

IEEE

# Broadcast Technology

The technologies to deliver information and entertainment  
to audiences worldwide, at home and on the go

RIEDEL  
BOOTH

Are you an A

*Las Vegas*

every  
**Story**  
starts here

***NAB Show Coverage Begins  
On Page p. 4***

DO NOT  
SIT

# President's Message

Ralph Hogan, BTS President



The 2019 NAB Show is now in the history books. There was quite a bit going on this year, but drones were noticeably absent. Of course, there were a few displays, but nothing compared to the last two or three years. ATSC 3.0 was the buzz, but unfortunately ATSC 3.0 tuners were nowhere to be found on the show floor. At least I did not see anything that

is currently available in the United States. Maybe we will have something announced from the major TV manufacturers at CES 2020. Several manufacturers had private showings of prototype tuners in various hotels around Las Vegas.

I had the pleasure to address four participants in the National Association of Broadcasters Educational Foundation now (National Association of Broadcasters Leadership Foundation) Technology Apprenticeship Program (TAP) and five participants in the PILOT Technology Internship Grant (TIG) program. The Technology Apprenticeship Program (TAP) is a six-month program for recent college grads with an interest in broadcast technology/engineering. The program gives students a one-of-a-kind educational experience through paid, hands-on training at a radio or television station and exposure to the latest technology and advances in the industry. More information can be found at <http://www.nabef.org/tap/>. The NAB PILOT internship program is new this year. It places scholarship winners into operating broadcast facilities for eight weeks to work alongside the engineering team and experience firsthand what broadcast engineering is about. The scholarship covers the salary of the individual and the station provides the training.

The TAP and TIG participants get a deep dive into broadcasting by attending the NAB Show during their training. They arrive on Friday before the show and are fully immersed from Saturday morning until they leave on the following Wednesday. They hear from industry leaders, attend sessions at the Broadcast Engineering and IT Conference (BEITC), tour a local broadcast station, have a quick "broadcast technology 101" tutorial taught by Cavell, Mertz and Associates, attend several VIP receptions with the opportunity to network with industry leaders, and learn about some of the latest advances in broadcasting. This is an invaluable opportunity for students just getting out of school. All of the participants compete to be part of the annual

TAP program, and once selected, they spend a year learning about leadership and engineering. The placement of these young graduates has been low. The industry should take note that these are some of the best and brightest young professionals who are enthusiastic and will form the next generation of broadcasters. There are many unfilled positions at stations and we all hear that no one is applying. I would challenge every hiring manager to create a program where entry level programs are created to encourage these young people to apply and have an opportunity to become broadcast professionals.

## Inside

President's Message.....	2
From The Editor.....	3
2019 NAB Show Draws >91,000 To Las Vegas.....	4
If You Didn't Notice ATSC 3.0 At The NAB Show, You Weren't There!.....	6
Special BTS NAB Sessions Tackle Basics of 3.0, Next-Gen TV SFNs, 5G Contribution, Distribution.....	9
Saturday Tech Sessions Further ATSC 3.0 Understanding.....	13
The 2019 NAB Show In Pictures.....	15
Garrison And Cindy Cavell Receive NAB Engineering Achievement Awards.....	21
2019 'Women In Technology' Awards Program Expands Scope.....	22
FOBTV Technical And Management Committees Meet During NAB Show.....	24
Madeleine Noland Chosen To Lead ATSC.....	25
DVB World 2019 Explores Technology Trends And More.....	26
HbbTV 'Masterclass' Kicks Off 2019 DVB World Activities.....	31
February HPA Tech Retreat Examines Content Production Issues.....	33
JPEG XS—The New Mezzanine Codec For High-Quality Video Production.....	39
Make Plans Now To Attend The 2019 BMSB.....	45
RF News And Views.....	46
The Downward Path To Broadcast Engineering—No. 15.....	51
DRM—A Short History Of Its Beginnings.....	53
DVB News.....	55
ITU Report.....	57
Upcoming Events of Interest to BTS Members.....	58
In Memoriam.....	59
Commentary And Opinion.....	60
What's New.....	62

Cover photo courtesy of Paul Shulins



# From The Editor

## The 2019 NAB Show, expanding our coverage, and the BMSB

By James E. O'Neal, Editor-in-Chief,  
BTS Life Member



I've just returned from a whirlwind week in Las Vegas at this year's NAB Show. As usual, it was "all stops out," and just like everyone else who attended, I'm still nursing sore feet and trying to overcome some serious sleep deprivation. However, as anyone who has ever attended this very important showing of new technology and presentation of new ideas in the broad-

casting arena, this is the "nature of the beast," and just another facet of the event that—over the years—you associate with the NAB Show. (My first show was in 1977, and the take-home feelings of both exhilaration and bodily fatigue are all part of this wonderful and very special coming together of people and technology each spring.)

It was very rewarding to see so many BTS people involved with the 2019 NAB Show, not only those who staffed booths, but especially those Society members who went the extra mile to assist in the educational portion of the show with some very timely and informative presentations. I also have to offer special commendations to those who were recognized for their contributions to broadcast engineering in the form of some impressive awards. Topping the list in this latter category were the husband and wife team of Gary and Cindy Cavell, who, respectively, received the 2019 NAB Radio Engineering Achievement Award and 2019 NAB Television Engineering Achievement Award. Congratulations Gary and Cindy; well earned and well deserved!

Aside from mingling with all of the wonderful people who help to make the NAB Show what it is, what were some of the other take-aways at this year's event? In my opinion, topping the list would be the expanding presence of ATSC 3.0. It seemed as if everywhere I turned there was a reminder about our new DTV transmission standard. This ranged from a full-day Saturday off-site presentation on the Physical Layer that was organized by the BTS, numerous BEITC presentations on various aspects of 3.0, several press conferences with news about ATSC 3.0 rollouts and related information, and a very visible physical presence in the exhibit halls in the form of showings of 3.0 gear in manufacturer's booths, a large information center in the Central Hall concourse, and an even larger presentation stage in the North hall. If you

had any doubts about the arrival of this new era of television broadcasting, the 2019 NAB Show went a long way towards dispelling them. Also, if you didn't make it to this year's show, you missed out on a lot!

Even though the eyes of the world's broadcasters were focused on Las Vegas during April 6-11; broadcast-related news is being made in other parts of the world too. One such event taking place a few weeks prior to the NAB Show was the 2019 DVB World conference that was held this year in Dublin, Ireland. In an effort to make our **Broadcast Technology** publication more global, your editor was there to provide in-depth reporting about the event, making this the first time we've done so. Look for expanded coverage of other industry events too in the months ahead. Also, with this issue of BT, we're launching a new international radio column which will feature news about the DRM (Digital Radio Mondiale) digital radio broadcasting technology in use in many parts of the world. This has happened through the efforts of BTS member Peter Siebert, who is the head of technology at the DVB (Digital Video Broadcasting) organization. We've received criticism in the past for publishing more television-related articles than radio, and I've been trying to better balance the situation, but up until now, no one has stepped up to the plate to help make this happen. I would love to publish even more content from the radio community; so if you have suggestions, or would like to contribute a regular radio-related column, please contact me.

Thank you Peter for reaching out to the DRM organization on our behalf, and thanks to everyone else who contributed to this issue of **Broadcast Technology**.

I would like to remind our members about the upcoming June 5-7 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB), which will be held this year on Jeju Island, Korea. I've attended and covered a number of these annual events, and they are very worthwhile and productive. I'm certain that this year's conference will be no exception, so if you haven't made your plans to attend you need to do so now, as the first week of June will be upon us before you know it. Full conference details are available at <https://www.bmsb2019.org/main.do>.

James O'Neal  
Editor

**Broadcast Technology**  
[IEEEBTeditor@gmail.org](mailto:IEEEBTeditor@gmail.org)

# 2019 NAB Show Draws More Than 91,000 To Las Vegas

## Next-Gen TV, 5G, AI in abundance this year

By James E. O'Neal

### LAS VEGAS

The NAB Show marked its 97th anniversary this year, making it almost as old as broadcasting itself. But even though the show is fast approaching centenarian status, there was nothing antiquated about the 2019 event. Everywhere you turned there were bright and colorful LED displays, shiny new solid-state radio and television transmitters and antennas from a multitude of international manufacturers, all the latest in audiovisual signal compression technologies, along with plenty of news vehicles and remote trucks, as well as new generation of smaller, better, and higher-resolution television cameras, and many, many other items from the more than 1,600 exhibitors who were vying to capture the attention of the 91,460 registered attendees arriving from some 160 countries. While this year's attendance figure was slightly down from the 92,912 at the 2018 event, it was really difficult to notice any difference, as the exhibit halls were as jammed as ever and it still took plenty of time to navigate one's way around in the three cavernous exhibit floors and meeting spaces.

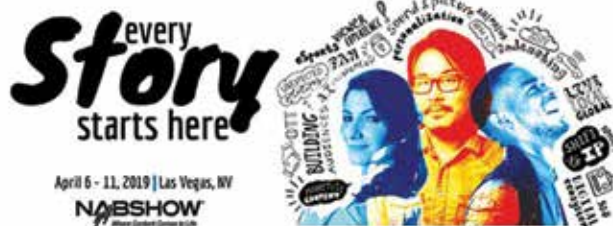
### Broadcasters, Story-Telling, And Remaining Relevant In A Connected World

The "theme" of the 2019 NAB Show was "Every Story Starts here," with this slogan appearing at just about every twist and turn in the host venue, the 3.2 million square-foot (297,290 square-meter) Las Vegas Convention Center. If that weren't enough of a reminder, the phrase was even emblazoned on attendee badges. The message is that 21st century storytelling is best done through the medium of broadcasting with its immense one-to-many reach.

Gordon Smith, NAB president, reflected on broadcasters and their story-telling mission several times during his show keynote address.

"There is a saying that goes, 'everybody has a story to tell,'" said Smith as he related the relevance of broadcasting to society.

"My own NAB Show story began a decade ago—almost to this day, in fact—when I spoke at my first show as the new president and CEO [of the NAB]."



"On that morning, I shared the story of broadcasters' unrelenting commitment to always be there for their communities...to inform them...and to help them.

"[This] is a deep-rooted commitment that manifests itself in many ways that often go unnoticed—in ways that have become ingrained in everyday life for millions of Americans. Our communities turn on the radio to find out what the weather is like before heading to work, to learn how to help their neighbors in need, or to listen to the great personalities who seem like old friends. They turn on their televisions to watch their favorite local news anchor and to get an unbiased report of what is happening in their communities. And, they turn to their local broadcasters for a lifeline during emergencies.

"This vital lifeline is the electronic thread that keeps every community together, informed and safe."

In his address, Smith referred to broadcasters and the service that they render to their communities of license as "a story of everyday heroes," observing that they are part of the American way of life, and adding that "what you do is vital—you are indispensable and irreplaceable."

Smith also reflected on the changes brought about by the rise of the Internet and dissemination of news via that modality.

"...in this digital age, when people can access virtually anything from virtually anywhere from millions of sources of information, broadcasters' role in every community has become even more critical as people search for a trusted and reliable news source," he said. "In the past, communities could also rely on their local newspapers...but [that] industry has been undermined by the rise of the Internet and social media companies."

Smith stated that he doubted that the Internet would ever be able to replace the localism provided by broadcasters, and praised the broadcasters' on-going commitment to expose government corruption and abuses of power through investigative reporting.

Smith also noted that Internet reporting would never have the connection to communities that radio and television broadcasters possess, stating "[This] is why local



Gordon Smith

radio and television stations are more relevant, more vital and more trusted than ever before.”

At the same time, Smith observed that as a result of the changing communications landscape, there is now a threat to local journalism from the large technology companies within that sector.

“They’ve bulldozed competition, used our private information for profit and tilted the playing field against everyone else,” he said. “And in the process, they have hurt small businesses and stifled innovation.”

Smith called their tactics a threat to journalism on the local level and proposed two measures that U.S. lawmakers could take to make things more equitable for broadcasters and to support journalism “in this new landscape.”

“First, modernize outdated broadcast regulations to allow us to compete on a level playing field with these behemoth tech and pay-TV companies to better ensure that broadcast journalism can flourish. And second, increase regulation on the tech industry to ensure that these companies cannot use their market power to stifle competition and the financial viability of local news.”

### New Technology At The Show

So, aside from all of the ultra-high resolution, very bright, large and realistic LED video imaging that seem to be present almost everywhere as you navigated your way through the show’s exhibit space, what were some of the other trends observed this year?

Perhaps the biggest was the presence of the next-gen television broadcast standard, ATSC 3.0. Both on the exhibition floor and off, reminders of 3.0 were almost everywhere, with new 3.0 gear being shown by a number of manufacturers, 3.0 displays in the lobby or concourse space of Central Hall, a special “Road to ATSC 3.0” presentation stage in North Hall, numerous 3.0-specific presentations that were part of both the BEITC program and other show conferences and events, and there was even a (hidden from sight) four-transmitter single frequency network that operated throughout the show. (See other sections of the issue if Broadcast Technolo-

gy for more information about ATSC 3.0 at this year’s show.)

Whether broadcasters and the public are ready for it or not, there was a very healthy dose of 8K UHD television in the exhibit space, with vendors demonstrating the latest in image capture, processing, storage and display of this extremely high-resolution video.

Now that IP connectivity has become more or less universal, there wasn’t as much mention of it this time round, with nearly everyone who makes equipment offering models that comply with the SMPTE ST 2110 suite of standards. For those who doubted its role in broadcasting, the IP Showcase returned once again to the NAB Show with wall-to-wall presentations on IP use cases, the advantages of moving to an all-IP platform and more.

Reminders of the ongoing U.S. repacking of television broadcast spectrum were present, but as this has now (with the completion of the third phase of the FCC’s “10-step program” nearing completion) become something of a *fait accompli* there didn’t seem to be as big a spotlight on it as in the past few shows. It seemed that more of the transmitter manufacturers were touting 3.0-readiness than the necessity to purchase a new rig for the repack.

In what appeared to be a small-scale replay of recent Consumer Electronics Shows, the connected car and enhancing the in-vehicle experience were on this year’s NAB Show agenda, with a dozen or so presentations directed at vehicular entertainment and the opportunities that this opens up for the broadcast industry.

The burgeoning field of artificial intelligence (AI) was very much in evidence at this year’s show, as was virtualization of facilities and utilization of the cloud.

Virtual and artificial reality are also still making inroads at the show, particularly in the sports video arena, where they’re being harnessed to create greatly enhanced viewing experiences. AI is also being tapped for automatic creation of on-field graphics and automatically registering scores and statistics, as well as speedily putting together highlights packages.

*continued on page 8*



PAUL SHULINS PHOTO

Margaux Toral, Amanda Temple, and Jenn Barbato are all set to hand out BTS-related items to show attendees as the curtain goes up on NAB Show number 97.



This photo ‘says it all’ in connection with the altered 2020 NAB Show dates. April 2020 is a long way away, but be sure and mark your calendars so that you don’t book incorrect dates for travel and accommodations.



# If You Didn't Notice ATSC 3.0 At The NAB Show, You Weren't There!

## New DTV standard omnipresent this year

By James E. O'Neal

### LAS VEGAS

It was very difficult for attendees at this year's NAB Show to ignore the presence of the ATSC 3.0 digital television transmission standard at the 2019 show. It seemed that "3.0" popped up at virtually every twist and turn, indoors and out, when navigating the Las Vegas Convention Center. And there was additional 3.0 technology on display at off-site locations if you wanted to journey away from mainstream NAB Show goings-on.

Within the exhibit halls themselves, more than 40 separate showings of either ATSC 3.0-related products, or technology demonstrations were available during show hours, and as reported elsewhere in this issue of **Broadcast Technology**, there were multiple tracks of 3.0 presentations and seminars occurring during the weekend at both the convention center and the Flamingo Hotel across town.

### ATSC 3.0 'Rides The Rails' With Help From An SFN

Perhaps the most noticeable (and animated) ATSC 3.0 presence within the LVCC exhibit space was the "Ride the Road to ASTC 3.0" model railroad display that was operating in multiple locations.

The exhibits featured miniature train cars carrying dongle-equipped tablets that displayed rock-steady ATSC 3.0 video as small-scale CSX engines pulled the receivers around the circular courses, demonstrating the robust nature of the OFDM-based off-air signal.



Unseen and unnoticed by most NAB Show visitors was the source of the Ch. 28 signals reaching the tiny "rubber ducky" antennas attached to the 3.0 demod dongles.

This turned out to be yet another demonstration of one of ATSC 3.0's attributes—easily implemented single frequency networks (SFNs). Kelly Williams, senior director of engineering and technology policy in the NAB's technology department, explained what was going on behind the scenes and how it came about.

"Lynn Claudy (senior vice president of technology at the NAB) conceived it around the first of the year," said Williams. "We always want to do something new here at the show, and we knew we wanted to do some 'on-the-air' demo—as we're broadcasters and we've done something that involved being on-the-air' for the last three years, and we didn't want to do the same thing we've done every other year.

"Lynn said 'why don't we build an SFN?' So we brainstormed on what it would take to do this and started reaching out to vendors."

Williams said that John Turner of Turner Engineering was brought in to actually design the SFN, and did so in a relatively short time.

"John set up everything in his lab in New Jersey to prove it would work," Williams said. "Comark actually provided the rack [of equipment]. They have a product that they're going to be selling which is an ATSC 3.0 'station in a rack.' They'd brought it to our Cleveland site for testing, and we asked if we could use it here and they said 'of course.' So we shipped it to John in New Jersey."



The LVCC North Hall ATSC 3.0 presentation stage.



This was one of three railroad-themed "Ride the Road to ATSC 3.0" demonstrations at the NAB Show.



ETRI's Jae-young Lee demonstrates 8K UHD video transmission accomplished via the bonding of two ATSC 3.0 six MHz channels.

Williams explained that the “transmitters” were actually ATSC 3.0 modulators or exciters obtained from GatesAir, Pro-Television Technologies, and Teamcast (being sold under the Comark name), and that the SFN consisted of four units located in both the LVCC North Hall and Central Hall concourse.

“Our signal is originating from the ‘Road To ATSC’ booth in the North hall where we have a small rack with ATSC equipment, and there’s a scheduler that’s controlling—in SFN mode—four transmitters; three in the North Hall and one in the [Central Hall] lobby.

“From the head end we have fiber runs. We have a GPS antenna and receiver on the roof, GPS locked, and there are fiber runs from the headend to each transmission location and the scheduler controls everything.

“The signal has good coverage. The modulation is set for 16-QUAM, as we wanted it to be pretty rugged and robust. The payload is set at about 10.5 mbps pushing video at about eight, and we’re using SurfacePro tablets with dongles from Airwave as receivers.”

Williams added that as far as he knew, the four-transmitter SFN was a first.

“We wanted to prove the SFN concept,” he said. “There have been a few tests that have involved a main transmitter and one other transmitter, but we essentially have a main and three others here.”

### Korea Brings ATSC 3.0 Technology To The Show

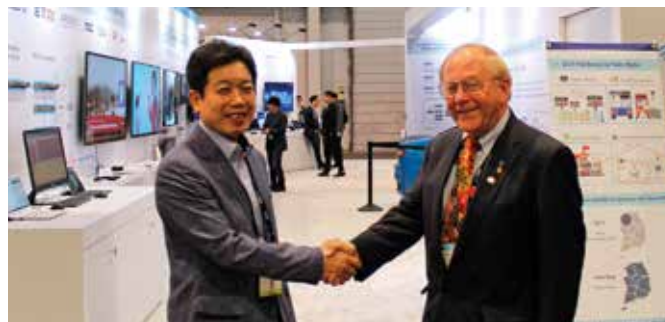
Not far from one of the “railroad” 3.0 demos was “Futures Park,” which is home to a lot of cutting edge technology, and Korea, as it was the first country to deploy ATSC 3.0 in a regular over-the-air service, had a very prominent place in the “Park.”

Korea’s Electronics and Telecommunications Research Institute (ETRI) was there with several exhibits of 3.0-related technology, including a new “set-top box” for demodulating and displaying ATSC 3.0 RF signals on an existing non-3.0 TV

set or other video display, a UHD mobile receiver “dongle” that supports Android, Windows, and Linux operating systems, allowing 3.0 to be enjoyed on hand-held devices, an ATSC 3.0 gateway to provide received 3.0 content to companion devices within one’s household, and a “small-scale” or low-power ATSC 3.0 modulator/transmitter for providing signals in a school, hospital, or industrial environment. Another demonstration involved the bonding of two ATSC 3.0 RF channels together for transmission of 8K UHD (something not possible at this time within a single six MHz channel, even with ATSC 3.0).

According to the information about the exhibit provided by ETRI’s principal research scientist, Jae-young Lee, the video resolution displayed was 7680 x 4320, and running at a bitrate of 80 mbps. The transmission capacity was achieved by the bonding of the two six MHz channels. Lee explained that the bonding could be accomplished using either non-adjacent or adjacent channels.

While in the Korean Pavilion, your editor was invited to meet with Korea’s deputy minister of Science and Information and Communications Technology, Jang Seok Young, and we discussed several aspects of the ATSC 3.0 “movement” and its progress in Korea.



Your editor meets with Korea’s deputy minister of Science and Information and Communications Technology, Jang Seok Young.

Young was asked about the very rapid establishment of a 3.0 broadcast service in South Korea versus the rather slow start it’s seeing in the United States. Speaking through an interpreter, he offered these thoughts:

“As compared to the U.S., South Korea was in a better position to roll out ATSC 3.0. Major broadcasters needed to change their business model as terrestrial stations are losing market in competition against paid TV service providers such as cable, satellite, IPTV, and OTT.

“ATSC 3.0 has ability to be connected to the Internet, so terrestrial broadcasters can provide more services and provide better viewing experience. Also, the Korean government put aside 700 MHz spectrum for UHD broadcasting service. This decision drove the industry harder to launch UHD broadcasting using ATSC 3.0 in Korea.

“From the consumer point of view, more advanced broadcasting service can improve viewing experience. Consumer electronics makers like Samsung and LG also pushed hard to promote UHD broadcasting services for new product sales.”



Saankhya Labs' Vasanth Shreesha demonstrates ATSC 3.0 reception via a smart phone equipped with a dongle demod powered by one of Saankhya's new chips.



The Saankhya low-power ATSC 3.0 transmitter.

Young noted that the incentive to move to ATSC 3.0 and UHD didn't really require a lot of debate and lengthy decision making, as it brings benefits to broadcasters, consumer electronics manufacturers, television viewers and others.

### More ATSC 3.0 'Dongles' And Transmission

Although not part of the NAB Show, there was another demonstration of ATSC 3.0 technology and progress going on at the Wynn Hotel, a few blocks away from the Las Vegas Convention Center. While the Sinclair Broadcast Group/Saankhya Labs demonstration suite was accessible on an "invitation-only" basis, a steady stream of broadcasters flowed through it during show hours to view the Saankhya's new integrated circuit for receiving ATSC 3.0 off-the-air. The chip was produced under the auspices of Sinclair and was premiered at the January Consumer Electronics Show (as reported in the first-quarter 2019 issue of Broadcast Technology).

The i.c. was designed to serve as the heart of software-defined receivers (SDRs) and draws only a few milliwatts of power, allowing it to be incorporated in smart phones and other consumer devices.

While the demonstrations being conducted this time didn't involve phones with embedded chips, there were several operating examples of "dongles" that were connected to smartphones and other handheld devices.

Saankhya was also demonstrating a complete ATSC 3.0 low-power integrated television transmitter/antenna designed for pole-mounting for rapid deployment of ATSC 3.0 service in a small community.

### The Biggest Year Yet For ATSC 3.0 Television

Whether it was part of the mainstream Convention Center exhibition and technical presentation sessions, or "off-campus" elsewhere in Las Vegas, there can be no doubt that ATSC 3.0 is very much with us now, and very much a part of the 2019 NAB Show experience. And as ATSC 3.0 continues to roll out across the United States and Korea, look for an even greater presence of the DTV transmission standard at the 2020 NAB Show.

## 2019 NAB Show Draws More Than 91,000 To Las Vegas

*continued from page 5*

There was one very big deficit at the 2019 Show. This was 3D. And if this was why you made the April trip to Las Vegas, you were definitely out of luck!

### A New Twist On A Long-Standing Tradition

For those who didn't get the news while at this year's NAB Show, don't plan your trip to the 2020 event around the traditional Saturday-through-Thursday show schedule that featured many paper presentations, meetings, and other events on Saturday and

Sunday, and the showing of new equipment and technologies in the LVCC exhibit halls beginning Monday morning and lasting through Thursday afternoon. The annual six-day show, which has followed this Saturday-through-Thursday schedule for years, will be shortened by one day in 2020, with Saturday reserved for many pre-conference meetings and presentations, and the viewing of the exhibits beginning on Sunday and lasting through Wednesday. The dates to remember when booking travel and accommodations for the 2020 NAB Show are April 18-22.