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THE BIG PICTURE: TECHNOLOGY TO MEET THE CHALLENGES OF MEDIA FRAGMENTATION

By Arun Ramaswamy, Chief Engineer, Nielsen

The world of measurement is changing.

Thanks to recent advances in data collection, transfer, storage and analysis, there's never been more data available to research organizations. But 'Big Data' does not guarantee good data, and robust research methodologies are more important than ever.

Measurement Science is at the heart of what we do. Behind every piece of data at Nielsen, behind every insight, there's a world of scientific methods and techniques in constant development. And we're constantly cooperating on ground-breaking initiatives with other scientists and thought-leaders in the industry. All of this work happens under the hood, but it's not any less important. In fact, it's absolutely fundamental in ensuring that the data our clients receive from us is of the utmost quality.

These developments are very exciting to us, and we created the Nielsen Journal of Measurement to share them with you.

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SAUL ROSENBERG

The Nielsen Journal of Measurement will explore the following topic areas in 2017:

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BIG DATA - *Articles in this topic area will explore ways in which Big Data may be used to improve research methods and further our understanding of consumer behavior.*

s

SURVEYS - *Surveys are everywhere these days, but unfortunately science is often an afterthought. Articles in this area highlight how survey research continues to evolve to answer today's demands.*

ns

NEUROSCIENCE - *We now have reliable tools to monitor a consumer's neurological and emotional response to a marketing stimulus. Articles in this area keep you abreast of new developments in this rapidly evolving field.*

a

ANALYTICS - *Analytics are part of every business decision today, and data science is a rich field of exploration and development. Articles in this area showcase new data analysis techniques for measurement.*

p

PANELS - *Panels are the backbone of syndicated measurement solutions around the world today. Articles in this area pertain to all aspects of panel design, management and performance monitoring.*

t

TECHNOLOGY - *New technology is created every day, and some of it is so groundbreaking that it can fundamentally transform our behavior. Articles in this area explore the measurement implications of those new technologies.*

THE BIG PICTURE: TECHNOLOGY TO MEET THE CHALLENGES OF MEDIA FRAGMENTATION

BY ARUN RAMASWAMY *Chief Engineer, Nielsen*

INTRODUCTION

It's a great time to be a media consumer, creator, or distributor. New streaming technologies with over-the-top (OTT) apps, connected devices and social media are expanding the media landscape. While traditional linear TV offers an increasing array of new channels and new features (e.g., cloud-based DVR), OTT providers are making their mark with curated and skinny bundles for live programming choices. Exclusive content from OTT and subscription video-on-demand (SVOD) providers is exploding. Consumers can truly choose to watch anytime, anywhere and on any device.

On the technology side, data management platforms, advertising exchanges and real-time programmatic technologies are revolutionizing the ad industry with data-driven and predictive ad delivery capabilities. These technologies are making it possible to reach consumers or preferred lifestyle segments with personalized ads.

While those changes are great for the consumer, they are creating more complexity in the ecosystem, and thus more challenges for media researchers. Those challenges can be grouped into two broad categories: media fragmentation (more content and channels that need to be measured) and device fragmentation (media consumption on more diverse digital platforms). To make the right business decisions in this highly complex marketplace, content owners, publishers,

advertisers and their agencies need a reliable solution that can address this two-pronged challenge. They need a full picture of the consumption of both ads and content, piecing together all devices and distribution channels to produce what we at Nielsen call a 'total audience' measurement solution.

This paper outlines the key technology developments that are making it possible.

HOW LINEAR TV AUDIENCE MEASUREMENT WORKS TODAY

Let's set the stage by first reviewing how audience measurement is performed in the U.S. for linear TV—the oldest and still the most widely used media platform available[1]. In linear TV, the same programming and the same set of national commercials are broadcast to all viewing audiences of a given channel. In that context, a panel that is statistically sampled from the TV viewing universe is well suited to collect the data and estimate audience figures for the vast majority of programs and advertisements.

The major technical components of the ratings system operated by Nielsen in the U.S. for linear TV are highlighted in Fig. 1.

Content identification

Nielsen leverages dual engines for content identification: watermarking and fingerprinting.

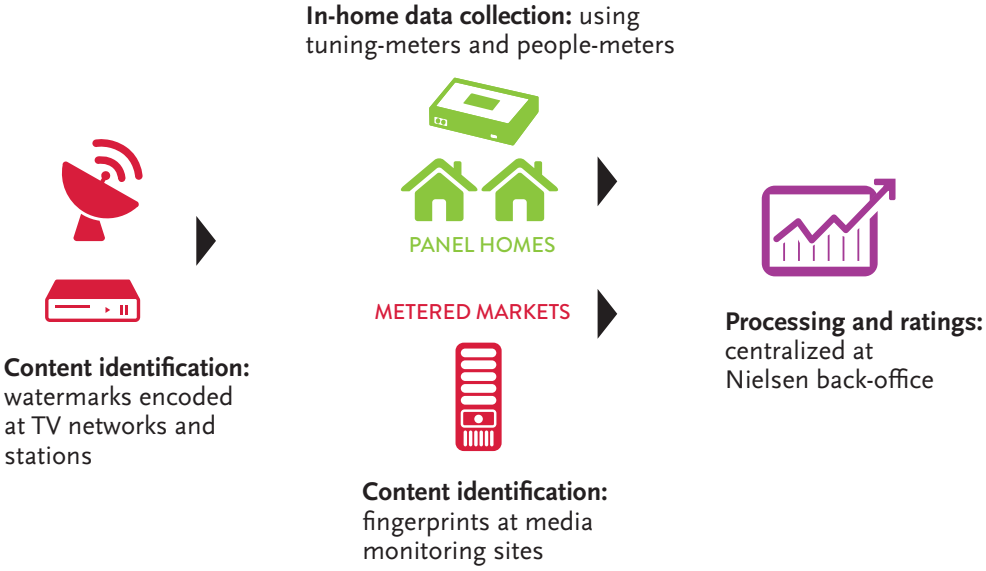
The Nielsen audio watermark is an inaudible signal that is inserted in the content's audio by a device called an encoder. The signal is algorithmically hidden or masked so that it is not audible to viewers. The information in the watermark helps identify the source of the program along with the time of broadcast. More than 3,000 Nielsen watermarking encoders (hardware and software versions) are installed at broadcast networks, cable networks and local TV stations in the U.S., covering over 97% of all broadcast content on the air. VOD content is encoded to carry the Nielsen watermark too.

Nielsen also identifies content via audio fingerprints (sometimes called 'signatures'). Fingerprinting is a popular content identification technology. Around 900 media monitoring sites collect fingerprints in all metered markets, for all broadcast content, and store them in a central reference library.

In-home data collection

Once a home has been recruited and has agreed to be part of a Nielsen panel, a Nielsen meter is installed at every TV site in the household by Nielsen field technicians. In every home,

FIGURE 1: TECHNICAL STEPS FOR NIELSEN'S TRADITIONAL TV RATINGS SYSTEM IN THE U.S.



[1] See: *The Nielsen Total Audience Report: Q3 2016*

the meters capture two important measurement ingredients: tuning (i.e., what is being watched); and audience (i.e., who is watching).

The software in the Nielsen meter performs the following key functions: It identifies which device is actively feeding content to the TV (source detection); It decodes the Nielsen watermark algorithm from the audio; It computes the fingerprint algorithm of the audio; It determines the On/Off state of the TV; And it communicates the collected data back to the Nielsen back-office.

Nielsen's current portfolio of meters is built to meet market needs. The GTAM (global television audience meter) is our most comprehensive meter and is installed when a site's measurement requirements are complex (i.e., with multiple consumer devices, surround sound audio, etc.). We can also deploy simpler versions (called GTAM Lite and Code Reader) for simpler configurations and for smaller markets. These various types of meters are shown in Fig. 2.

FIGURE 2: VARIOUS TYPES OF NIELSEN METERS

GTAM

GTAM Lite

Code Reader

FIGURE 3: THE NIELSEN PEOPLE-METER

Meters are required to perform at a high level of accuracy. One metric that Nielsen monitors closely is the amount of identification that comes from watermarks. High numbers validate the efficacy of watermarked transmission and detection. For example, in the past six months, GTAM meters were able to credit 97.59% of all viewing using watermarks, and the balance of 2.41% using fingerprints.

In panels where we wish to electronically capture the audience (who is watching), an additional device is installed: the people-meter. The people-meter has a text-based display to communicate with the panelist, and a remote control for the panelist to interact with the device (see Fig. 3).

The people-meter is installed near the TV and is fully visible to the panelists. When the TV is on, this device prompts the panelists to periodically log themselves in as active viewers. The people-meter transfers the data it collects to the co-located Nielsen TV meter, so that the tuning in the home can be properly attributed to who is watching the content.

Processing and ratings computation

The data collected from panel homes is cleansed, credited to distributors (a network or local station, for example) and mapped to specific programs and commercials. It serves as the basis for daily ratings computations.

MEETING THE CHALLENGE: MEDIA FRAGMENTATION

Now that we have a basic understanding of the traditional TV measurement infrastructure, it's time to examine how today's media realities are affecting the ratings environment, and what type of technology development is underway to address those challenges.

Today's media environment features many more distribution channels than ever before. As the number of channels multiplies (live as well as on-demand), there are instances, for programs with very small audiences, where the ratings derived from the panels are zero. Simply put, panels are not large enough to capture the audiences of the long tail.

One solution to that problem is to leverage return path data (RPD) from set-top boxes, Smart TVs and other devices. These sources of big data, while missing demographics, can fill specific volumetric gaps in panel data[2]. Another solution is to increase the size of the panel by deploying more meters. Nielsen has done just that many times in its history—after all, the national TV measurement service in the U.S. relied on 5,000 households up until 2003, and it now includes nearly 40,000 households.

But panel expansion can create a strain on logistics and maintenance operations. It's not just the total time needed to install measurement equipment in those new homes that's at stake. Once meters are installed, Nielsen ensures that panels are maintained through regular field technician visits and a strict monitoring of key performance indicators. Visits are also needed to coach and maintain contact with panelists, service malfunctioning meters, or connect new devices. The attention we pay to these field operations is one of the main reasons why Nielsen's panels are so robust, and the data so reliable.

These technical and operational realities gave us an opportunity to rethink our metering technology. By leveraging new low-energy processors (spurred by the IoT phenomenon) and integrated components, we've developed next-generation meters that combine measurement functions in a single compact unit with a modern design. The physical interfaces on those new devices are kept to a minimum in favor of wireless interfaces, significantly reducing the amount of wiring—and thus the amount of time spent on installation. They can communicate with other elements around the house—such as wearables, smartphones or even a new breed of devices developed by Nielsen to capture over-the-top (OTT) and broadband content delivery.

These new meters are making it possible for us to address the measurement requirements of the modern connected home and its cloud-based content delivery. And they come with remote troubleshooting capabilities that can give technicians a real-time view into the home's television environment—reducing the need for a field visit in many of the cases.

Of course, as with any replacement to production equipment, we need to make sure that these next-generation devices are delivering at a level of data accuracy that's at least equivalent to current benchmarks. One particular metric of interest is the in-tabulation (in-tab) rate, the percentage of homes in the panel with data that has passed stringent quality tests, and that are therefore cleared to be part of the ratings estimates for the day. We're in the process of evaluating the performance of our next-generation meters and the early results are extremely encouraging. We're looking forward to their rollout in the near future.

FIGURE 4: AN EARLY VERSION OF THE NEXT-GENERATION METER

[2]*See The value of panels in modeling big data in VOL1 ISSUE1 of the Nielsen Journal of Measurement.*

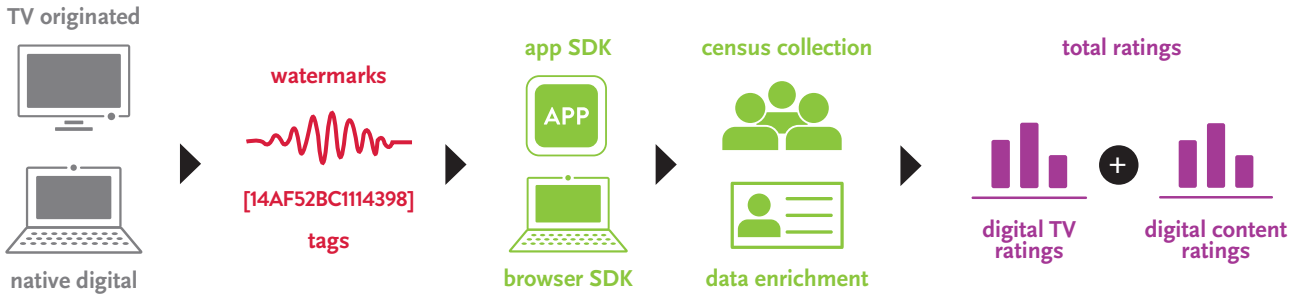
MEETING THE CHALLENGE: DEVICE FRAGMENTATION

Consider now the connected devices landscape—devices like smartphones, tablets, connected TVs and other OTT devices (Roku, Apple TV and more). There are myriads of apps that offer content choices. That content could have originated from TV (on-demand or live), or it could be purely digital. What about the ad model? Some of the content may have no ads, linear ads or ads that are targeted dynamically. Fig.5 helps visualize these various combinations of digital content origin and ad model. From a measurement perspective, even a large panel may be statistically insufficient to capture all the variances in devices, apps and ad models. To address this challenge, we use census impressions from digital devices and calibrate those impressions with data from our panels (where we know what the demographics are). Census collection is a 360-degree view of all impressions for all consumers from all digital devices and apps (PCs, Macs, mobile, tablets, connected devices). The overall measurement process is shown in Fig. 6. It involves the familiar steps of content identification, data collection and processing and ratings computation, but with a few adjustments to meet the needs of the digital infrastructure. Let's review what those adjustments are.

FIGURE 5: VARIOUS CONFIGURATIONS OF DIGITAL CONTENT ORIGIN AND AD MODEL

CONTENT ORIGIN	AD MODEL
Originates from linear TV	Linear ad load (the ads are the same as when the content aired on linear TV)
Originates from linear TV	Dynamic ad load (the ads are not the same, and their insertion might be a function of a number of audience targeting criteria)
Native digital	Changes to number of ad spots and ad loads

FIGURE 6: TECHNICAL STEPS TO ADDRESS DEVICE FRAGMENTATION IN THE U.S.



Content identification

Nielsen has created software that has been embedded in most leading transcoders to extract the Nielsen watermark from the audio and re-insert it as metadata in the digital stream. This metadata tag (called ID3) is supported on most leading streaming formats and is now easy to access from the streaming content.

If there is no Nielsen watermark present (as is often the case for native digital content), we leverage the client's metadata (program name, title, length, type and more) to identify the content. This metadata is provided directly by the client's content management system (CMS). Note that video content isn't the only media type that can benefit from this approach: static media (e.g., banner ads, pop-ups, etc.) can be tagged in exactly the same way.

Data collection

The next part of the puzzle is the meter equivalent. Rather than physical meters in a select number of panel homes, we have created a software library called the software development kit (SDK) that's deployed to the universe of digital viewers. The SDK is instrumented in publisher and aggregator apps (e.g., apps from multichannel video program distributors), as well as on browser pages that stream or render content. Every time a consumer watches content, the SDK captures the measurement data (impressions) and transmits ID3 or CMS tag data back to Nielsen's collection system. By having the same software handle both ID3 and CMS tags, Nielsen clients have the flexibility to choose between advertisement models (linear or dynamic) in order to maximize their monetization objectives.

Processing and ratings computation

Processing census impressions is in the domain of very big data, and we make use of all the relevant data storage and processing technologies (such as Hadoop, Spark, NoSQL and Kafka) on cloud-based platforms in order to process that data at scale. Once impressions and demographics are combined, we can proceed with ratings computations and produce digital TV and digital content ratings.

As a final step, the linear TV ratings and digital ratings are combined for a total content ratings number, and the complex, fragmented picture we started with at the beginning of this paper is now complete.

A COMPREHENSIVE SOLUTION AND A ROADMAP FOR THE FUTURE OF MEASUREMENT

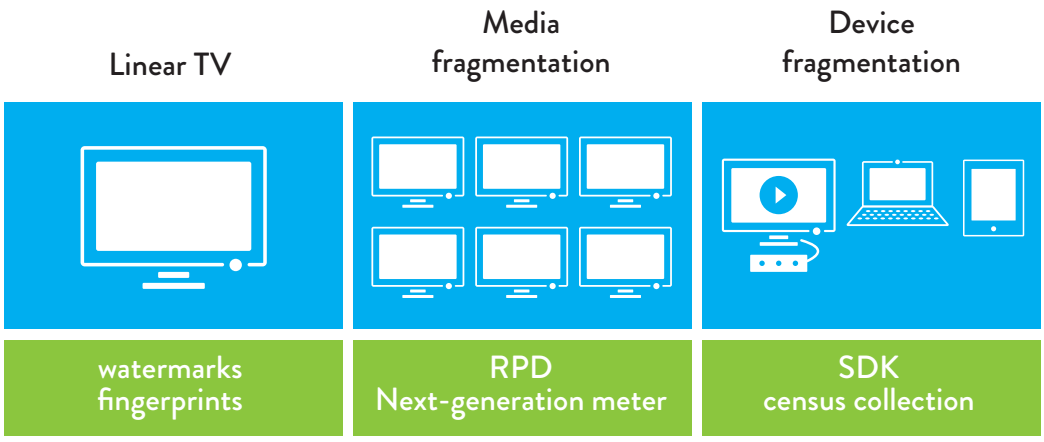
Recent innovations such as smarter meters and census data collection are helping us solve the puzzle of today's fragmented media ecosystem (see Fig. 7). So, what lies ahead?

The marketplace keeps evolving, of course, and we're already exploring exciting new developments to track where consumers are going in the next few years. In particular, the world of IoT is upon us. More devices and in-home appliances are getting connected every day, and becoming smarter. It's a natural fit for us to envision ways to integrate our meters with consumer IoT devices. We're also investigating wearables embedded with our modern content recognition technology to create new person-based measurement devices.

On the digital front, our focus is to increase the footprint of our solutions and make it easier for clients to implement our measurement technology. To that effect, the engineering team at Nielsen is working on a new innovation, named cloud API, that doesn't require an integrated client library like the SDK, but rather leverages web APIs to collect data. With a cloud control, it will be easier to take advantage of advances in machine learning to make the systems cognitive and intelligent.

There's a whole world of developments ahead of us, and we will expand on these new opportunities in a future paper. It's an exciting time to be a technologist at Nielsen!

FIGURE 7: A SUMMARY OF TECHNICAL SOLUTIONS TO ADDRESS TODAY'S MEASUREMENT CHALLENGES



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