critical importance of maintaining the NAVE encoder in the active audio and video program stream. While the passive system can act as a failsafe emergency back-up, using the primary active codes for viewing detection is more accurate and requires less processing/memory resources.

Cable channels where the original signal is either from off-air/ fiber delivered local TV stations or from national satellite feeds which will already be encoded will not need a NAVE encoder. At some point when cable desires to measure xVOD it will need to either require that the programming be already NAVE encoded or locally encode the material itself before delivery to viewers.

SUMMARY

Digital TV is triggering a global shift to new TV measurement technology solutions. In the US, Nielsen Media Research, Inc. has Initiative (UMI) in which its audio based redundant Active/Passive (A/P) system is already being deployed. This system has the capability of measuring both analog and digital TV, including HDTV and time-shifted viewing.

The new NAVE audio encoding is very robust and generally will survive all but the worst "bad practices." Both the current AMOL used with today's Mark-II metering technology and new NAVE audio coding will be required during a multi-year transition period.

Since most of the programming carried by cable will already be encoded with the new NAVE psychoacoustic encoding technology by the original local TV station or TV, cable, satellite programmer/ network-- a cable system will not need to encode much if any of its programming. If cable operators eventually desire xVOD viewership measurements either the program supplier or the cable operator will need to NAVE encoder the content and provide Nielsen with the content name details.