BTS IEEE

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President's Message

Ralph Hogan, BTS President

Summer is in full force where I live in Phoenix, Arizona, USA. We have been having 117 degree F (47 C) days for the past couple of weeks, and have set several new record highs. It's a good time to stay inside and get out of the heat. Business travel and face-to-face meetings are slowly beginning again with some cautions. Many of these are being planned as hybrid meetings with both virtual and face-to-face components. The NAB Show has been moved from April to October this year, and the IBC event moved from September to December. This has forced a number of other meetings and conferences to be clustered in the fourth-quarter of the year. At this time, it appears that most everyone is looking forward to some relief as we move into a post-pandemic world. The pandemic is still turning out variants of the virus, but the vaccines seem to be doing a good job of protecting those who chose to be vaccinated.

The Society has gone through an IEEE TAB Periodicals Review and Advisory Committee (PRAC) review of the Transactions on Broadcasting, and is in the process of going through an IEEE TAB Society and Council Review Committee (SCRC) review in 2021. Both of these reviews are conducted every five years for each Society or Council.

The objectives of the PRAC review process are to:

- examine timeliness and quality of publications
- assure that periodicals comply with IEEE policies and procedures
- assist the Society/Council in enhancing self-awareness of its periodicals
- determine the financial health of the publications
- provide suggestions for improvements and share best practices from other Society/Councils.

The SCRC has three main purposes:

- provide feedback and recommendations to the Society to ensure they remain the top organizational unit in their field of interest,
- help the Societies and Councils in any area they may need help and
- share best practices among Societies and Councils

One of the outcomes of the SCRC review is that BTS can demonstrate our accomplishments during the past five years, and there have been many. We have also expanded our international reach into other IEEE regions and developed additional industry participation by joining several European industry organizations. We have also produced best practices guidelines for our conferences and started a new virtual conference "Pulse," along with numerous other webinars for members and Young Professionals.

Our 2020 and 2021 budget years have been hard hit by the pandemic and loss of IBC revenue, but due largely to BTS staff and volunteer support, we have managed to start several new revenue streams. There's not a lot of income yet, but

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Inside

OUR COVER: The New York SiriusXM satellite control room in as it appeared in the early 2000s.
(Photo courtesy of SiriusXM)

From The Editor

Business 'As Usual,' Hopefully!

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

While it hardly seems possible—time goes way too fast these days—it's been more than a year since we've been living in "unusual times" due to the outbreak of the Coronavirus pandemic. I remarked early on in this column that with the abrupt cessation of "normal" activities and the "lockdowns" that had occurred in many localities to try and halt the spread of the disease, I was reminded of a WWII-era song, "When The Lights Go On Again All Over The World." The intent of the song was to try and spread optimism about the ending of the war and the world getting back to normal.

Unfortunately, even after some initial hope as we (in the Northern hemisphere) were going into the summer season that with declining infection and death rates being reported, it seemed that we may be getting close to the point where indeed, lights were beginning to come on again. Bans on group activities and other restrictions were lifted in many places and more and more of the population was getting vaccinated; however, with the emergence of the "delta" mutation or variation of the virus, the number of new infections (and unfortunately, deaths) have again begun to climb, and some of the previously ended restrictions are again being put back in place. However, there is still hope that the "light will be coming on again" sooner rather than later, as here in the United States, more and more of those who were skeptical of the mass vaccination programs that were conducted earlier this year are now seeking out the vaccines. Great Britain announced just a few days ago that entry restrictions were being eased on fully vaccinated travelers from the United States and E.U. nations, so maybe before too much longer business can resume "as usual."

In the meantime, plans are fully underway to resume the NAB Show, which was cancelled last year (the second time ever for the nearly one hundred-year-old event). It's been pushed back from April to October this time, though. The IBC Show is also scheduled to return, but will be held a few months later than its usual September time frame.

And while I have come to enjoy being able to attend technical conferences held all over the United States and the world without having to travel any further than the chair in front of my computer, I still miss visiting with friends and colleagues at "bricks and mortar" real-world events.

End Of An Era

The United States has reached another milestone this summer—not in connection with the pandemic, but rather in broadcasting. This was the sunsetting of analog television transmissions. Some 12 years ago (June 2009), our communications regulatory body, the FCC, mandated the end of all analog broadcasting by full-power TV stations, but cut another class of television station operator—the "low-power" broadcaster—some slack, as no federal funding for equipment necessary to convert to digital had been made available for these smaller, typically community-oriented, stations. (As part of an on-going spectrum reallocation, the full-power broadcasters did receive government monies for transitioning to both new spectrum and digital transmission.)

The low-power TV stations (LPTVs) were initially given until 2015 to sort things out and come up with a way for funding the necessary equipment for ATSC 1.0 transmissions. However, before that "line in the sand" arrived, another spectrum repack was starting to happen, and the FCC stretched the LPTV conversion deadline to the middle of this year. (By the way, the "100 percent" digital TV mandate affected another class of transmitting facilities also, the low-power "translators" that receive over-the-air signals from a station's main transmitting facility and retransmit them on a different frequency to provide service in areas where terrain or other issues make reception of the main signal problematic. (In the state of Utah alone, there are some 400 translators in operation.)

At any rate, with the arrival of July 13, the curtain came down for good on U.S. analog television broadcasting. It's hoped that by now (12+ years since the full-power analog shutoff) that the percentage of households receiving television over-the-air has had sufficient time to make the switch. (How long has it been since anyone has seen a CRT TV receiver with a "set-top" digital-to-analog converter in operation?) I imagine that the only such recipients of analog OTA broadcasts here in 2021 are the handful of cable TV operators who haven't invested in digital demodulators for the LPTVs they've been carrying.

While U.S. low-power TV broadcasting only seems to have come into its own a few decades ago, the concept is far from new. When the post-World War II TV broadcast boom began, the FCC had planned for such community operations with the allocation of a common spectrum space for this purpose, similar to the setting aside of a half-dozen or so "local" frequencies for AM radio broadcasting in the medium wave spectrum. Stations opting for such positions on the dial were initially limited to 250 Watts and could broadcast day and night non-directionally. (The power cap was increased to 1,000 Watts in the 1960s as a possible answer to the increasing amount of MW manmade noise and spectrum congestion.)

So, what was the frequency first allocated for low-power "community" television?

To save some "Googling," it was 44 to 50 MHz (or megacycles back then)—U.S. television's long-lost Channel 1. How many of our U.S. readers recall ever seeing a TV set with the channel selector beginning with anything other than "Ch 2."?

There's a "back story" here that I won't go into, but not long after TV broadcasting took off in the United States, Channel 1 was reassigned away from television purposes, and after 1947, it was no longer seen on station selectors. In researching this some time ago, I only located a couple of construction permits issued by the FCC for Ch. 1 stations—in Riverside, California and Trenton, New Jersey—but there's no evidence these were built or that anyone ever operated on Ch. 1. (Wikipedia now shows a few additional authorizations, but again, these were never constructed.)

Fast forward from 1947 to 2021 and there are now some 3,000 LPTVs on the air in the United States, dwarfing the 1,900 or so full-power operations licensed to operate. These "smaller voices" are a valuable part of smaller communities, filling the void created by the cessation of publication of many small and medium size newspapers and the move by many radio stations away from local programming, broadcasting instead massive amounts of nationally syndicated programs.

We salute these smaller television entities, and hope that all of them have successfully transitioned to digital operations by the FCC's deadline.

'Franken' FMs: All Evil, Or Could Some Good Come From Them?

The end of U.S. LPTV analog operations was supposed to have been the death knell of another type of quasilegal over-the-air radio service, the so-called "Franken FM" station. As the audio carrier of U.S. Ch. 6 analog television stations falls at 87.75 MHz, just below the 88-108 MHz FM broadcast band, some enterprising entrepreneurs have used low-power Ch. 6 TV licenses as a means for entry into radio, rather than television broadcasting, especially in metropolitan areas where all conventional FM allocations are filled. In such operations the visual portion of the transmissions are secondary to the aural, with unrelated video—color bars, etc.—being transmitted. Such operations have been dubbed "Franken FMs," playing on the legend of the "monster" created from an assortment of body parts from different individuals by Victor Frankenstein, the protagonist in Mary Shelly's 1818 Gothic horror novel.

These Franken FM stations have been around for more than a decade, possibly longer, and have a questionable status, with "legitimate" FM and television broadcasters having frequently complained about their operation. A ruling on their status has not been high on the priority list at the FCC during the past decade, with TV spectrum auctions and repacking occupying the lion's share of time and personnel assigned to broadcasting operations. It has been hoped by some that the mandatory July 13 cessation of analog broadcasting by LPTVs would forever silence these "not-quite-FM, not-quite-television" stations.

However, this has proven not to be the case. One of the Franken FM operators, KBKF-LD, in San Jose, California, has been granted Special Temporary Authority (STA) to operate with an analog 87.75 MHz audio-modulated carrier in addition to Ch. 6 video/audio transmissions using the ATSC 3.0 broadcast standard. The STA is valid for six months, with the station having to prove that such a hybrid transmission does not limit its normal TV coverage or result in interference to its digital video/audio transmissions, or interference with radio or television broadcasts from other stations. (It must also transmit at least one stream of conventional television broadcasting with related sound and picture.)

An FM radio broadcasting service that doesn't really fit within FCC rules has evolved in the United States during the last decade or so, utilizing the audio carrier of low-power Ch. 6 TV stations. These so-called 'Franken FMs' were supposed to go dark in July when LPTV stations must convert to digital, but at least one will live on for at least a while.

This scenario is worth of mention for a number of reasons. One is that as far as can be determined, the ATSC 3.0 television standard was not designed for such hybrid broadcasting purposes and does not recognize this transmission mode. I'm sure that this will result in several interesting papers on the subject. Also—if the station can prove that its hybrid operation doesn't result in interference to itself or others—there is the possibility of providing an additional

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SiriusXM Celebrates Twenty Years Of Continuous Service

Sat-delivered radio now important part of U.S. broadcast scene

By Deborah D. McAdams

WASHINGTON, D.C.

Commercially available satellite-delivered radio service marks a 20-year milestone this year, but the story of this unique broadcasting platform starts long before its launch two decades ago. As with many such stories, this one involves genius, gamesmanship, perseverance, colossal amounts of cash and a shared frustration with the status quo.

"You always look for something better," said Robert Briskman, one of the architects of satellite radio. "I drive a lot. I always do. I think terrestrial radio is not very good, you drive 10 miles, you lose the station, assuming you can

find a station you like. The second thing, even if you've got a decent station, you'll find what you're listening to is broken up by ads. That drove me to feel there should be a better way."


Robert Briskman

The idea of nationwide uninterrupted radio service might have remained fanciful had it not piqued the interest of people like Briskman, a program director for NASA at its inception who was asked by the legendary aerospace engineer Wernher von Braun to "fix a problem." Briskman responded by creating the unified S-band tracking and communication system used in the Apollo program, and still in use today. He would go on to create ComStar, a groundbreaking domestic satellite system deployed to carry long-distance voice traffic for AT&T, among other satellite engineering feats. [1,2,3]

Briskman was long established in the field of satellite communications in the mid-1970s when an itinerant 19-year-old UCLA student showed up at a satellite tracking facility in the Seychelles. Engineers, being generally delighted to show off their accomplishments to anyone showing interest, explained to the student how their system worked.

Years later, that student (now Dr. Martine Rothblatt) recalled asking those engineers, "'Would it be possible for somebody to put a satellite up there and have it broadcast information back to the entire earth?' and they said, 'If you made a powerful enough satellite, then the receiving equipment on Earth could be so small that you could hold it in the palm of your hand,' and I could have kissed the guy. I mean, I just said, 'Wow, that's the purpose of my life,' and I made a beeline back to UCLA."[4]

Lawyers, Birds, And Money

Creating a handheld mobile satellite receiver was only part of the equation, and while this may seem provincial in the age of the iThing, it was groundbreaking at the time. Consumer satellite TV receivers were transported on flatbed trailers and antennas sunk inconcrete. Rothblatt and Briskman wanted high-fidelity sound they could listen to in a car traversing the lower 48 states. That called for wildly powerful satellites with huge solar panels and palm-sized, line-of-sight receivers. Innovative though it was, the engineering was but one element of the triad that comprises any major infrastructure undertaking—along with money and lobbying.[5]

Rather than studying engineering after returning to UCLA, Rothblatt earned an MBA, a law degree, and a spot with Covington & Burling, one of the most prestigious law firms in Washington, D.C. Five years and one international satellite system (PanAmSat) later, Rothblatt became chief executive officer of Geostar Corp., the global-positioning system progenitor created by visionary physicist Gerard K. O'Neill, whose work Rothblatt read in college. Geostar's multi-bird, aircraft-tracking system demonstrated the feasibility of beaming the Top 40 records of the week into every car on the D.C. freeway system, even when traffic actually moved. Rothblatt followed up with WorldSpace, an L-band-based satellite radio service targeting Africa, the Middle East and Asia, and Satellite CD Radio, a U.S. startup with a similar purpose.[6]

Soon came the filing "heard 'round the Beltway." On May 18, 1990, Satellite CD Radio petitioned the FCC for permission "to construct, launch and operate two satellites in geostationary orbit providing nationwide digital, CD-quality radio service in the 1,470 -1,530 MHz [L-]band."[7]

XM Satellite Radio launched operations from this facility in September 2001.

This awakened the force with which Briskman was disillusioned—terrestrial broadcasters, who were already on high alert over satellite radio. Just four months earlier, National Association of Broadcasters executive vice president John Abel told radio broadcasters that "DBS [direct-broadcast satellite] digital audio services can be directly competitive not just with our in-home audience, but also with audiences at work and in other places."[8]

Moreover, satellite radio was transpiring in Europe with the hybrid satellite/terrestrial Eureka DAB project, which debuted among the technical presentations at the 1990 NAB Show in Atlanta, Georgia in early April. Satellite radio would ultimately get far more attention than the keynote speaker that year—President George H.W. Bush—or the counterculture luminaries playing across the street, The Grateful Dead. [9,10,11.]

Satellite CD Radio's application would be followed by others, including filings from Radio Satellite Corp., licensed to the American Mobile Satellite Corp. (a consortium formed as the sole grantee of an earlier L-band license for mobile satellite services such as voice calls, paging, and geolocation, that would become XM); Strother Communications, Primosphere and two more.[12]

In the end, just two of the six would be left standing. But this was 1990, and the end was still years away, despite the FCC's display of urgency when it issued the Notice of Inquiry (NOI) on establishing these new services.

And They're Off!

"The expediency of this proceeding assumes even greater importance, as we are in the process of formulating the United States frequency allocation proposals for the 1992 World Administrative Radio Conference [WARC]," the Aug. 1, 1990, NOI stated. Any spectrum assigned to a new service requires WARC ratification.[13]

In the meantime, the lobbies commenced lobbing. The NAB asked the FCC to dismiss the Satellite CD Radio petition on the grounds that it was "'premature' and 'packed' with 'technical infirmities,' [and] 'would be a direct contravention of the principles of broadcast localism… There are 12,000 stations that serve local communities and provide a public service. Satellite CD would disrupt that entirely.'" [14]

Satellite CD Radio asked to be left alone on the grounds it would help sell albums, imploring the FCC to let it "develop without regulatory burdens [because this] will stimulate sale of copyrighted works because [d]igital audio broadcasting provides the best possible 'showcase' for copyrighted works recorded on records, tapes or compact discs." [15]

This notion of showcasing copyrighted works was indeed a valid point, but the goal in the early '90s was getting spectrum. There was no spectrum carved out for satellite radio in the United States. The 1-to-2 GHz L-band, which carried WorldSpace overseas, was used for military telemetry stateside. This caused a dilemma. Either the military would have to retool its telemetry capability or the entire U.S. satellite radio infrastructure would be incompatible with that of other nations served by the same equipment makers—making the endeavor more expensive than it would be otherwise.

Some Defensive Maneuvers

"In preparations for WARC-92, the most difficult allocation problems, domestically and internationally, involve the use of the L-band," states a November, 1991, report to Congress on issues of U.S. importance at WARC-92. "Private companies, including those developing… [satellite radio] … would like to use portions of this band because of its favorable transmission characteristics. The Department of Defense, however, opposes a reallocation of the 1,435 to 1,525-MHz portion of the band… because of existing uses." [16]

Using the L-band also "would have meant less power at the satellite," Briskman recalled. "There was no way [the military] could give that up. I cut a deal with them. They gave me unoccupied frequencies to work with."

The United States ultimately proposed allocating 2,310 to 2,360 MHz in the S-band for satellite radio "on a worldwide basis" at WARC-92. Instead, the governing body specified three different allocations to accommodate fledging systems in member nations around the world, including the S-band for the United States. [17]

By late 1992, Satellite CD Radio still had only eight employees, yet they requested a waiver from the FCC to build a transmission facility. The NAB once again objected, saying it would give satellite radio a "competitive head-start over the nation's 11,000 radio stations," which had yet to go digital.[18,19]

It was around this time that Rothblatt moved onto other technology endeavors and David Margolese, founder of what became the largest cellular provider in Canada, brought in a much-needed cash infusion of $25 million and took over as CEO. Two years later, on Sept. 14, 1994, CD Radio (having dropped "Satellite") went public at $23.75 a share, raising $7.5 million in an initial public offering for something that did not yet exist.[20, 21, 22]

"Its prospectus claimed that it would offer 30 channels of CD-quality, commercial-free music via S-band radio receivers, which were not yet being made. Its monthly subscription price was projected to be less than $10. The cost of the company's ambitious plan to launch satellites and create programming was estimated at upward of $500 million," according to the International Directory of Company Histories.[23]

A Little Artful Prodding

It's not unusual for costly ventures to hang in the balance while regulators compile a public record, postponing the inevitable stepping on of toes—in this case, those of terrestrial radio broadcasters. Here, a familiar name joins our story—although he was involved from the get-go. Richard Wiley is a former FCC chairman and founder of Wiley, Rein & Fielding, the D.C. law firm integral to the development of HDTV and one of the most influential in broadcasting, which vigorously opposed satellite radio.

"In 1990, I was approached by David Margolese and Martin Rothblatt about representing CD Radio. They introduced me to the idea of satellite DARS. They took me out to Tysons Corner (a Virginia suburb of Washington, D.C.) in a car with an antenna on the roof and you could hear this programming coming in from satellite," Wiley recalls. "They said they were a subscription service, so we thought we could do that."


Richard Wiley

In November of 1994, Wiley submitted proposed rules for Satellite Digital Audio Radio Service (SDARS) on behalf CD Radio, which had already waited more than four years for an answer from the FCC while Europe's Eureka was moving forward, he chided, conjuring the reliably motivating specter of U.S. technical non-primacy.

"Without prompt action, the United States, which originally had technological and service leadership in providing digital audio via satellite, will now slip behind," Wiley warned.[24]

Two months thereafter and three years after WARC-92—in January 1995—the FCC allocated 2,310 to 2,360 MHz for SDARS. Four applicants were approved: CD Radio, Digital Satellite Broadcasting Co., Primosphere, and American Mobile Radio Corp. (XM). By June, the FCC proposed the rules to govern the SDARS allocation, and by September, the Commission gave CD Radio the go-ahead to spend $10 million to build a two-satellite system despite not yet granting a service authorization.[25, 26, 27]

Just When It Seemed Safe…

There are few things done that a body of legislators cannot undo, particularly when there are dollar signs in the airwaves. An omnibus spending bill passed in late 1996 directed the FCC to split the SDARS allocation up between developing and established services and auction off tranches. Consequently, the 50 MHz set aside for SDARS was cut in half to 25 MHz. It would be further divided between the two highest bidders. In March of 1997, the FCC set up an auction to issues two 12.5 MHz licenses among the four approved SDARS applicants. On April 2, the FCC announced the winners. CD Radio, with a bid of $83,346,000; and American Mobile Radio Corp. with a $89,888,888 bid.[28, 29, 30]

By the fall of that year, both winners were granted authorization to build SDARS systems at their assigned frequencies. The race to launch was on. Both licensees started out with the intention of using geostationary satellite systems. Then Briskman and Margolese had second thoughts. [31, 32]

"I and my partner, David Margolese, looked at a problem," Briskman said. "In the cities, you need terrestrial repeaters because of the infrastructure, the buildings, particularly in the northern part of the country, with trees and foliage attenuation. The number of repeaters you need are drastically changed by the angle of the satellite. We switched from geostationary to get the number of terrestrial repeaters down."

This decision would lead to complications later on, but the goal of launching was paramount—and pricey. Both companies were expected to spend nearly half-a-billion dollars just to get off the ground. Both fortunately had access to deep pockets. AMRC investors included AT&T, General Motors, Hughes and Singapore Telecom, while CD Radio's Margolese had raised $446 million by the end of 1997, "which will go a long way toward paying the $660 million the company says it will need to build the network," according to *Barron's*. "The largest expense—some $453 million—will go toward the purchase and launch of two satellites that will float 22,000 miles above the U.S."[33, 34]

By 1999, CD Radio had become Sirius, after the "Dog Star." AMRC became XM Satellite Radio Holdings with an IPO in October of that year at $12 a share and a powerful investor in the form of Englewood, Colorado-based Liberty Media Corp., which acquired one million shares.[35, 36]

System Disparities

Sirius and XM both initially intended to build geostationary systems, but Sirius switched to a geosynchronous platform in late 1998 to reduce the number of terrestrial repeaters necessary to provide a line-of-sight signal to a vehicle zipping under an overpass. XM would need 900 repeaters. Sirius got by with 100, Briskman said, but there was a trade-off that required "seven or eight years and at least five patents' worth of technology," according to *IEEE Spectrum.* [37]

"The reason it works is because of satellite spatial diversity and satellite time diversity and satellite frequency diversity," said Briskman, who holds patents for the first two. "These diversities are required, so that as you drive throughout the whole coverage area, you don't get outages. You have more than one signal coming into the receiver. That's very important. If you drive and look up, you see overpasses, so that would block the satellite signal, so you need either more than one satellite or time diversity.

"How do you achieve time diversity? You broadcast the same programming from two satellites at two different frequencies and delay one for four seconds," he continued. "XM does it a little differently… They interlace the signal. You can get the same four-second delay from interleaving. The receiver knows which signal to reject. Every receiver has a delay line of roughly four seconds, so it brings the late signal back in time."

The result of this inventive odyssey was that three Sirius birds would dance in an elliptical orbit that bowed closer to earth on their southern perigee, seeking out those speeding automobiles through mind-boggling mathematics, while two XM satellites would cleave to the planet like great silvery hatpins, supported by a phalanx of ground repeaters. This also meant the two had incompatible receivers, which the FCC wasn't allowing. Sirius and XM signed an agreement in February 2000 to develop a unified receiver standard, although they said it take "several years."[38]

A universal receiver would make sense in short order. Car companies were coming around. XM had distribution deals with GM, Freightliner, Peterbilt and Winnebago; Sirius scored Ford, Daimler Chrysler and BMW, all before a single satellite was launched.

T-Minus Zero

A quarter of a century after a wandering UCLA sophomore imagined satellite radio, the first bird was launched. Sirius' Radiosat-1 went up on June 30, 2000, followed in September and November by -2 and -3, respectively. XM would launch its two Boeing 702 satellites, nicknamed "Rock" and "Roll," on March 18 and May 8 of 2001. [39, 40, 41]

By this time, investors had sunk an estimated $3 billion into Sirius and XM, including the automakers. Analyst William Kidd at CE Unterberg Towpin exuberantly predicted that satellite radio would generate up to $10 billion a year by 2007. Sirius looked the part, with a $38 million headquarters in Midtown Manhattan, "all ultramodern hipness: clean blond wood, stainless steel, spotless white walls, and planes of glass," according to *CNN Money*. XM headquarters, by contrast, was set up in an abandoned building in an industrial section of Washington, D.C.[42]

Tony Masiello had left CBS Radio in the summer of '99 to become vice president of broadcast operations for XM. [43] His credentials were ideal: "I was, together with Glynn Walden of Westinghouse and Paul Donahue of Gannett, one of the founders of USA Digital, which became Ibiquity, the provider of HD Radio. As part of that project, I became heavily involved with digital signal processing and audio compression algorithms. Satellite radio offered a way to marry digital signal processing and audio compression with my expertise in satellite content distribution," he said.

A Very Big Build-Out

"We did the build-out during 2000, and the treating of audio as data that could be transmitted over IT systems was in its infancy. Our whole facility was based on audio-over-IT systems, and we had to deal with the non-deterministic character of IT network systems, and understanding how to operate and manage large-scale data storage systems. In 2000, a 25-TB storage system was considered a good size. When I left [in 2015] we had just implemented a 1.5-PB system."

SiriusXM

SiriusXM satellites in orbit graphic, circa early 2000s.

Masiello was put in charge of standing up the 150,000-square-foot Broadcast Operations Center with its 82 interconnected studios, the "largest audio broadcast facility of its kind in the United States," according to an XM press release. [44]

"The studios, and all systems needed for the creation, management, storage, playback and distribution of content were completed in 11 months. The uplinks were also completed during this timeframe. The repeater network took about two years to fully deploy," Masiello said.

"The challenge was interfacing the various systems so that they operated smoothly. With the use of a large number of servers and IT-based systems, the need for redundancy was very important. We had to develop systems to make sure the content never stopped flowing to subscribers," he said.

"As an example," he continued, "To prevent an audio content outage, we had a playback system for each of the 100 channels that ran in isolation from the rest of the network, with its own dedicated storage, with generic content for each channel constantly running. Silence sensors at the end of the program chain would switch in the backup content after 30 seconds of outage. By and large we made good system and hardware decisions."

XM Goes Live

While Sirius beat XM at getting *in* the air, XM was the first to go *on* the air. XM Satellite Radio launched commercial service on Sept. 25, 2001 (after an originally planned launch date of Sept. 12, 2001 was disrupted by the tragic events of 9/11). Any associated elation was short-lived, as the next day, Boeing warned of a solar panel malfunction on its BSS 702s.[45,46]

XM, however, still had an edge over Sirius on the ground. Tony Masiello summed it up: "Receiver design and manufacturing for the XM receiver was handled by our Innovation Center based in Florida. I believe XM had a competitive advantage at the time because of the fact we kept the chipset design in house."

Sirius, on the other hand, outsourced its receiver chips to a single supplier, according to Terry Smith, who joined the company in early 2002 after 23 years at the skunkworks of electrical engineering and the birthplace of color TV, Sarnoff. Not one to job jump, Smith remains at SiriusXM to this day as corporate vice president and chief engineering officer. In late 2005, he

told Douglas Dixon of *Manifest Technology* that the Sirius chip supplier had sole custody of the intellectual property, which left Sirius vulnerable. His job was to bring silicon in-house. He assembled a team of Hitachi and NEC alumni plus 15 Sarnoff colleagues. The resulting Princeton, New Jersey-area lab continued to develop receiver technology, including connected-vehicle software. [47]

Briskman, too, said the silicon was a problem: "We were not happy with the quality of our car radios. We decided to wait until we got the radio quality we wanted in cars. Essentially, it was the receiver chips, but there are other things as well." The delay would give XM a nine-month head start in the battle to sign up subscribers.

Sirius Joins In

Sirius would soft launch service in a handful of markets in February of 2002, and then nationwide on July 1. It would end the year with 29,947 subscribers, $805,000 in revenue and a net loss of $468.5 million. It had offered a mail-in rebate offer to attract subscribers that cut subscription revenue—at about $13 per—by 43 percent. Concurrent with its 2002 results, Sirius said it completed a previously delayed $1.2 billion restructuring that would allow it to cover expenses into 2004. No one imagined that satellite radio would be cheap, but both companies had spent $1 billion before they made a dime.[48,49]

Satellite radio was preposterous in so many ways. Terrestrial radio was free, universally available and didn't have the expense of a satellite network. iPods and Internet radio were emerging. WorldSpace could not pay for itself. Globalstar and Iridium each put $5 billion into satphone systems that were too expensive to use. Even Boeing couldn't get airborne broadband off the ground. But here was satellite radio, chugging along against the odds.

"The founders must have enormous energy, enthusiasm and stamina," according to Roger Rusch, a satellite technology expert retained by Sirius and XM to testify before the Copyright Royalty Board in 2006. "Preferably, the initiative would be backed by a large institution with large reserves of wealth, technical talent and management resources." [50]

GM, Ford, Chrysler, Hughes, Liberty Media, et al, certainly met the definition of "large institution," while Margolese and XM CEO Hugh Panero were exemplars of "energy, enthusiasm and stamina." Both had wooed the big investors and guided the startups through their respective IPOs.

"Luckily, we both began raising money at a time when there were very large satellite projects out there like Globalstar and Iridium, and investors understood the capital needed for these kinds of large satellite projects," Panero told *Satellite Today* in 2016. "If those companies had failed earlier, which they eventually did, the market may well have been less optimistic about investing in satellite radio." [51]

SiriusXM

An in-car "plug and play" satellite radio, circa the early 2000s.

Along Came Mel

XM's head start was evident in the subscriber counts. Sirius reported having 100,000 subscribers as of mid-October, 2003, while XM had 10 times as many. Both operations offered about 100 channels of music and talk, but Sirius was charging around $13 a month while XM would stay at $10 for another 18 months. The fortunes of both companies would soon change. [52, 53]

Joe Clayton had been serving as CEO of Sirius since 2001, when Margolese resigned the post, remaining as chairman into 2003. It was Clayton who led the launch and restructuring while tensions escalated between two media titans across town. By 2004, CBS and Viacom were four years into a $44 billion merger that brought together broadcast heavyweight Mel Karmazin and cable king Sumner Redstone. They were oil and water. Karmazin resigned that summer. Clayton made his move.[54,55]

"When Mel left Viacom, we all felt we had a unique opportunity," Clayton said when Karmazin was named CEO of Sirius in November. "The hiring of Mel Karmazin is the final piece in the turnaround of Sirius that began when I joined the company three years ago. My contract was ending on December 31, and I advised the board of directors that I was willing to stay on for a transitional period." [56]

Active Whisper Net

Within months, rumors of a merger began to circulate. Karmazin quickly saw the writing on the wall, according to Wiley.[57]

"He said, 'Look we have to get a merger between Sirius and XM. Some car companies are using one or the other. The FCC has a requirement that they want a chipset that works for both services. We're not going to be able to make it. It's a fringe service,'" Wiley recounted. "I said this is going to be very tough. How are you going to merge the only two companies in the business?"

That would come later. Sirius ended 2004 with 1,143,258 subscribers and $67 million in revenue, up more than fourfold the previous year, bumped by subscriber growth. This came with a cost, however. Sirius spent nearly $100 million getting those subscribers, driving an operating loss of $456 million, up 360 percent from 2003. The 2004 results were released the same day the anonymously sourced merger rumors hit the *New York Post*.[58]

XM ended 2004 with 3.1 million subscribers, revenues of $244 million, up 166 percent from 2003; and a net loss of $642.4 million, also up from 2003 due to "de-leveraging" costs as well as around $180 million acquiring the 1.8 million subscribers it added in 2004.[59]

A year later, under Karmazin, Sirius would triple its subscriber base, more than triple its revenue and cut its losses by a third. XM would have Oprah, 5.9 million subscribers, twice the revenue, a slightly larger net loss and subscriber acquisition costs that would trigger a small shareholder revolt and the exit of at least one board member.[60, 61, 62, 63]

Active Bullhorn

Despite the genius and big backers behind satellite radio, it couldn't go on losing nearly $1 billion a year. Karmazin went back to Wiley and said, "We gotta do it."

"I could understand where Karamzin was coming from, but I knew this was going to be a tough plot to sell," said Wiley. "It really was a larger audio industry. You had all this Internet music. You had iPods, Apple Music, etc. Why would anyone continue to pay for this service? People like to have things programmed for them."

SiriusXM

SiriusXM's latest-generation in-car radio, SiriusXM with 360L, which combines satellite delivery with IP streaming to deliver enhanced functionality, in the dash of a 2019 RAM 1500.

Karmazin went bold at the 2006 Credit Suisse Media and Telecom Week, saying, "Consolidation creates value . . . particularly when you are in the same industry as another company to be able to combine." [64, 65]

Neilson Barnard/Getty Images for SiriusXM

Chris Martin of Coldplay performs for SiriusXM and Pandora at the SiriusXM LA Garage Studio on January 15, 2020 in Los Angeles, California.

Together, the two providers would have 12.3 million subscribers, some of them paying $12.95 a month, just about every major sports league extant, Stern, Oprah, Martha Stewart, Snoop Dog and Bob Dylan, among others. Sirius agreed to buy XM for $4.6 billion in stock in early 2007. Over the objection of the NAB, regulatory approval was granted in mid-2008 with conditions of a three-year price cap, an *a la carte* channel option, donated air time, interoperable receivers and enough terrestrial repeaters to reach Puerto Rico within three months of the merger, plus payments by XM and Sirius for FM modulator and terrestrial repeater violations. Four days later, Sirius closed the merger. The combined companies became SiriusXM.[66,67,68]

Mirged!

The first interoperable receiver, the Mirge, appeared in early 2009, just as the two providers were consolidating the channel lineup, making the device obsolete right out of the gate. The Mirge nonetheless satisfied an FCC condition, but SiriuxXM now had bigger fish to fry. Shares would hit eight cents in February when it looked as if the company would miss a debt payment to EchoStar. John Malone's Liberty Media stepped in the day the note was due and took a 40 percent share of the satcaster for $530 million—roughly the cost getting a satellite online.[69, 70, 71]

Coincidentally, the 12,831-pound Sirius FM-5 was launched from Kazakhstan that June. The FM-5 was the first geostationary satellite for Sirius, and "one of the most powerful ever constructed, with end-of-life power capability at more than 20 kW," according to *Gunter's Space Page*.[72, 73, 74]

By now, the fleet consisted of the original three Sirius geosynchronous satellites, plus FM-5 as well as "Rock and Roll" and their intended replacements, "Rhythm and Blues." FM-4 was built as a flight-ready spare and eventually mothballed at the National Air and Space Museum.

SiriusXM ended 2009 with 18.8 million subscribers and, for the first time in the business—a profit. Fourth quarter net income was $14 million compared to a loss of $246 million in the 2008 quarter. "2009 was a notable year of firsts for SiriusXM," Karmazin said in the announcement.[75]

And The Beat Goes On

Mel Karmazin tapped out as chief executive officer in 2012, and was followed by James Meyer, who led the company in its $3.5 billion acquisition of online music streamer Pandora. Meyer left at the end of 2020, making way for SiriusXM's first female chief executive officer, Jennifer Witz. [76, 77,78]

SiriusXM is now standard in most GM vehicles as well as Maserati, BMW, Jaguar, Land Rover, plus most Volkswagen models. A new hybrid platform, the 360L, combines satellite-delivered and streaming content (via Verizon's 4G LTE network) "into a single, cohesive in-vehicle entertainment experience," in 10 of Audi's 2021 cars, *Radio World* reported.[79, 80, 81]

The satellite saga also continues. Late last year, SiriusXM announced the SXM-7, a geostationary satellite that would "deliver the highest power density of any commercial satellite on-orbit, sending more than 8,000 Watts of content to the continental U.S., Canada, Puerto Rico and the Caribbean." SXM-7 was intended to take over for Rhythm (XM-3), while SXM-8 would replace Blues (XM-4), neither of which have reached end of life.

SiriusXM

Launched on a SpaceX Falcon 9, the 15,400-pound SXM-7 unfolded its 100-foot solar array and started transmitting on Dec. 13, 2020. It was functioning properly until it wasn't. Roughly six weeks later, SiriusXM notified Securities and Exchange Commission of SXM-7's failure, with assurances that operations would continue uninterrupted, the insurer had been notified, and SXM-8 was on the way. Westminster, Colorado-based Maxar, parent company of Space Systems Loral—maker of the widely used SSL 1300 platform on which SiriusXM's satellites are based—investigated SXM-7's failure, but no specific cause had been identified as of early June. XM-8 was queued up to be carried aloft by another Falcon 9 on June 6. [82, 83, 84]

According to a 2017 paper authored by Briskman and SS/L's Joseph Foust for the 68th International Astronautical Congress, SXM-7 and -8 represented a 20 percent increase in power over their immediate predecessors, and twice that of original Sirius constellation, due to more powerful traveling wave tube amplifiers. They also carry experimental 220-Watt gallium nitride solid-state transmitters to see if the technology can handle SiriusXM's requirements, and newer Li-ion battery technology, which shaved off 220 pounds. Both were designed with dual-mode Sirius and XM repeaters to reach legacy receivers. Briskman, who, at 88 years old, has stacked up more accomplishments and accolades than mere mortals might in 20 lifetimes, is now working on a patent "to create a satellite that senses orbital debris and moves out of the way," he said.

There are certainly more names and faces in the history of satellite radio, and there are sure to be more. By the close of 2020, the year Covid-19 gripped the world, SiriusXM reported 30.9 million "self-paid" subscribers generating $5.23 billion, a $131 million profit on $8 billion in revenue, a "new-car penetration" rate of 80 percent and approximately 135 million vehicles in operation with SiriusXM receivers.[85]

All of this, because a genius walked into a NASA satellite facility on a tiny island in the Indian Ocean 45 years ago and fell in love.

"It seemed to me kind of magical that we can put up a machine way out in space and that machine can do amazing things across the whole face of the planet." — Dr. Martine Rothblatt.[86]

About The Author

Deborah McAdams *has worked in business and technology journalism for more than 25 years, with an emphasis on television technology, policy and regulation. She's appeared on national TV news and spoken at industry conferences, executive summits and other events "where the food was free and worth every penny."*

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IEEE Broadcast Technology Society hosts technical session as part of the Broadcast Engineering and IT Conference (BEIT)

IEEE-BTS Technical Session: Welcome to the New Age of Radio and Television Broadcast Engineering!

Monday, October 11 @ 9AM, Convention Room S224/S225

Part 1
9:05 AM - 9:40 AM
Automated Remote Workflows for Radio - William ("Dub") Irvin, Vice President, Radio Automation, WideOrbit

9:40 AM - 10:15 AM
App vs. App (Application vs. Appliance) - Phil Owens, Sales Engineer, Wheatstone

Part 2
10:40 AM - 11:05 AM
Near-field Drone Measurements of Broadcast Antennas - Keith Pelletier, Vice President, Dielectric

11:05 AM - 11:30 AM
Tower Safety, Climbing and Inspections - Tom Silliman, President and CEO, Electronics Research, Inc. (ERI)

11:30 AM - 12:00 PM
ATSC 3.0 Implementation Update - Jerry Whitaker, Vice President, Standards Development, Advanced Television Systems Committee

ATSC Launches Inter-Tower Wireless Communications Project

By Madeleine Noland and Jerry Whitaker, Advanced Television Systems Committee

As linear television gets better and better with the deployment of ATSC 3.0, broadcasters and researchers continue to develop new innovative applications that this new technology enables. In June 2021, the ATSC launched the Tower Network Implementation Team (IT-5) to study and develop methods to implement a bi-directional integrated inter-tower wireless communications network using ATSC 3.0.

Led by Dr. Yiyan Wu of Communications Research Centre, Dr. Dazhi He of Shanghai Jiao Tong University, and Louis Libin of Sinclair Broadcast Group, the new IT-5 has set its sights on designing, implementing, testing, validating, and ultimately demonstrating an inter-tower wireless communications network. The team will explore in-band full-duplex technology on a portion of the broadcast spectrum to distribute linear programing and data between and among broadcast towers, where the transmission and reception occurs simultaneously in the same RF band. The Tower Network system is conceived as a method to link broadcast towers together to form a Tower Communications Network for control, monitoring, data communication, and localized datacast and broadcast services.

New Technologies And New Opportunities

ATSC 3.0 creates new paths for broadcasters to enter vertical markets and explore business opportunities that have traditionally been left to other industries. Key technologies specified in the standard enable these doors to open. For example, single frequency networks (SFNs) can significantly increase data capacity and/or signal strength, allowing broadcasters to offer more services to a wider range of receiving devices that may be indoors, outdoors, stationary, or in motion. And broadcast core network technology (BCN) can enable coordinated datacasting across multiple transmission coverage areas, opening the potential for new business-to-business services requiring a large region or even nationwide footprint; for example, delivering large map update files to vehicular navigation systems.

As broadcasters look to develop SFNs and wide-area datacasting, the need arises to consider options for studio-to-transmitter links (STLs) (aka backhaul) to multiple towers. Microwave and fiber connections are available backhaul solutions today; however, these may require capital and/or operational expenditures that can have a significant impact on the potential return on investment of entering new business verticals. As such, research is being conducted to determine whether in-band tower-to-tower backhaul solutions could be a viable and attractive alternative.

The research to date has yielded promising results, leading to a logical next step of developing a working system that can be tested in the field. ATSC's IT-5 is setting out to do just that.

IT-5 expects to develop two scenarios, starting with a one-way in-band distribution link (IDL). This scenario is best described in the context of an SFN implementation. Using the advanced cyclic prefix (CP) options among other technologies specified in ATSC 3.0, SFNs can offer broadcasters improved spectrum efficiency, power consumption savings, higher coverage reliability, and reduced interference among adjacent cells. An SFN is often comprised of at least one high-tower high-power (HTHP) transmitter and multiple low-tower low-power (LTLP) transmitters operating in concert to optimize service coverage and quality. An STL is needed for each transmitter in the SFN set-up to carry data to the transmitter for emission, which is often achieved with fiber links or dedicated microwave links. In this scenario, IT-5 will study and develop an IDL from the HPHT to each of the LPLTs in the SFN, eliminating the need to install fiber or microwave to each of the LPLT instances.

In the second scenario, IT-5 will develop two-way links among multiple towers, creating a bi-directional wireless inter-tower communications network (ITCN). This solution will enable full-duplex transmission among transmitters, essentially creating a "mesh network" of inter-tower data transmissions. One could envision an ICTN covering a very large geographical area, resulting in a highly efficient backhaul path for regional or national datacasting services. Use cases such as IoT, connected cars, emergency warnings, and software/firmware updates come to mind. A broadcast core network could be built to coordinate the transmissions, and an ICTN could reduce the cost to develop and operate the necessary infrastructure for the transmissions.

Both scenarios, IDL (one-way) and ICTN (two-way), take advantage of new technologies described in ATSC 3.0 together with characteristics of the broadcast infrastructure.

Key technologies present in the ATSC 3.0 suite of standards are proving to be lynchpins of tower communications networks, including layered-division multiplexing (LDM), low-density-parity-check (LDPC) coding, non-uniform constellation (NUC) modulation, up to 32k FFT OFDM, and MIMO. Among these technologies, LDM, described in A/322,

is expected to play a central role in unlocking the potential of inter-tower communications. LDM compliments frequency-division and time-division multiplexing (FDM, TDM) by adding a power-based multiplexing technology to the palette (Figure 1). LDM can enable higher cumulative transmission capacity when delivering multiple services with different quality requirements, which helps to offset the impact of bandwidth allocated to inter-tower data delivery on existing transmission services. In addition, higher order NUC modulation, new error correction codes, 32k or larger size FFT, and MIMO all have the potential to significantly increase the efficiency of the physical layer, contributing to offset the data capacity needs of the in-band backhaul data.

Some of these technologies may seem out of reach in a consumer service scenario due to the number and cost constraints of user devices. For example, MIMO may take some time to reach critical mass in consumer services due to the complexity of the receive antennas. However, in an IDL/ICTN scenario, the number of receivers is dramatically fewer (i.e., thousands of towers versus tens of millions of consumer devices), and so it becomes feasible to envision MIMO as a professional equipment feature as opposed to a consumer equipment feature. Using these technologies to increase data capacity for the backhaul services makes it possible to allocate bandwidth to backhaul while preserving bandwidth for services to end-user devices.

Further bandwidth efficiencies for IDL/ICTN backhaul can be found in the tower topology itself. Terrestrial broadcast interference can come from obstructions between the transmitter and receiver, such as trees, buildings, mountains, and other common signal barriers. If every receiver had clear line-of-sight to the transmitter, signals would be considerably more robust, allowing stronger signals and higher data capacity. Tower-to-tower data paths have the advantage that both the transmitter and receiver are elevated and will have clear line-of-sight between them in many cases.

In Figure 2, the green areas represent each towers' transmission area to end-user devices. Typical terrestrial obstructions can be expected between the transmitters and the devices located at or near ground level. However, transmissions between the two towers take place above many of the common obstructions found at ground level. With fewer obstructions, more data can be delivered using less bandwidth, thus further increasing the efficiency of the transmission.

Two exciting challenges also come with the Tower Network solution development. One is latency and the other is "self-interference."

Again, referring to the IDL scenario, signal timing must be coordinated such that the main tower can not only transmit the IDL backhaul to the other towers, but also transmit to the end-user devices on the ground. This requires careful attention to the delay between the time the main tower receives its STL data and the time the other towers receive theirs from the main tower. In the end, all the towers in the SFN must transmit the signals to the end-user devices in concert and so the delay between the main tower's backhaul vs. the other towers' backhaul must be accommodated.

The concept of "self-interference" presents a challenge in that the towers have both transmitters and receivers. In the case of ICTN, all the towers in the mesh network can have both Tx and Rx capabilities. In the case of IDL, all the towers except the main tower have both. The presence of both a transmitter and receiver presents the potential that a tower's own transmission could be picked up by its own receiver. Members of IT-5 will explore mechanisms to reduce the "self-interference" factor, which may include "smart" tower technology that "knows" what it is transmitting and can thus "subtract" transmitted data from received data, resulting in a clean received data stream. Some isolation options are illustrated in Figure 3.

The ATSC IT-5 team will certainly face many exciting engineering challenges. Much of the development for IDL/ICTN has taken place on paper and in theoretical simulations, and now the team will put theory into practice as it develops real world solutions based on these innovative ideas.

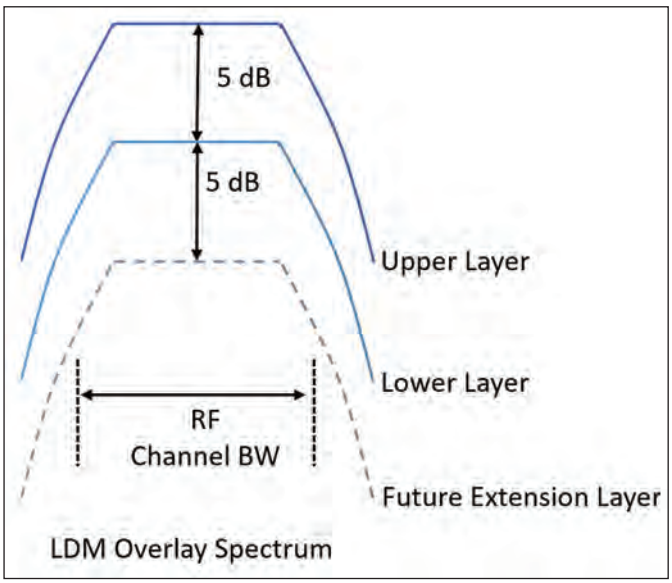

Figure 1. Layer-division multiplexing.

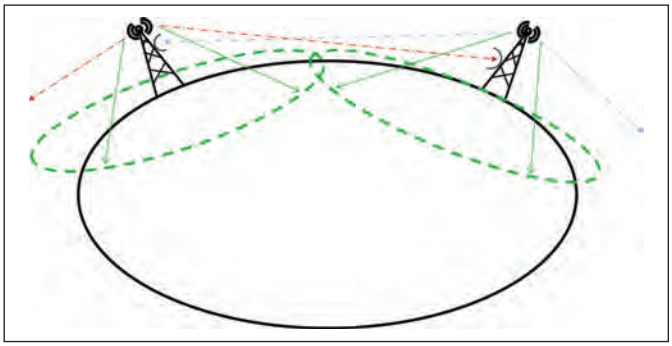

Figure 2. In-band two-way communications between towers.

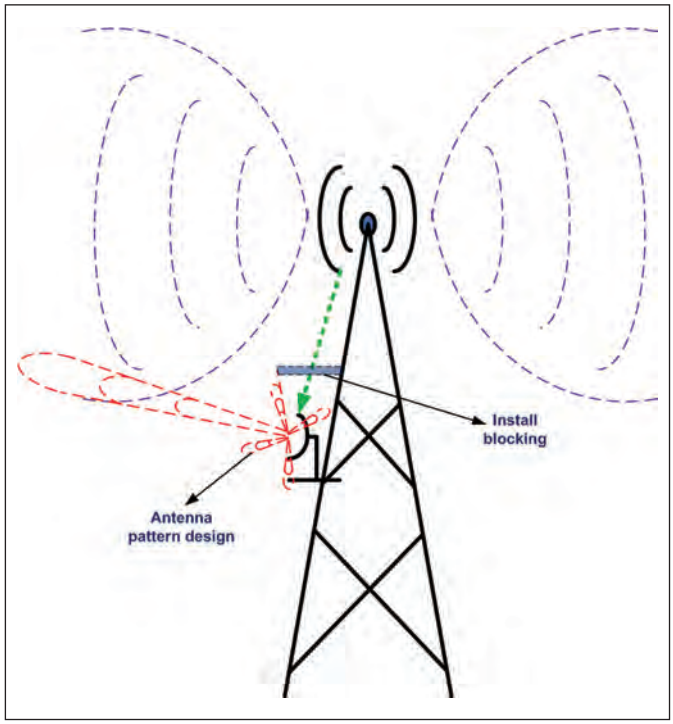

Figure 3. Self-interference isolation options for full-duplex communication.

ASTC 3.0 is a platform, and the use cases and innovations emerging in the marketplace continue to proliferate and surprise us. The ATSC is committed to continuing its work to provide an open, due process forum for participants across the broadcast ecosystem to collaborate, develop and deploy modern broadcast services.

Get Involved

Work within the ATSC is open to all groups with a direct and material interest in the work. Membership information can be found on the ATSC website (*https://www.atsc.org/members/become-a-member/*). The benefits of membership are numerous, including:

- Involvement in developing and approving Standards and Recommended Practices for the digital terrestrial transmission industry.
- Involvement in Planning Teams exploring new technologies and verticals that are emerging in the broadcast industry.
- Develop and share information on the implementation of ATSC Standards and Recommended Practices.
- Coordinate/harmonize with standards-setting bodies around the world.

All ATSC Standards and Recommended Practices can be downloaded at no charge from the ATSC web site (*https://www.atsc.org/documents/*).

Acknowledgement

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About The Authors

Madeleine Noland *is president of the, Advanced Television Systems Committee (mnoland@atsc.org). Widely respected for her consensus-building leadership style, she chaired the ATSC technology group that oversees the ATSC 3.0 broadcast standard before being named ATSC president in May 2019. Previously, as a representative of LG Electronics, she chaired various ATSC 3.0-related specialist groups, ad hoc groups and implementation teams since 2012. A 15-year industry veteran, Noland held key technology management and standards roles at Backchannelmedia Inc., Telvue Corp. and LG. She received* ***TV NewsCheck's*** *"2019 Futurist" Women in Technology Award and was named one of 2018's "Powerful Women in Consumer Technology" by* ***Dealerscope*** *magazine. In 2016, she received ATSC's highest technical honor, the Bernard J. Lechner Outstanding Contributor Award. She graduated cum laude from the University of Massachusetts.*

Jerry Whitaker, *Vice President for Standards Development, Advanced Television Systems Committee (*jwhitaker@atsc.org*). Whitaker supports the work of the various ATSC technology and specialist groups and assists in the development of ATSC Standards and related documents. He currently serves as secretary of the Technology Group on Next Generation Broadcast Television, and is closely involved in work relating to educational programs. He is a Fellow of the Society of Broadcast Engineers and a Life Fellow of the Society of Motion Picture and Television Engineers. He has served as a board member and vice president of the Society of Broadcast Engineers.*

President's Message

continued from page 2

it is slowly growing. Unfortunately, it appears that 2022 will be another sparse year for revenue; over time, it's anticipated that we will be able to return to a somewhat normal operation. I encourage everyone to look towards a bright future for BTS. Please contact me or any of the BTS staff if you are interested in becoming a volunteer. May everyone stay safe and healthy.

Ralph Hogan
BTS President
rhogan@ieee.org

Estimating The Environmental Impact Of BBC Radio

By Chloe Fletcher
BBC Research & Development

Climate change is one of the greatest threats to humanity. To minimise its negative impacts, many United Nations countries have joined the Paris Agreement—a commitment to limit mean global temperature rise to 1.5-degrees C above pre-industrial levels.[1]

Strategies to reduce, mitigate and adapt to the effects of climate change must be implemented across all public and private sectors for this objective to be met,[2] and this requires organizations to benchmark, track and minimize their environmental impacts over time.

The BBC is the United Kingdom's largest public service broadcaster, attracting audiences in the millions for its television, radio and online services. The preparation, distribution and consumption of these services inevitably affect the environment.

Previously, researchers at the University of Bristol and BBC Research & Development quantified the environmental impact of BBC television services in 2016, estimating the energy use to be 0.6 percent of the annual U.K. total, which was equivalent to 0.2 percent of U.K. carbon emissions that year.[3] These results were aligned with other studies investigating the energy use of television services[4] and online video streaming.[5]

Until last year, there was limited research investigating the environmental impact of radio. With the U.K. government currently reviewing the prospect of a radio digital switchover, and the media industry discussing the potential migration to internet protocol (IP)-only radio services, it is essential that the environmental impacts of such changes are understood. This will aid emissions reduction efforts and ensure sustainability is embedded into decision-making and system design processes. To address this gap, researchers at BBC Research & Development conducted a study on the energy footprint of BBC radio services, both now and in the future, which was published as a white paper in October 2020.[6] The objectives, approach and results from this research are outlined below.

Research Objectives And Scope

The main objectives of this study were:

- to quantify the total energy required to prepare, distribute and consume BBC radio in 2018,
- to establish the energy used by each BBC radio delivery platform in 2018,
- to model how the energy consumption of BBC radio may change over 20 years under a variety of future scenarios (outlined later)
- to identify the largest drivers of electricity use within the end-to-end radio chain

In this study, BBC radio was defined as live radio, podcasts and other on-demand audio content, where only delivery and listening within the United Kingdom were taken into consideration. A methodology based upon lifecycle assessment was used to quantify the energy used by each radio platform—AM, FM, DAB, digital television (DTV) and IP—at various stages in the radio chain. These stages were categorized as preparation (playout, encoding and multiplexing), distribution (transmitters and Internet networks) and consumption (audio and multimedia devices, and home networking equipment). Embodied energy from the manufacturing, transportation, installation or disposal of equipment was not included.

Figure 1 provides an overview of the BBC radio system from the point of production to the listener consuming radio content anywhere, including at home, in the car or on the go. This system was translated into a mathematical model, where each of the components outputted energy used on a monthly granularity. Monte Carlo analysis, which represents parameters as distributions that are randomly sampled from over a high number of simulations, was applied to capture uncertainty. Full details on the methodology, data sources and assumptions used are available in the white paper.[6]

Baseline Results in 2018

Figure 2 presents the estimated energy used to prepare, distribute and consume BBC radio in 2018, overall and per platform. The total energy was found to be 325 GWh, equivalent to around 0.1 percent of U.K. electricity used that year and 0.03 percent of U.K. carbon emissions. Of all radio platforms, FM was calculated to have the largest footprint at 100 GWh (31 percent), followed by IP (79 GWh; 24 percent), DAB (65 GWh; 20 percent), DTV (56 GWh; 17 percent) and AM (25 GWh; 8 percent).

Consumption was shown to use the largest proportion of energy across the radio chain at 239 GWh (73 percent), with distribution at 86 GWh (27 percent) and preparation at 0.3 GWh (< 0.1 percent). This result may come as a surprise, as individually, transmitters are much higher powered than audio devices. However, due to the quantity of consumer devices in the millions, versus in the hundreds or thousands for transmitters, the accumulative energy of devices is greater. The three biggest hotspots in the radio system were identified to be analog receivers, DAB receivers and television sets, which collectively represented more than half of the total energy at 170 GWh (52 percent).

However, the total energy per platform does not necessarily represent a fair comparison, as listening hours

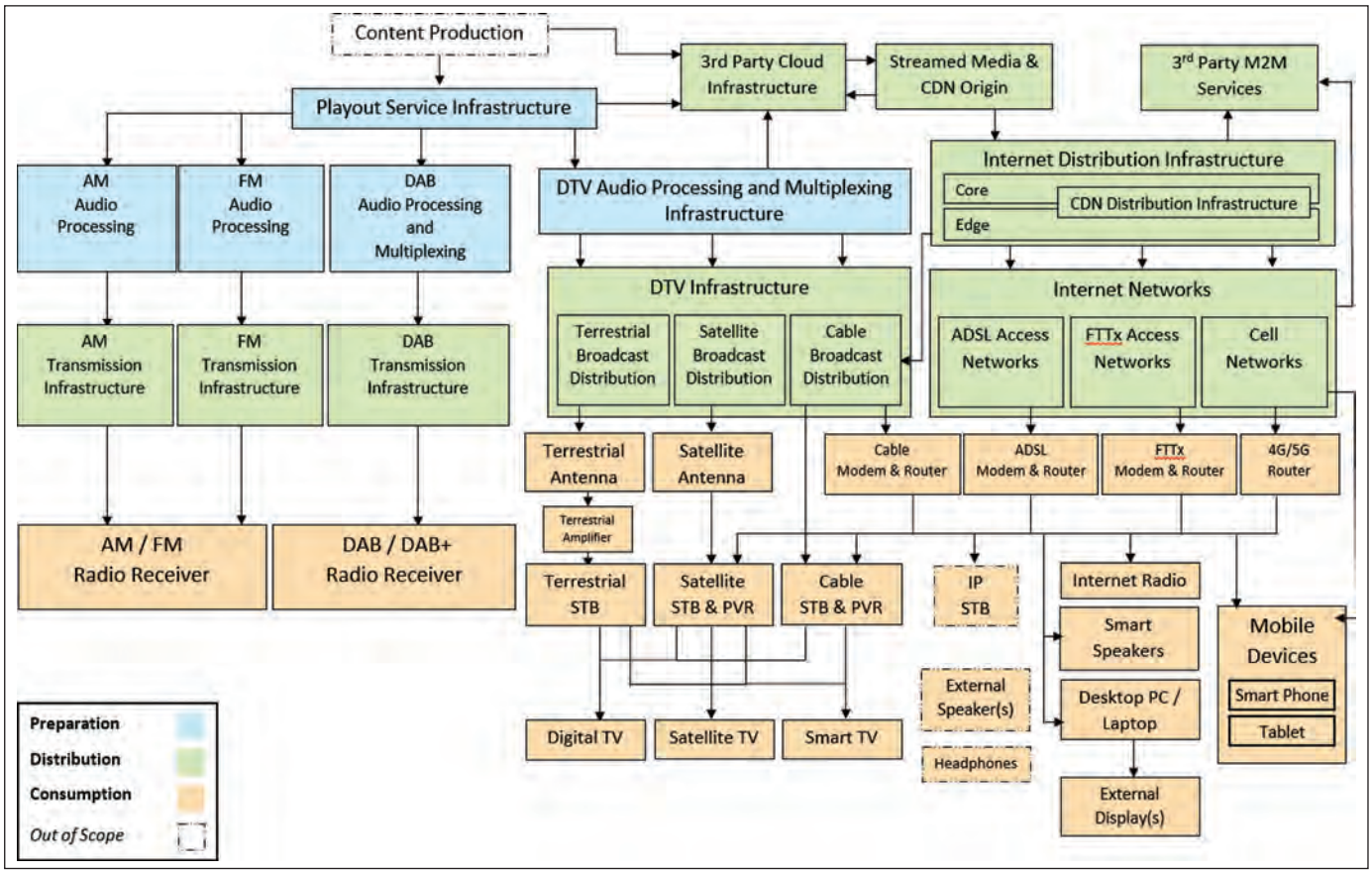

Figure 1. System map of the end-to-end BBC radio chain from production to consumption.

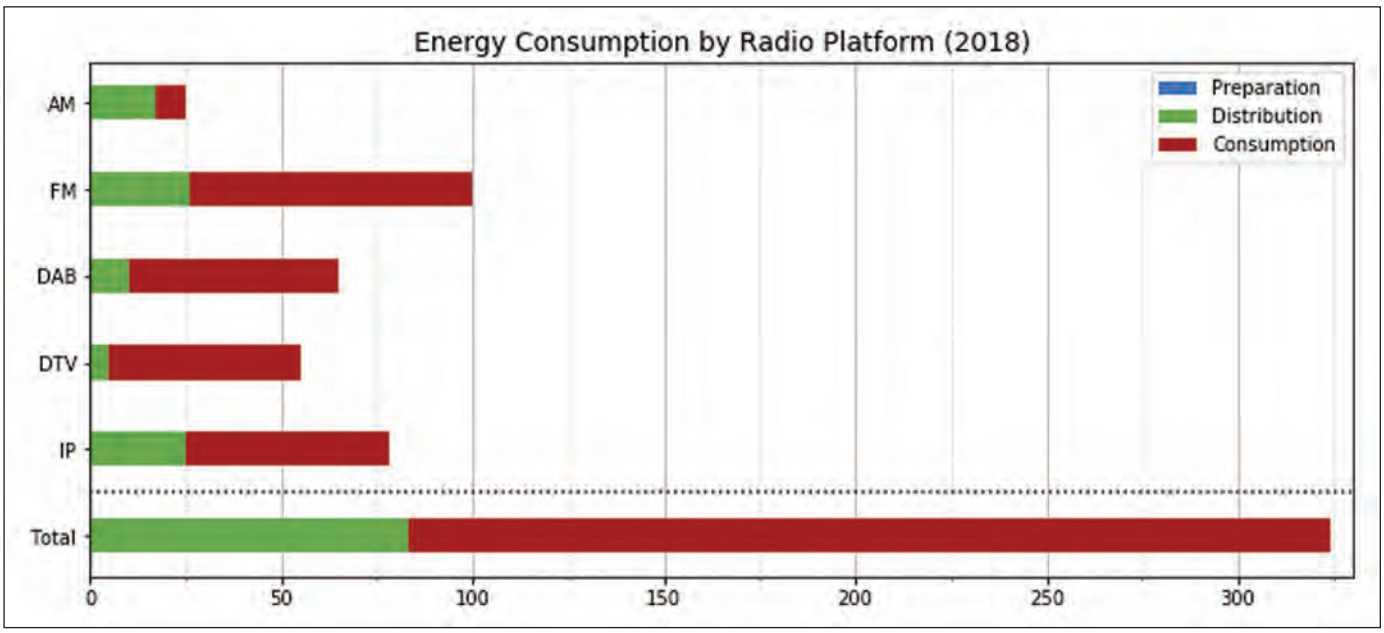

Figure 2. Energy used by BBC radio system in 2018, overall and per platform.

vary substantially across delivery methods. For example, audiences consume audio content around 10 times greater on FM and DAB than on AM or DTV. Figure 3 shows the mean unique listening hours per platform per month in 2018, which accounts for shared listening on the same device.

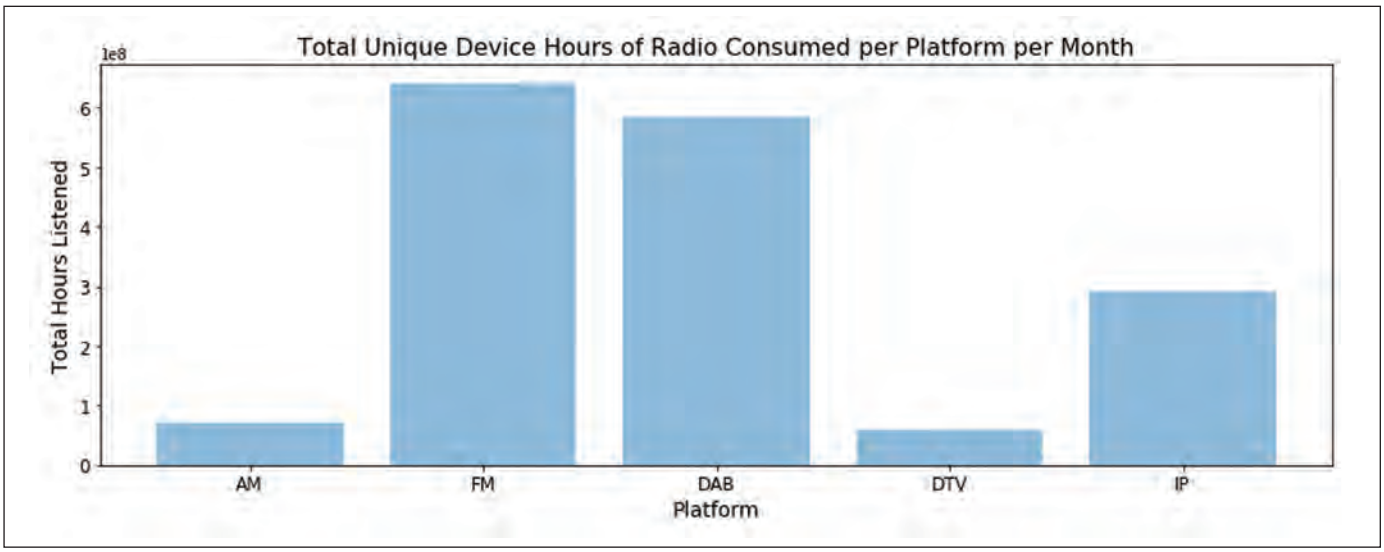

Figure 3. Mean number of unique listening hours for BBC radio in 2018 per platform per month.

Another way to evaluate the energy footprint of each platform is to determine energy used per hour of listening, which gives an energy intensity value in Wh/device-hour. Figure 4 shows the comparative energy intensity between radio platforms in 2018. The average energy intensity was found to be 16 Wh/device-hour. Of all five platforms, DAB was estimated to have the smallest energy intensity at 9 Wh/device-hour, followed by FM at 13 Wh/device-hour, IP at 23 Wh/device-hour, AM at 29 Wh/device-hour and DTV at 81 Wh/device-hour.

As such, the energy intensity of DTV, when taking listening hours into account, is approximately nine times that of DAB. Furthermore, FM was found to consume approximately 40 percent more energy than DAB per hour of listening. This is due to the FM transmitter network requiring more power than the DAB equivalent, and that the mean standby power of DAB receivers was estimated to be slightly lower than that of FM receivers. Further results and sensitivity analysis can be found in the white paper[6].

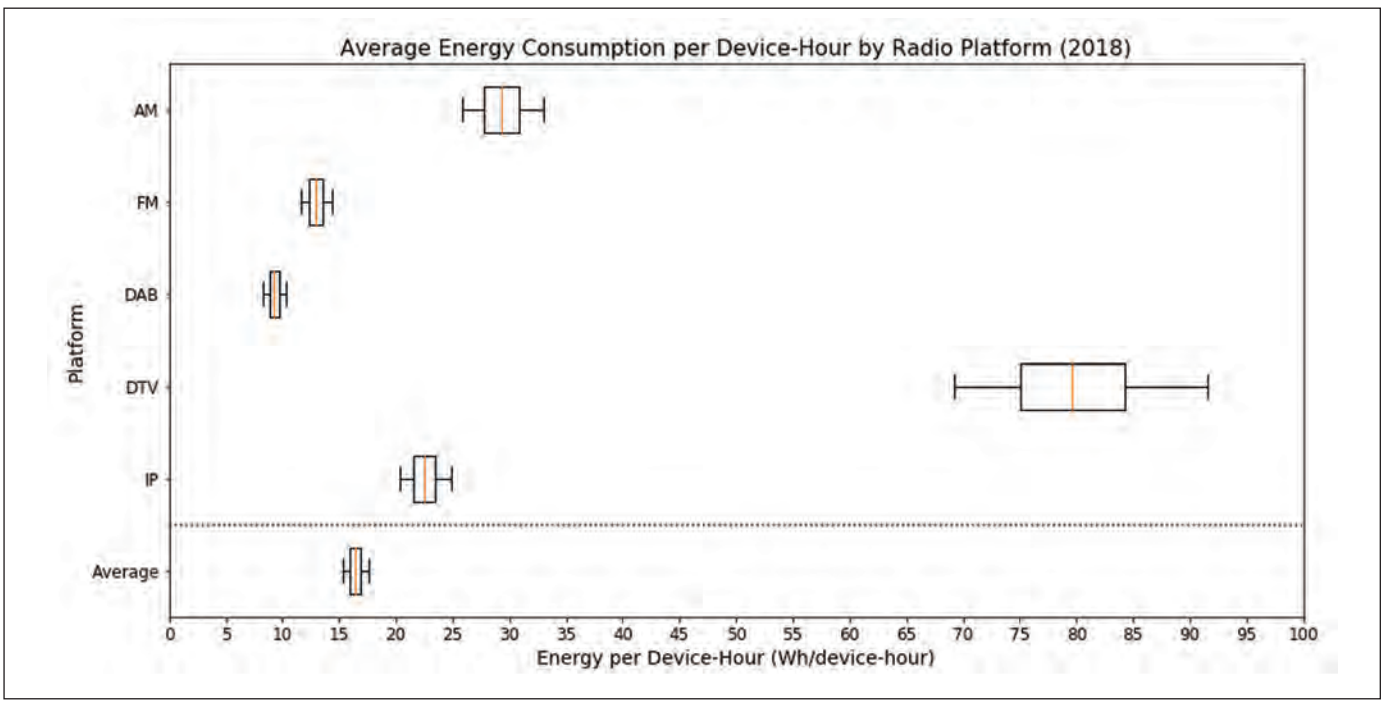

Figure 4. Estimated energy per device-hour to prepare, distribute and consume BBC radio in 2018 per platform.

Scenario Results Over 20 Years

The scenarios simulated over 20 years from January 2018 to December 2037 were:

- **Scenario 0: Business as Usual** – all platforms retained
- **Scenario 1: Digital Only** – switch off AM and FM from 2030
- **Scenario 2: DAB/IP Only** – switch off AM, FM and DTV radio from 2030
- **Scenario 3: IP Only** – switch off AM, FM, DTV radio and DAB from 2030

These scenarios and dates were chosen for illustrative purposes only, and do not represent the intentions of the BBC. It is worth noting that a sudden switch-off of platforms was assumed from January 2030 for Scenarios 1–3, as opposed to a gradual process that would realistically take place.

Scenario 0: Business as Usual

Figure 5 shows the energy consumption under the Business as Usual (BAU) scenario. There was minor change in the total energy over the 20-year period. The mean annual energy use was estimated to be 323 GWh/year, comparable to the 2018 baseline of 325 GWh. Although, when evaluating the individual components, there were notable changes. For example, the energy used by analog receivers, TV sets and set-top boxes (STBs) decreased over time due to projected reductions in AM, FM and DTV radio consumption. However, there was a surge in energy use from IP devices resulting from projections of increased radio listening over IP, particularly through smart speakers. Consumption was the largest contributor of energy at 76 percent over 20 years.

Scenario 1: Digital Only

Figure 6 presents the energy consumption under the Digital Only scenario, where the mean annual energy use was estimated to be 315 GWh/year. This indicated that switching off AM and FM delivery platforms would lead to minor reductions in the total energy compared to BAU. At the point of switch off in 2030, the energy only decreased by 0.03 percent despite the immediate removal of analog receivers and broadcast infrastructure. This was primarily due to additional energy use from smart speakers, TV sets and STBs, which were modelled to have an increase uptake. The decline in energy use from 2030 to 2037 resulted from the modelled reduction of listening via DTV in favour of IP. Consumption accounted for 81 percent of the total energy over the 20-year period.

Scenario 2: DAB/IP Only

Figure 7 shows the energy consumption under the DAB/IP Only scenario, where the mean annual energy use was estimated to be 293 GWh/year. This represented the largest reduction in energy from all scenarios compared to BAU, estimated to decrease by 599 GWh between 2030 and 2037. At switch-off, the total energy reduced by 23 percent due to the adoption of less energy intensive platforms such as DAB and IP instead of DTV and analog. Consumption was, again, the dominant energy use within the system at 80 percent over 20 years.

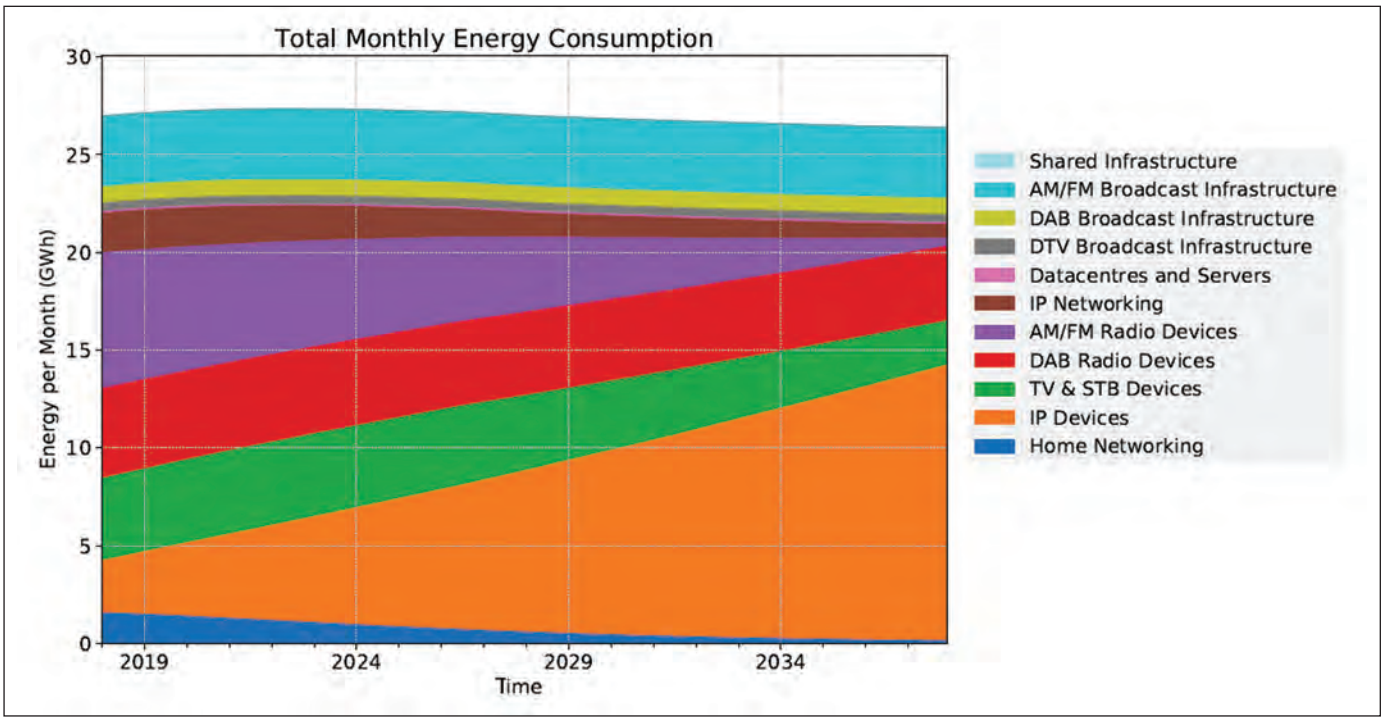

Figure 5. Energy per month to prepare, distribute and consume BBC radio from 2018 to 2037 for Scenario 0 (BAU).

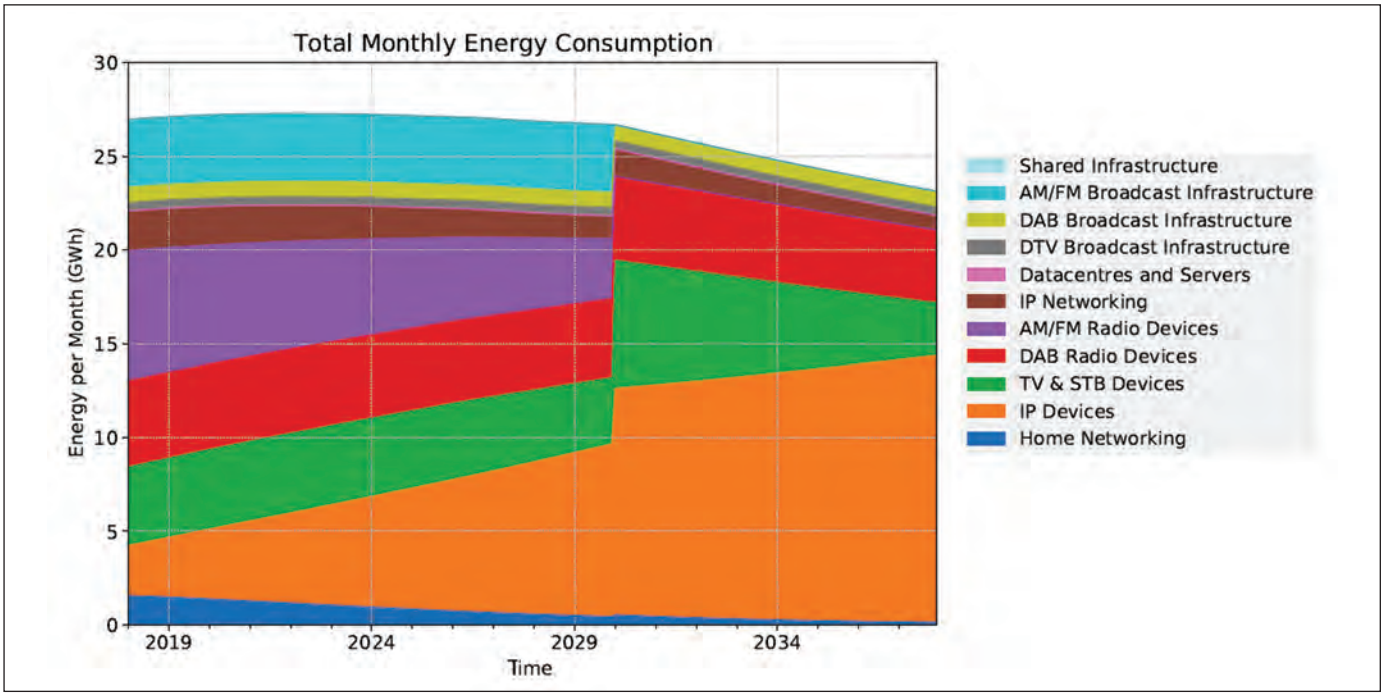

Figure 6. Energy per month to prepare, distribute and consume BBC radio from 2018 to 2037 for Scenario 1 (Digital-Only).

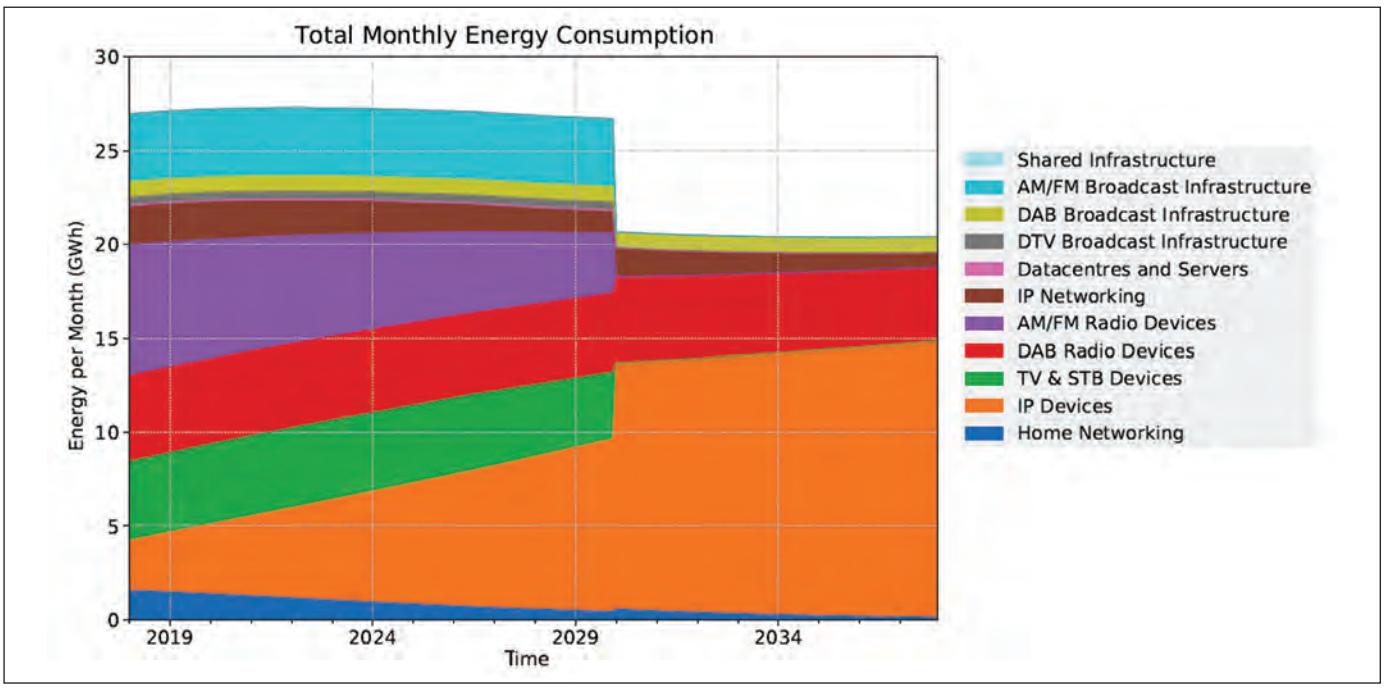

Figure 7. Energy per month to prepare, distribute and consume BBC radio from 2018 to 2037 for Scenario 2 (DAB/IP Only).

Scenario 3: IP Only

Figure 8 presents the energy consumption under the IP-only scenario, where the mean annual energy use was estimated to be 308 GWh/year. This implied that a migration to IP-only radio services would lead to a decrease in energy by 301 GWh compared to BAU. However, this showed only half the energy-saving potential of Scenario 2, where DAB was also retained. This was mainly due to the increased uptake in smart speakers which typically have a higher standby power than radio receivers. In this scenario, smart speakers were the biggest hotspot in the system, utilizing 28 percent of the total energy over the time-period. Consumption overall accounted for 81 percent of the energy over 20 years.

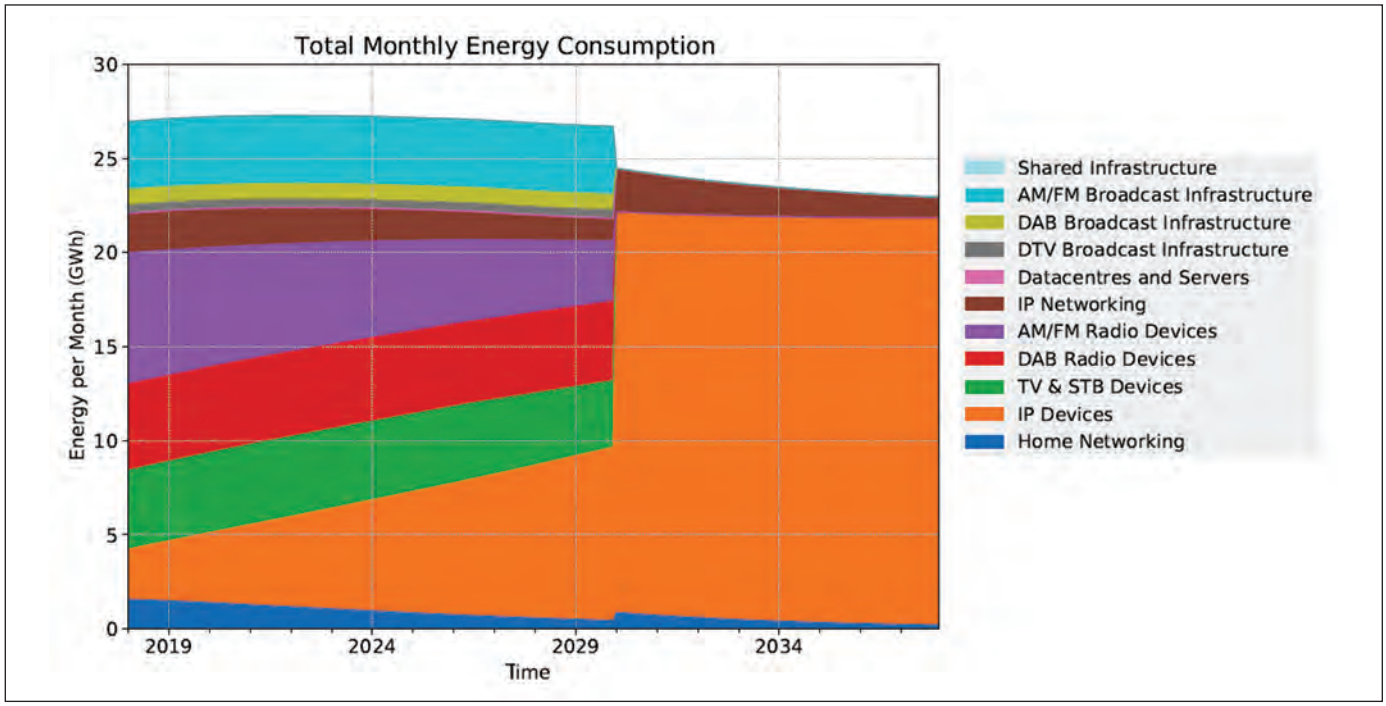

Figure 8. Energy per month to prepare, distribute and consume BBC radio from 2018 to 2037 for Scenario 3 (IP Only).

The Hidden Power Of Standby

The most notable finding in this study was that the biggest drivers of energy consumption were the standby power of radio receivers and smart speakers. The standby energy was substantially higher than the on energy by a factor of between two and six in the baseline study, dependent on the device. This may appear counterintuitive when considering that the average on power of radio receivers and smart speakers ranges from 2 Watts to 6 Watts compared to 0.3 Watts to 2 Watts for standby. However, on average, these audio devices spend around eight times longer in standby.

Therefore, due to its significance, the removal of standby energy from 2021 was simulated in the model across all four future scenarios. In practice, this would imply that devices were either unplugged when not in use or had a standby power of zero. This enabled the researchers to evaluate the impact of reducing standby power on the total system energy, thereby evaluating the effectiveness of this as a potential intervention. For each scenario, this model simulation led to a reduction in the total energy by 36 percent for Scenario 0 (BAU), 37 percent for Scenario 1 (Digital Only), 40 percent for Scenario 2 (DAB/IP Only) and 41 percent for Scenario 3 (41 percent).

Although the complete removal of standby energy may be unfeasible in practice, it highlighted the significant contribution of standby power, where any reduction to this could lead to vast energy savings. This could be effected by promoting tighter regulations on consumer electronic devices, encouraging manufacturers to reduce the power consumption of their products, and influencing audiences to change their behaviour, where possible. Although, with audience numbers in the millions and many devices needing to be kept in standby for other functions like clock radios, such interventions would be most effective through top-down initiatives. As such, since this research was conducted, Amazon has incorporated low power modes into their smart speaker devices as part of their "Climate Pledge Friendly" program to reduce their energy and carbon footprints.[7] There are likely to be other examples of positive change as organizations commit to net-zero emissions.

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The Downward Path to Broadcast Engineering—No. 24

Forklift keys can also be keys for a disaster

By John Heimerl


John Heimerl

Let's face it, every broadcast engineer that's been around for any length of time has been awakened in the early morning hours, either by the boss, the station owner, the program director, a disc jockey, or maybe the control room operator. Such middle-of-the-night calls come with the job. However, you know you've really got a problem when that phone call comes from your city's chief of police.

That happened to me a few years ago during the construction of a 1250-foot (380-meter) transmitting tower. This was going to be the biggest tower around, and everybody in the community knew what was going on, as it began to stretch up into the sky.

I was no stranger to the town's police department, as over the years I'd worked with them on several security items such as getting major antenna loads across highway intersections on the way to our transmitter site. But when I got that surprise call from the chief of police, I immediately knew that this was about something far more serious.

The chief simply said, "all I know is that there are some hot wires down on the highway and my guys have had to stop traffic back a mile in each direction. You need to call my captain for the details; here's his number."

What Is Going on Here?

This really got my attention, and I came out of my sound sleep quickly, asking myself "how could we be responsible for something like that?" I got the captain on the phone and told him that I was heading to the tower site. He responded by saying that I was needed there as quickly as possible.

My first thought was that the tower had fallen, but a quick check of the radio showed that all the stations normally heard from the old tower 80 feet away were still on the air, so that couldn't be it. A mystery was beginning to unfold.

As I got closer to the site, I could see the flashing red and blue lights from the police and fire department vehicles. The police captain greeted me and asked if I was the person in charge of the site and who was supposed to be working there at this time of night? I told him that there was no work scheduled overnight and no one was supposed to be there. He then walked over to the site entrance and pointed down at the access road from the highway. Sure enough, there were a couple of tracks left by a very heavy piece of equipment which seemed to indicate that it had left the site, headed down the road and then returned to the transmitter site. While I was puzzling over this, I couldn't help but notice the bright arcs and snapping noises from the power lines that were down across the main road in that direction. Amazingly, all the stations transmitting from the site were still on the air and our generator was silent, as fortunately the site was served by a buried power line that came from a different direction.

An Important Clue Is Discovered

While I was trying to make sense out of all this, the police officer asked me to follow him to the transmitter building.


A larcenous contract employee and a large guy line reel can equal a big early morning headache.

There we discovered an open security gate and our big four-wheel-drive forklift. The captain put his hand on the radiator and remarked that it had been used recently, because the radiator was still warm. The mystery deepened, as nobody was supposed to be on site then, and certainly no one should have been using the forklift. I theorized that perhaps someone had stolen the forklift and then had a change of heart and returned it.

The police officer agreed, saying that the return trip was made after the would-be thief pulled down the main telephone trunk line and power lines running across the highway, also breaking off the top of a power pole, and probably just missed being electrocuted in the process.

I wondered if this might have been an inside job as the tower workers knew that the forklift was kept at the site, and a few knew that its keys were kept on a peg inside the shipping container that served as a construction office.

We looked inside the container and saw that the forklift keys were hanging on the peg where they were supposed to be. On returning outside, I happened to notice that one of the empty big wooden guy cable shipping reels was laying on its side near the forklift, and at that point the pieces started to fall into place as to what might have happened to cause the damage and the afterhours maneuvering of the forklift.

About a week earlier, one of the riggers had asked if he could have one of the empty 15-foot (4.6-meter) diameter cable reels, as he thought it could serve as the basis for a tree house for his young daughter. I told him that I would be only too happy to let him have one, but I would need $1,000, as that was the deposit we paid on each reel. He responded that he didn't have that kind of money and let the matter drop.

What Part Of 'No' Did He Not Understand

I theorized that the worker didn't want to take no for an answer and decided to go ahead and take the reel anyway, doing it under cover of darkness, and using the forklift in the commission of his crime, as he probably knew where the keys were kept.

I could just see him, firing up the forklift and hauling the 15-foot diameter reel down the access road and onto the highway, operating in stealth mode with no lights. He probably didn't see the telephone and power lines running across the highway and snagged them with his oversize load. In the process, he'd managed to pull down the utility pole. At that point, he likely became frightened, aborting his plan to steal the reel and returning it and the forklift back to the site.

The amazing things were that nobody died in the incident, and that the would-be thief was able to back the forklift up, get untangled from the fallen cables and make it back to the site.

Now it was my turn to call someone in the wee small hours—the tower crew boss. I told him that some funny business had occurred at the site and that he needed to join me and the police officer there. After we informed him of what had happened, he said that he had a very good idea about who the perpetrator might be, as the home of one of his workers was only a little more than a mile away. The worker likely decided to take the reel while no one was around, and come morning, we would just assume that someone not connected with the project had stolen it.

The crew boss led me and the police officer to the worker's home, but no one answered when we knocked on the door.

We talked it over with the police officer, and rather than escalate matters, decided to wait until morning at which time the crew boss would confront his worker and get him to turn himself over to the police. As he departed, the captain reminded us that if the worker didn't turn himself in, the officer would be back and put us all under arrest.

A Confession Clears Up the Mystery

When the morning came, the rigger showed up and admitted his guilt (he had been hiding under the bed and had given his family instructions not to answer the door). We learned that he'd had a helper in his unsuccessful attempt to steal the reel and both were arrested. Eventually, they were released after having agreed to make restitution for the large amount of damage they'd caused. (It had to have been considerably more than $1,000!)

I never did find out if this happened, as both had been fired by the construction boss. The tower construction continued without them, and it was eventually completed and put into service.

This became a learning moment for me, as in looking back if I hadn't been such a trusting soul as to leave the forklift keys there in the construction shack, the incident likely wouldn't have happened. Fortunately, there had been no serious injury or loss of life.

The lesson learned was that it's never wise to tempt fate (or a potentially larcenous worker). From that day on, the keys to the forklift and other vehicles on site were always kept either in my pocket or that of the tower construction boss's. Also, if anyone ever asks for an empty reel bearing a deposit, ship it back to the supplier immediately!

About The Author

***John Heimerl**'s career in broadcast engineering began in 1965 and spanned five decades with a focus on studio and tower site management and construction. Before retiring in 2015 he constructed two 50 kW directional AM facilities from the ground up, and built or rebuilt some 200 broadcast towers, including a 1,257-foot tri-candelabra. He has also served as vice president of technology for a public broadcaster with nine regional FM stations and a full-service television facility. John is a Fellow and Life Member of the Society of Broadcast Engineers and has served on that organization's national board. He is also an active amateur radio operator, and serves as co-trustee of a North Carolina amateur radio repeater facility.*

5G MAG

By Jordi J. Gimenez and Peter Siebert

An Update on 5G MAG


Jordi Gimenez


Peter Siebert

As of February this year, 5G MAG is a market representation partner (MRP) of 3GPP. As the name implies, 5G MAG is now regarded by 3GPP as the representative of major stakeholders in the production and distribution of audio-visual media content and services area.

As pointed out by Antonio Arcidiacono, the chair of 5G MAG, the members will "jointly contribute to ensure that their interests in the media industry domain are considered adequately in 3GPP standardization, that the solutions are able to create added value across the entire value chain and that appropriate regulatory frameworks are in place to foster technology deployment and implementation."

Accommodating Broadcast TV Channel Bandwidths

One of the first inputs of 5G MAG to 3GPP was a liaison statement approved by 5G MAG General Assembly, in which 5G MAG members expressed their support for a work like 3GPP for considering new carrier bandwidths for "LTE-based 5G terrestrial broadcast" as specified in 3GPP Rel-14 and Rel-16. As explained in more detail in the article by Thomas Stockhammer and Rico Alvarino elsewhere in this issue of **Broadcast Technology**, the current set of 3GPP specifications does not support 6/7/8 MHz bandwidths. However, these are the TV channel bandwidths specified in the UHF broadcast bands. To allow compatibility between this 5G-based broadcast system and current DTT transmission based on ATSC 3.0 or DVB-T2, these 6/7/8MHz bandwidths need to be supported by 3GPP as well.

In addition, 5G MAG is looking into further improvements of the 3GPP specifications for media distribution. For this purpose, 5G MAG organized a workshop in which various proposals were discussed to enhance LTE-based 5G terrestrial broadcast and new radio (NR) multicast/broadcast services (MBS) for 3GPP RAN Release 18. Following the outcome of this work, 5G MAG proposed further enhancements, including the connection of LTE-based 5G terrestrial broadcast to the 5G core, or the optimization of simultaneous broadcast and NR unicast reception. On the MBS work, 5G MAG members proposed to enable free-to-air reception for MBS or the introduction of SFN coordination between cellular sites. The final 3GPP Rel18 package is still under discussion.

In the last issue of **Broadcast Technology**, we reported about the potential of 5G standalone non-public networks for media production. A work item on connecting these networks to the existing production network infrastructure and analyzing varying degrees of integration with public networks has been proposed.

In addition, two work items have been proposed for the distribution use case. The "Media Distribution over 5G Mobile Networks" proposal will focus on the distribution of content via all-IP 5G mobile networks including unicast and multicast/broadcast. The other work item will focus on "LTE-Based 5G Terrestrial Broadcast.". Here the focus will be on standalone broadcast. The main scope of this work item is to investigate the commercial, technical and regulatory aspects relevant to the exploitation of LTE-based 5G broadcast standard for the efficient distribution of media content to mobile users in to provide cost-efficient and high-quality distribution of TV content to large audiences.

5G Broadcast In UHF Spectrum

By Alberto Rico Alvarino
and Thomas Stockhammer
Qualcomm Incorporated

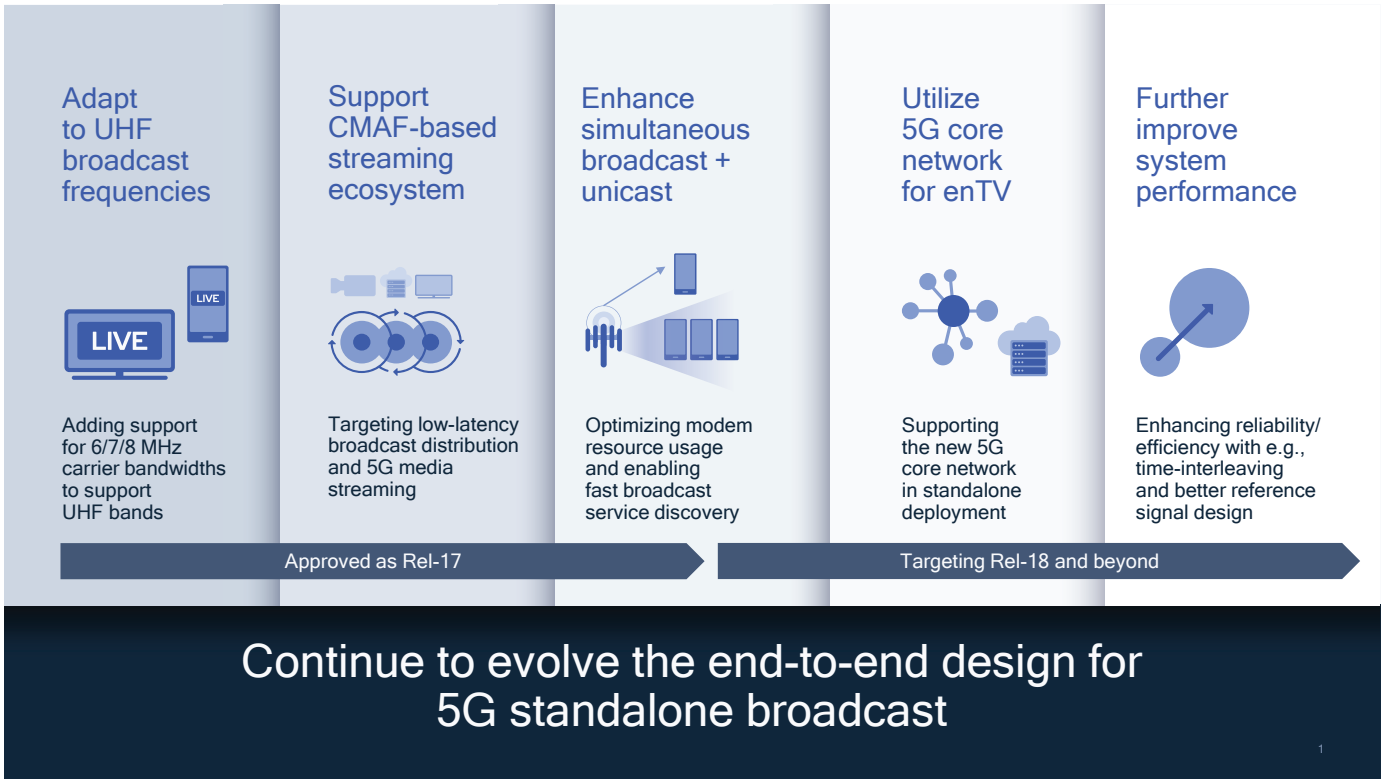
With the completion of Release-16 specifications in 3GPP and the ETSI TS 103 720 LTE-based 5G Broadcast specification, digital TV delivery with 5G Broadcast is ready for deployment.[1] The 3GPP specifications of 5G broadcast can meet all key requirements for digital TV delivery. Spectrum is available in the UHF band (i.e., 470 to 698 MHz) and can be used for digital TV broadcast in Europe, China, and other regions. The system is designed for low deployment cost, high efficiency, quick time to market, reuse of broadcasting infrastructure (including high-power high-tower) and existing 3GPP receiver functions. 5G broadcast is tailored for broadcasters and supports free-to-air services, receive-only mode reception, downlink-only distribution, and delivery in dedicated broadcast spectrum to replicate functionalities of existing digital TV services. The IP-based service layer allows deployments of apps and IP-centric service layers such as DVB-I, DASH/HLS and CMAF on top of 5G broadcast and to seamlessly integrate with unicast. And finally, 5G broadcast technology promises to continuously evolve in future releases, bringing new services and functionalities, better performance and efficiency, as well as rapid replacement cycles. 5G broadcast is ready for prime-time TV to mobile and stationary roof-top receivers.

Bandwidth Disparity

However, the current Release-16 of LTE-based 5G broadcast only supports the same system bandwidths as LTE unicast: 1.4, 3, 5, 10, 15 and 20 MHz. This channelization is inherited from cellular systems, where the spectrum is typically allocated in multiples of 5 MHz. In the case of broadcast spectrum, however, channelization is different, and thus the bandwidth channelization for broadcast is not compatible with these bandwidth values.

As an example, according to EBU TR054,[2] "HPHT transmissions require careful coordination between countries, particularly in the border areas between one country and another. The use of broadcasting bands V/V, in ITU Region 1 (mainly Europe, Africa, Middle East) are subject to the Geneva 06 (GE06) Agreement.[3] This agreement provides a framework to manage the rights to use the UHF Bands, which are subdivided into 8 MHz UHF channels, in associated countries. All transmissions in the 470 to 694 MHz band must conform to the framework of GE06 which ensures compatibility between services."

For ITU Region 2 (North, Latin and South America), an international agreement provides for a unified television band plan using 6 MHz channels for both VHF and UHF



bands. For ITU Region 3 (most of Asia and Oceania), different countries use different channel bandwidths (6, 7 and 8 MHz). As examples, India currently uses channel bandwidth of 7 and 8 MHz in VHF and UHF bands,[4] and China adopted an 8 MHz channel.

Work Item Initiated To Address Channelization Issues

In summary, worldwide territories require either 6, 7 or 8 MHz of bandwidth for services operating in the UHF broadcast band. This problem was acknowledged by 3GPP, and during the RAN (radio access network) plenary in March 2021, the European Broadcasting Union (EBU), together with 27 supporters, brought a new Work Item[5] with the objective of specifying the support of 6, 7, 8 MHz channel bandwidth for LTE-based 5G broadcast. The Work Item had been previously discussed in December 2020, but no conclusion was reached. Since then, support has increased in different parts of the ecosystem, including traditional broadcasting entities across the globe (EBU, BNE, TDF, Cellnex, Saankhya Labs), vendors of TV sets (LGE, Panasonic), cellular operators (NTT Docomo, Reliance Jio), universities (SJTU, IIT Bombay, University of the Basque Country), TV technology providers (Dolby, Xperi, Rohde & Schwarz, ATEME) and social media companies (Facebook).

The new Work Item, which is now approved, will start in August 2021 and is targeting completion date of March 2022 (Rel-17). To minimize the changes at the physical layer and maximize commonality with unicast, the project will define the new channel bandwidths for the physical multicast channel (PMCH), while the synchronization/system information acquisition will still rely on a legacy bandwidth (5 MHz).

In addition to defining the necessary physical layer features to support the new bandwidths, the Work Item will also specify the broadcast UHF band as a 3GPP band supporting the new channel bandwidths. This part of the work will specify RF requirements for both transmitter and receivers. The transmitter requirements will be based on the currently defined requirements in different regulatory bodies, so that broadcast transmitters can be reused for 5G broadcast just by swapping the baseband part, and without requiring a modification in the radio frequency part (including filters). This second part of the work is expected to start in Q2 2022 in a release independent manner.

Additionally, 3GPP in Rel-17 agreed to support the integration of 5G Media Streaming with LTE-based 5G Broadcast.[6] This adds the Common Media Application Format (CMAF) based streaming including low-latency to 5G broadcast and enables enhanced simultaneous broadcast and unicast on service layer to support hybrid services.

Despite being a completed standard, new features can be brought to 5G broadcast in every release, in line with the usual 3GPP process. 3GPP RAN is holding a workshop (June 2021) to kickstart a process that will culminate in the approval in December 2021 of a package of new features to be defined during Rel-18. There are several proposals related to 5G broadcast, including the connection to the 5G core network, further enhancements to support of simultaneous unicast / broadcast with the same modem, and introduction of physical layer time-interleaving. The Rel-18 work is expected to start in Q1 2022 and be finalized around Q3 2023. We will keep you posted on news around 5G broadcast.

About The Authors

Alberto Rico Alvarino *joined Qualcomm in 2014, and has been involved in R&D and standardization aspects related to 4G and 5G, including IOT feature, non-terrestrial networks, and broadcast. He has co-authored more than 600 patents and more than 20 research publications. He received his Ph.D. degree in electrical engineering in 2-14nfrom the University of Vigo, Spain.*

Thomas Stockhammer *received the Dr.-Ing. degrees from the Munich University of Technology. After serving as cofounder and CEO of Novel Mobile Radio (NoMoR) Research, he joined Qualcomm in 2014 as director of technical standards. He is the active and has leadership and rapporteur positions in 3GPP, DVB, MPEG, IETF, ATSC, CTA, ETSI and the DASH-Industry Forum in the area of multimedia communication, TV-distribution, 5G Broadcast, content delivery protocols, immersive media representation and adaptive streaming.*

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New Organization Created To Speed 3.0 Development/Implementation

Manufacturing Alliance Shows the Way to NextGen TV

By Bill Robertson
Digital Alert Systems

The NextGen Video Information Systems Alliance (NVISA) is a worldwide coalition of developers and manufacturers that exists to accelerate the development and practical implementation of advanced information services over next-generation broadcast and OTT television systems. A core task of NVISA is to promote interoperability and a common understanding of next-generation TV standards within the aligned industries, including the Advanced Television Standards Committee's ATSC 3.0. In this way, manufacturers and broadcasters alike will be fully aware of what is truly possible today and what is feasible in the future.

The group focuses on sharing information regarding technical approaches, advancing new solutions, and advocating for industry adoption of next-generation TV technologies. Importantly, this is the first time there has been a video services alliance organized and led by such a diverse group of manufacturers and developers. Under this banner, NVISA's primary mission is to provide a common voice for manufacturers on advanced video information systems.

Let's take a deeper dive.

The Origins Of NVISA

To better understand what NVISA is here to do, it helps to know why the organization was formed in the first place.

The ATSC 3.0 suite of standards, among others, presents nearly countless innovation options for manufacturers and their broadcast/OTT customers. However, that raises the question of how to implement those standards across a common framework that can be used from broadcaster to broadcaster. The broad range of technical and service possibilities ATSC 3.0 enables has also raised many questions and much speculation about how NextGen TV will benefit broadcasters and consumers. With the broadcast industry seeking to deploy 60 additional ATSC 3.0 stations in 2021, several companies realized the urgency of closing the gap between standard development and product implementation.

And so NVISA was born. NVISA gives manufacturers a much-needed opportunity to confer about NextGen TV technologies and arrive at a common way to implement them in a real-world environment, with additional input from a cross-section of potential users. This broadens the platform to prevent development or designs that might only suit one user. Discussing and sharing ideas creates a better overall solution. This is a highly sought forum because these types of manufacturer discussions don't typically happen within standards bodies. NVISA allows manufacturers to take the next step in development from standard to practice and understand how others in the ecosystem may be impacted.

"One of the great things about NVISA is that it provides a forum where the manufacturers can discuss what implementation of these services means and what a service is really supposed to look like for the system operator and the consumer," said Edward Czarnecki, NVISA chairman and executive director. "This dialogue has already contributed to a meaningful redefinition of how several companies had been approaching advanced emergency information, to name just one example."

From an initial core of four companies, the alliance grew almost immediately to include most of the key industry players who are developing and deploying ATSC 3.0 solutions. Now NVISA represents more than a dozen major developers of NextGen TV solutions around the world ... and counting.

NVISA's Members

The ever-growing NVISA membership encompasses the technology core of ATSC 3.0 along with broadcast groups representing more than 250 stations across the United States. By participating in NVISA, these organizations ensure they're developing products and solutions that are consistent in the industry. By extension, they're helping broadcasters to avoid bumps on the road to NextGen TV.

NVISA's regular members are companies that are driving the definition and realization of ATSC 3.0 and other NextGen TV technologies. This global network of companies includes leaders in advanced technology and content. The second category of membership—the associate level—consists of broadcasters and other service providers who have demonstrated a pioneering

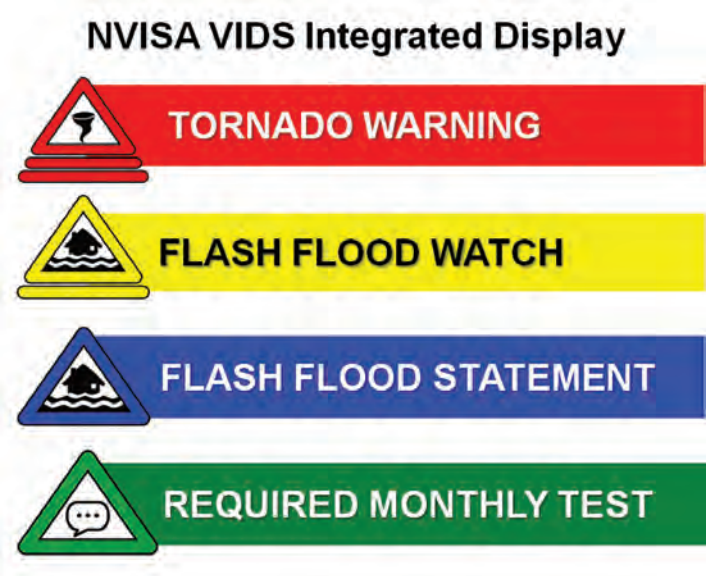
commitment to implementing NextGen TV and act as a sounding board for the group's ideas.

What's In It For The Broadcast Industry?

Developing a common understanding of NextGen TV services is essential for manufacturers to be able to implement them in an interoperable manner. The object is to clarify among both manufacturers and their broadcaster customers what's truly possible right now with NextGen TV and bring everyone onto the same page.

In turn, NVISA serves as a source of objective, well-grounded, and technically correct information on existing industry solutions for advanced broadcast and cable video information services—information broadcasters can use to determine which systems to implement within their particular business strategy.

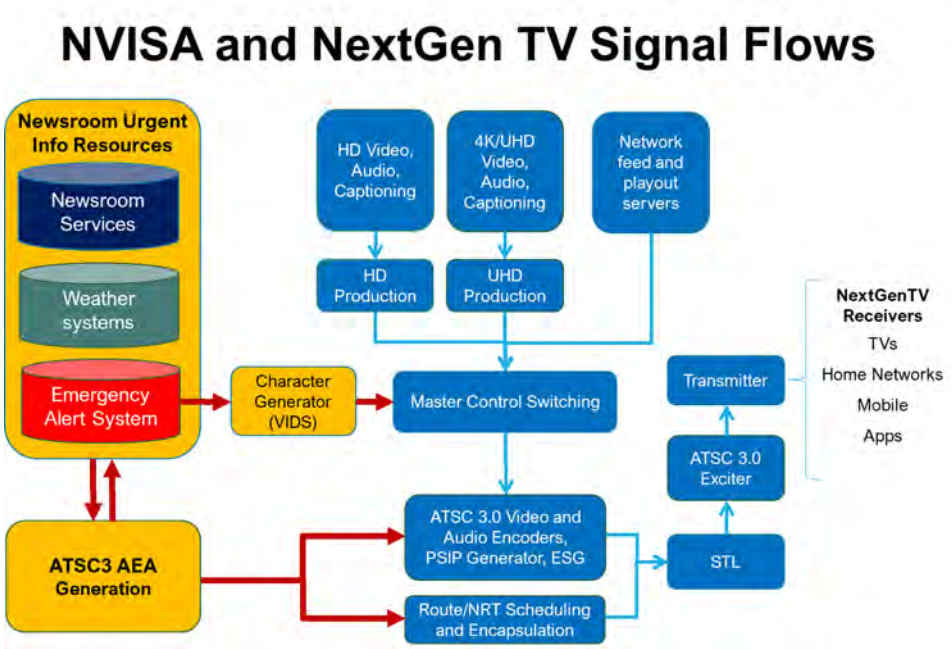
To put it simply, NVISA is advancing real-world technologies that have been enabled by standards bodies and showing people how to connect them and make them work—and clearing up misconceptions and misunderstandings in the process. Many of NVISA members' products have already proven to be interoperable. Now it's important for everyone to know exactly how to combine them into services that make a difference.



NVISA VIDS examples showing associated symbols, text, and color schema

How NVISA Does This

NVISA members collaborate to help broadcasters accelerate their transformation to ATSC 3.0 systems and other NextGen TV technology. Pete Sockett, director of engineering and operations with NVISA member Capitol Broadcasting Corp., noted, "Early on it was always a science fair project to get different manufacturers' equipment to communicate with each other. Having this forum not only allows manufacturers to work with each other, but it gives us broadcasters an avenue for input."



Simplified block diagram showcasing many NextGen TV processes in distributing urgent information to viewers

Among the organization's initial objectives is to ensure the successful deployment of enhanced emergency information solutions across the ATSC 3.0 ecosystem, including next-generation Advanced Emergency Information applications, enhanced media display for the Emergency Alert System (EAS), and accessible emergency information audio. To this end, NVISA has formed three working groups:

- ***Visually Integrated Display Symbology*** (VIDS) - places attention on harmonizing a recommended practice for emergency information display in visual media, including a shared symbology and look and feel that can be used by video services across the Emergency Alert System, ATSC 3.0, digital signage, and other visual media
- ***Advanced Emergency Information*** - focuses on developing recommended practices and use cases for the advanced emergency information capabilities of NextGen TV (ATSC 3.0)
- ***Bitcasting and Broadcast Internet*** - concentrates on examining advanced data broadcast technologies and applications (including public safety applications).

Around each of those areas, NVISA is working to create recommended practices, white papers, and industry guidance that will be available to anyone. For example, NVISA's VIDS working group has already issued a recommendation on enhancing emergency information displays over broadcast and, potentially, cable video services.

One thing crucial to NVISA's mission is keeping an open channel of communication with standards bodies, industry associations, and government agencies—such as the Advanced Television Standards Committee (ATSC), the National Association of Broadcasters (NAB), the Federal Communications Commission (FCC), the Federal Emergency Management Agency (FEMA), and others—on a range of standards and technical and regulatory issues. For instance, NVISA helped coordinate various filings with the FCC on NextGen TV and emergency alerting. Furthermore, NVISA has already briefed the three main federal agencies related to disaster communications—the FCC, FEMA, and the National Weather Service—to explain the various services and approaches that NVISA is helping to foster. (More on this later.)

Significant Progress Already

In less than a year of work, NVISA's efforts are already starting to bear fruit. The first major work product released by NVISA was a recommended practice for the visually integrated display symbology (VIDS) specification—a powerful and impactful new way of displaying emergency alerts based on easily discernable graphical elements. After the briefing for the FCC, FEMA, and the National Weather Service, FEMA acknowledged that the VIDS specification builds on the symbology that FEMA itself has promoted. Now FEMA specifically refers to VIDS as an approach to symbology and multilingual communication for making emergency information more accessible. Getting a reference from a government agency is a big win and will go a long way toward ensuring consistent implementation.

Meanwhile, the Advanced Emergency Information working group has developed documentation intended to clear up confusion about Advanced Emergency Information, also known as Advanced Emergency Alerting (AEA). A service that's part of the ATSC 3.0 suite, the Advanced Emergency Information/AEA specification makes it possible to push urgent, targeted bulletins, graphics, video, etc. to consumers through an app. Importantly, it doesn't replace the government-mandated Emergency Alert System. Rather it augments the EAS alerts that the broadcaster already sends.

NVISA is also collaborating with the government partners to both demonstrate and further investigate what's possible today with advanced emergency information. For example, NVISA has installed an operational VIDS system in a government lab so that they can evaluate how the VIDS approach can be used to make emergency information more accessible (and even persistent, in the case of certain critical, nationwide alerts). In the next couple of months, NVISA will also put a full solution for ATSC 3.0, advanced emergency information, and EAS over NextGen TV into a government test facility.

Looking Forward

Since its inception just a year ago, NVISA has quickly gone from taking its first steps to walking at a brisk pace, and by this fall, the organization expects to be running at speed. As we progress, NVISA members will continue pooling their cross-industry expertise to collaborate, implement standards, and create best practices to help broadcasters accelerate their transformation toward next-generation ATSC 3.0 systems. They will also examine the business cases for NextGen TV technologies and, as a group, offer nonpartisan guidance on what products, services, and approaches will benefit broadcasters the most.

As one key associate member, Fred Baumgartner with OneMedia/Sinclair Broadcasting, noted, "With the roll-out of NextGen broadcast moving from simply retransmitting a DTV program to more interactive content, the role of NVISA is critical. Probably the first truly NextGen broadcast service you will see is 'Advanced Emergency Alerting and Informing.' From there, there is a world of opportunity and invention for the broadcast industry."

About The Author:

Bill Robertson *is the vice president of business development at Digital Alert Systems, which offers solutions across the emergency information landscape. With a long history of management and strategic planning in broadcast manufacturing, Robertson also serves as the chair for NVISA's Video Integrated Display Symbology (VIDS) working group.*

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For more information on recruitment options, contact Amanda Temple, BTS Society Operations Manager, bts@ieee.org

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DRM Standard Ready For Local Services In India After Successful Trial

By Yogendra Pal, Hon. Chairman, India Chapter of DRM Consortium

DRM in the FM band is ready for India's mass market, being based on the in-country vast know-how, accumulated over many years, especially in chipset design, production and success of adoption by the Indian car industry. This is the conclusion of the recent trial carried out using DRM for FM. Adopting DRM in the FM band, thanks to its flexibility, backward compatibility and the fact that it is evidently part of a single standard for one nation, will only fast track the digitization process and will be embraced by the industry and the broadcasters alike. All the stakeholders are eagerly waiting for the Indian government to announce the much-awaited policy recommending the adoption of DRM in the FM band for public service, as well as for private broadcasters in India, after the rollout of DRM in AM.

About DRM

DRM (Digital Radio Mondiale) is the open standard digital radio successor to the former analog AM and FM standards. DRM for the FM band was introduced in 2011 after successful trials all over the world, and is now part of official policies in Russia, Pakistan and South Africa, and is recommended by the Southern African Development Community for its 16 Southern African countries.

Broadcast Scenario In India

The landscape includes Prasar Bharati, the public service broadcaster in India with its radio arm of All India Radio (AIR), private FM stations and community radio stations.

AIR is broadcasting in MW, SW as well as in the FM bands. AIR coverage in MW is nearly 100 percent of the population, where FM coverage for both public and private is only about 52 percent. Private broadcasters and community radio stations are allowed to broadcast only in the FM band. Coverage of private FM broadcasters is limited to about 50 percent, most of which is overlapping with that of coverage of AIR.

Digital Radio Broadcasting In India

Today, India has successfully established the largest digital radio network in the world. It has the largest automotive fleet (more than three million cars) with DRM reception capability, and is host to a world-leading chipset industry with products for DRM reception.

The Telecom Regulatory Authority of India (TRAI) is the regulator for broadcasting, and has recommended to the Ministry of Information and Broadcasting Government of India that private broadcasters should also be allowed to broadcast in digital, by utilizing the unused white spaces in the FM band and without disturbing the existing analog transmissions. This regulatory body has not specified the digital standard to be used nationally.

Trial Of DRM FM Band Digital Radio Broadcasting In India

Considering the TRAI recommendations, the Ministry asked AIR's Prasar Bharati to test the various digital standards approved by ITU and recommend the one best suited for digitizing the FM band after taking into consideration the existing state of FM broadcasting and the infrastructure in the country. Tests have been carried out with HD and DRM.

DRM Test Plan And Duration

The DRM trial in India was carried out in two locations. The first phase was in Delhi from Feb. 24, 2021 to March 18, 2021. Its aim was to demonstrate and test the key features of DRM, its efficient coverage potential and flexible on-air signal configurations.

The second phase from March 22-24, 2021 was in Jaipur. It was designed to prove the compatibility of DRM with the FM band "channelization" in India, where DRM fills the gaps between existing analog FM services that are not otherwise usable, as well as its compliance with the existing CTI (shared FM transmitter infrastructure) sites.

The DRM standard in the FM band (VHF band-II) occupies a fixed amount of spectrum: 96 kHz of bandwidth per 'block' (i.e. DRM transmission signal).

Every DRM signal can carry as many as four services; as many as three DRM audio services including PAD (program associated data) and one DRM Data Service (such as Journaline).

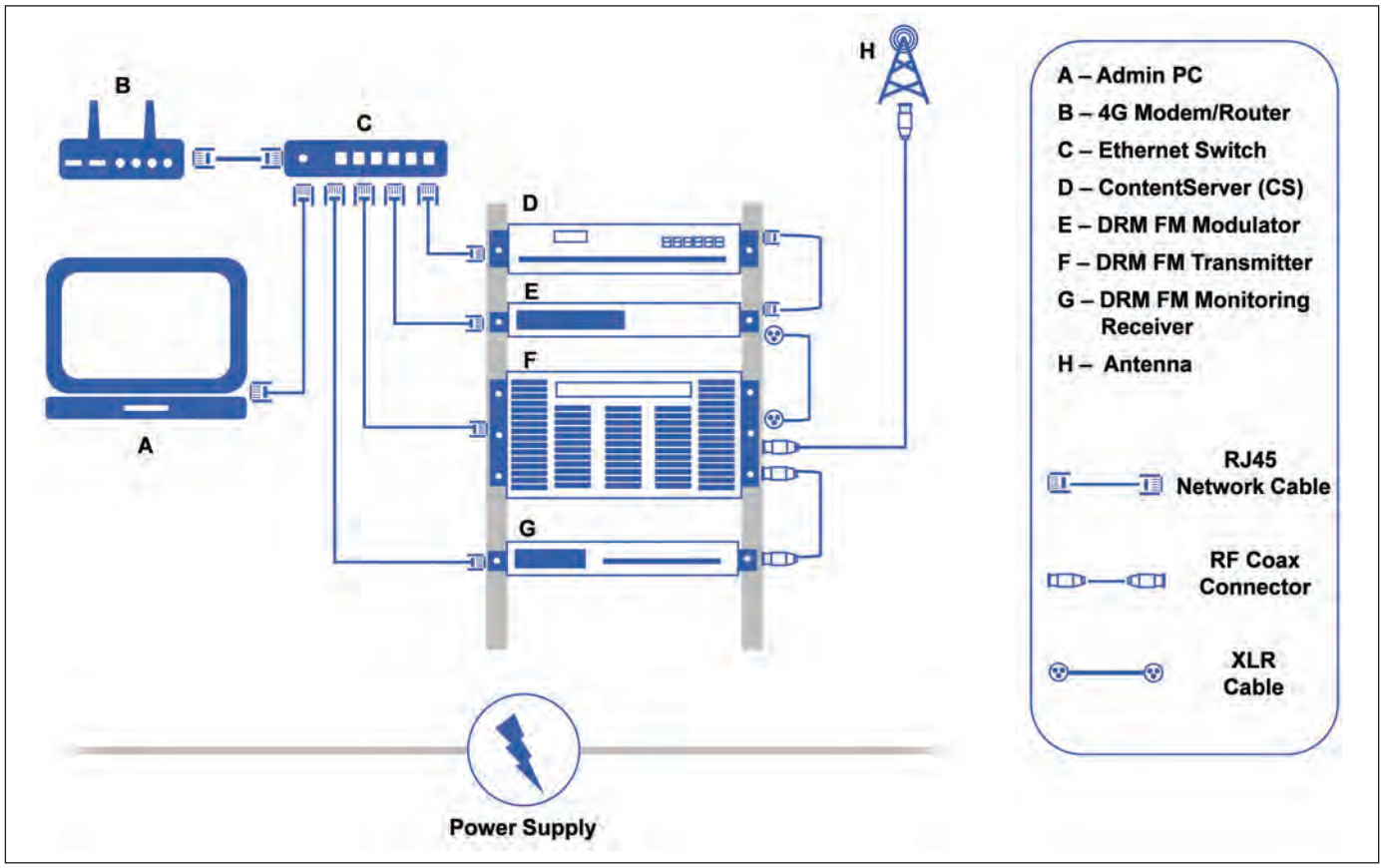


Figure 1. Transmitting test setup.

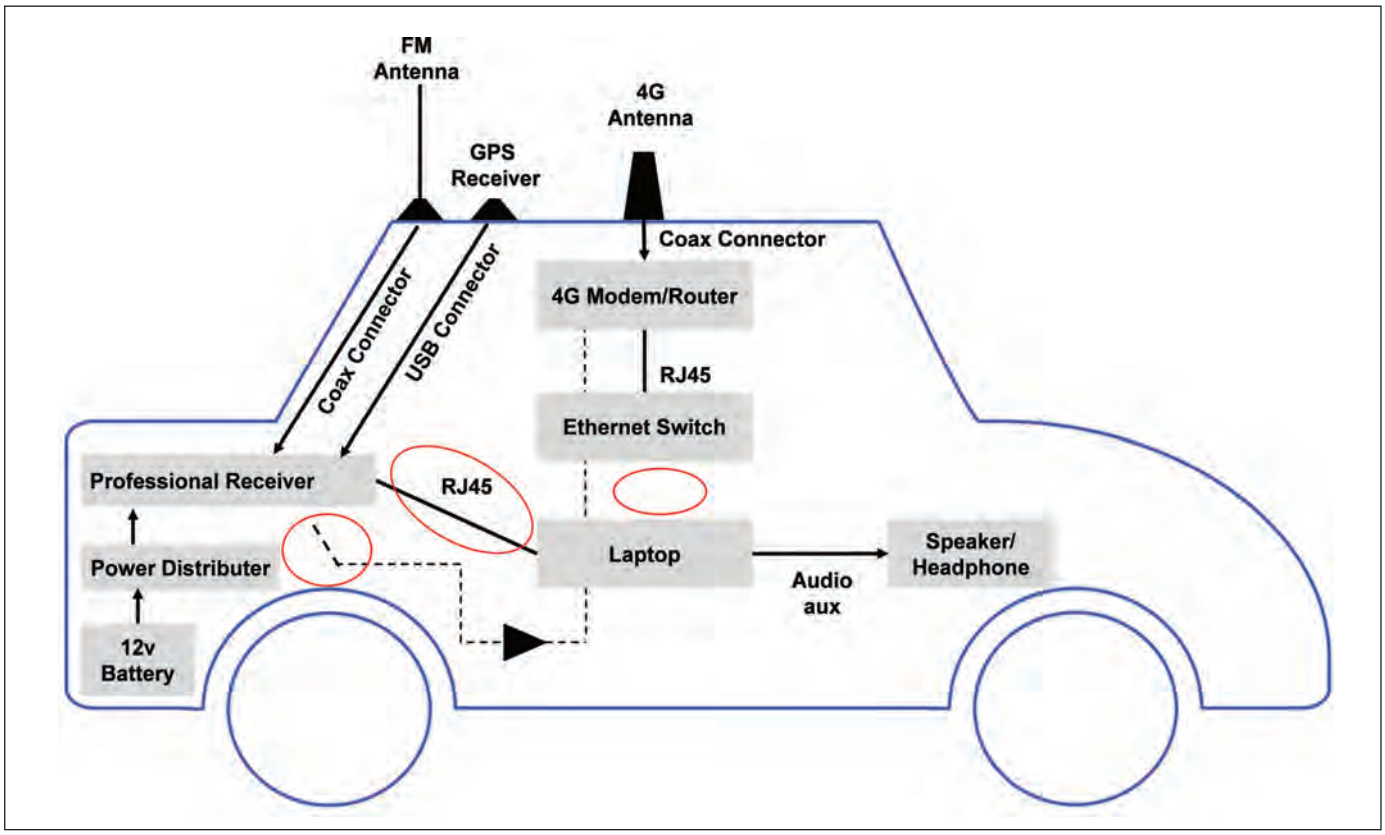


Figure 2. Receiving test setup.

The following features were introduced to the test committee and then demonstrated during the trial. On-the-road measurements were also carried out in all the cases:

- Pure Digital operation for single and multiple-DRM configurations
- Simulcast (DRM and analog FM) operation
- Multi-DRM in FM white spaces

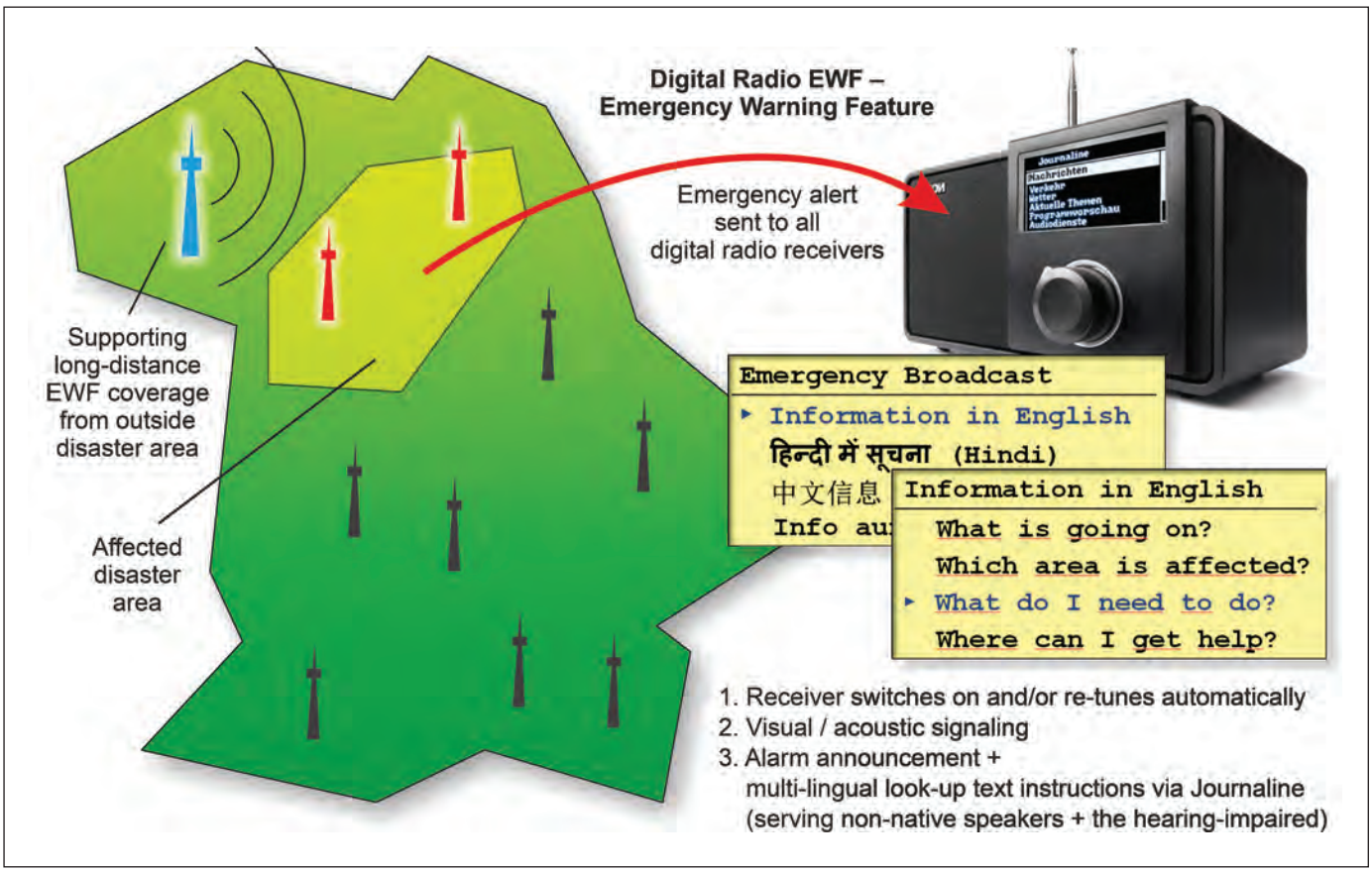
Transmitting/Receiving Setups

The transmitting setup employed is seen in Figure 1, and the receiving setup is shown in Figure 2. A measurement vehicle arranged and equipped by the DRM Consortium was fitted with the receiving set up as shown in the graphic, with a professional DRM monitoring receiver by RFmondial (RF-SE) along with the Fraunhofer DRM MultimediaPlayer Radio App at its core. This setup recorded the transmission parameters and reception signal quality.

Demonstrations Carried Out During The Test Period

The following DRM features were demonstrated:

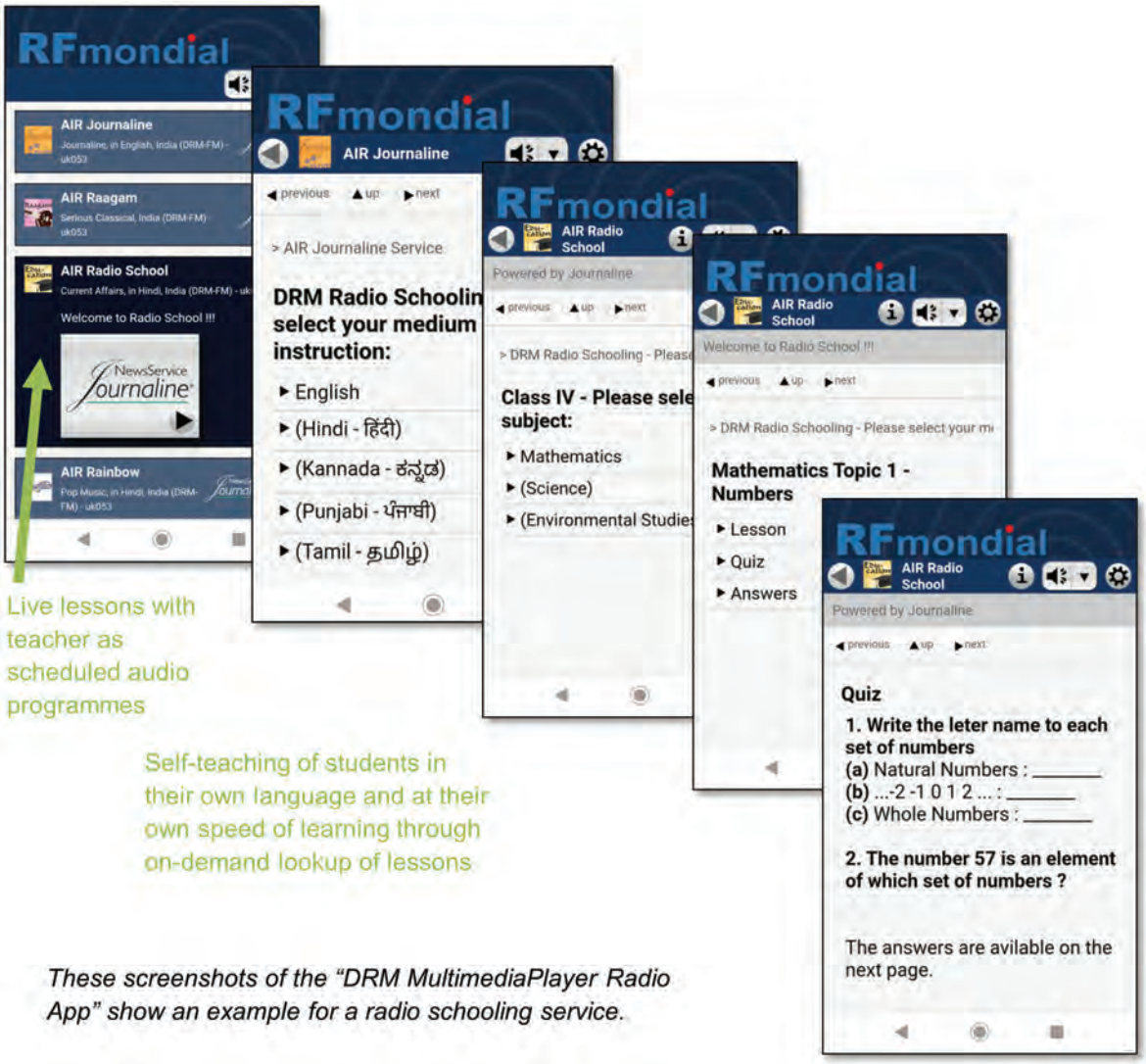
- Transmission of as many as three audio services and one multimedia service
- Service labels (Unicode) including Hindi and other official Indian scripts
- Service description indicating audio program type, language and country of origin
- Graphical station logo for every audio and data service



- DRM text messages which can accompany every audio service
- Journaline, the advanced text application of DRM digital radio services, which provides hierarchically structured information to access information on-demand without the need for Internet or mobile networks, fully based on Unicode
- DRM Online hybrid and interactivity functionality through Journaline
- Transmission of live content, illustrating that it's possible to transmit the AIR News Channel and the "Mann ki Baat" program originated from online services
- Emergency Warning Functionality (EWF), DRM's fully integrated disaster and early warning service
- 5.1 surround sound capability (5.1 surround sound services with full backward compatibility to mono/stereo-only receivers)
- Advanced applications including Radio Schooling/Distance Learning using Journaline as a core element
- Transmission/reception of traffic and travel Information along with program schedules (EPG information)
- Public signage use case based on Journaline content.
- Slide Show (transmission of a sequence of images displayed by multimedia-enabled DRM receivers
- Simulcasting of FM and DRM

Multi-DRM Operation

Six different simulcast configurations were demonstrated in Delhi from one single transmitter (18 audio and 6 data services) on 600 KHz. Multiple DRM signals (blocks) can be transmitted from a single FM transmitter. The number of individual DRM signals is only limited by the bandwidth of the transmitter. Every DRM signal can have its individual power



These screenshots of the "DRM MultimediaPlayer Radio App" show an example for a radio schooling service.

level; even gaps in the spectrum are possible. Individual SFN networks per DRM signal are also possible.

Every DRM signal can originate from an individual broadcaster, who remains in full control over both content and the on-air configuration (e.g. DRM modulation parameters and content elements).

Transmission of up to six DRM digital blocks (18 audio + 6 multimedia Journaline services) was demonstrated from the VS series Nautel transmitter, which has 600 kHz bandwidth, enabled by the RFmondial DRM modulator.

Four configurations of multi-DRM were also showcased.

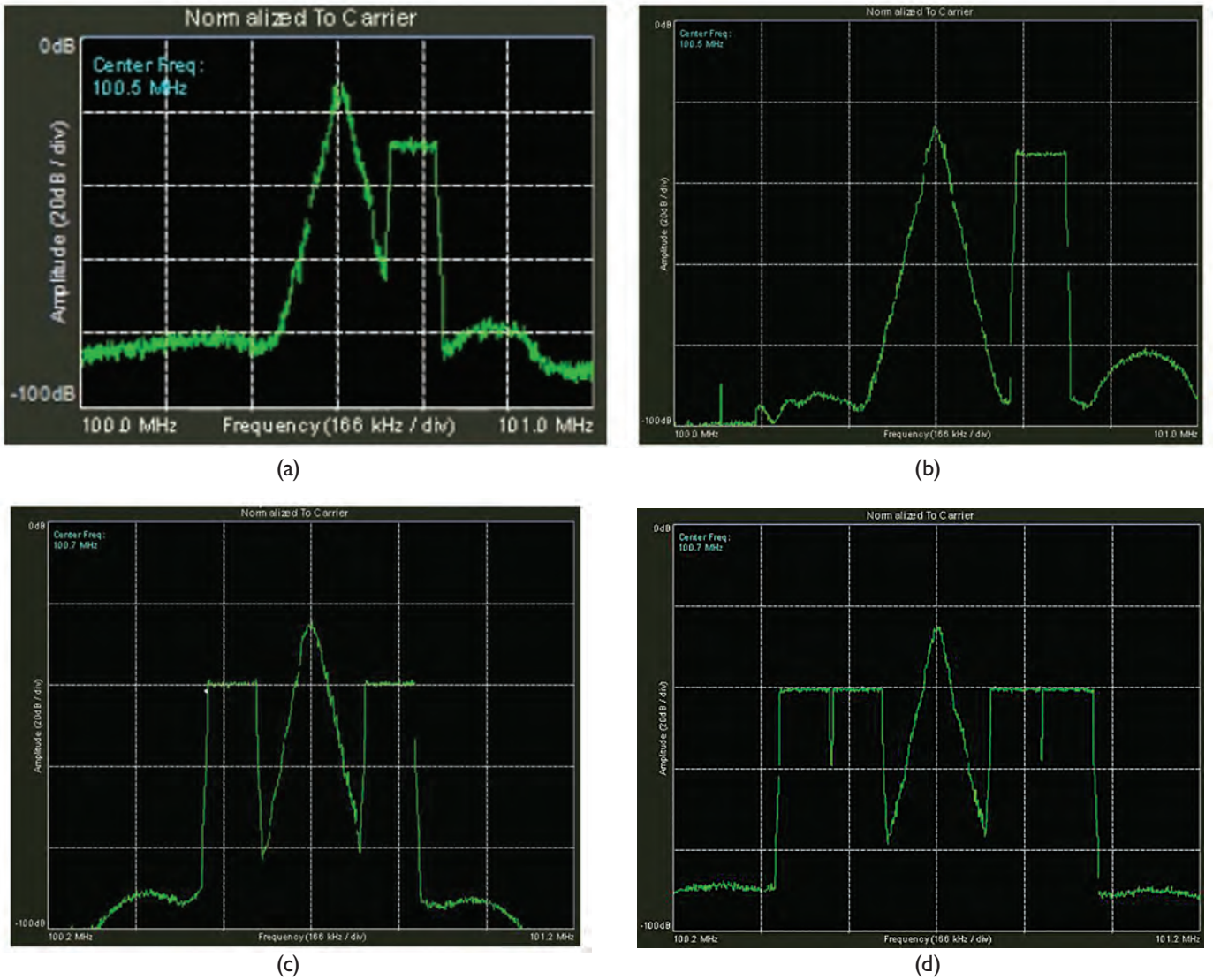
DRM In Analog-FM White Spaces

In the second test city, Jaipur, there are six private FM stations operating from a common tower with frequencies of 91.1, 93.5, 94.3, 95.0, 98.3 and 104.0 MHz. They all transmit from a shared single antenna via an FM combiner. Each analog FM signal occupies 200 kHz and 10 kW transmitters are used. There is a 600 kHz white space between the stations operating at 93.5 and 94.3 MHz, and DRM digital transmissions were carried out within this white space. The maximum configuration was five blocks which operated with the following parameters:

- Five-block multi-DRM transmission at 500 W total
- DRM Configuration: 15 audio services plus five multimedia services
- Gap to each existing analog FM signal: 50 kHz
- DRM tuning frequencies: 93.7, 93.8, 93.9, 94.0, 94.1 MHz

DRM Digital Devices Used In Demonstrations

A number of receiver manufacturers (RFmondial, Gospell, Starwaves, Mobis, Hartman) provided DRM receiver devices for this trial. These included desktop and portable radio sets, automotive line-fit head-units, automotive after-market



Single transmitter DRM/FM simulcasting configurations demonstrated in the testing.

The Mobis (Hyundai) mobile receiver used in the demonstrations.

USB-dongles employed in the DRM testing and demonstrations.

models and upgrade kits, Android-based mobile phones and Windows-based tablets, laptops and desktop computers were also incorporated into the testing and trials.

(Receivers being used for the regular AM DRM service in India were software-upgraded to receive DRM FM band services.)

Measurements Performed

Field measurements were carried out in eight directions in Delhi and two directions in Jaipur. Recording of the reception parameters were carried out by the DRM Consortium using the RFmondial professional receiver RF-SE 12 with the mobile setup previously described.

Industry-Wide Support Of Demonstrations

The trial and demos of the DRM digital radio standard were successfully completed by the DRM Consortium along with the joint collaborative effort and support of Technomedia, BECIL, Fraunhofer IIS, Nautel, NXP, RFmondial, the DRM Indian Platform, the DRM Automotive India Workgroup, the Gospell and Starwaves receiver manufacturers, and automotive Tier-1 companies Mobis (Hyundai) and Harman (Maruti-Suzuki), and all the members and supporters of the DRM Consortium. This DRM FM band demonstration proved to be an excellent example of international cooperation during Covid-19 times.

FM Band DRM Best Fit For Indian Environment

The Committee created by the Prasar Bharati reportedly has already submitted its test report, but this hasn't been made public so far. (The DRM Consortium has its own detailed measurements and data).

The demonstration of DRM services in the FM band is a feast of 'firsts' for digital radio services and features in India demonstrating:

- Ease of implementation
- Digitization without disturbing existing analog FM services
- Backward compatibility
- Existing DRM receivers can be easily firmware upgraded
- DRM capability in existing Android phones
- No additional royalties (DRM in the FM band is the same digital radio standard already used in MW and SW bands in India, so no additional IP royalties are required).
- Made in India
- Unmatched spectrum efficiency (several services form one transmitter)
- Maximum spectrum utilization
- DRM tuning frequency is within the allocated frequency band (DRM tuning frequency for each DRM signal (block) falls within the allocated frequency band in all cases, even in the multi-DRM use case).
- Additional Journaline service in multiple Indian languages
- Full compliance with regulator's (TRAI) recommendations and existing analog FM spectrum licensing
- Commercial potential (DRM in the FM band provides additional revenue streams for broadcasters)

The DRM's chairperson, Ruxandra Obreja, observed: "We hope that the expected good results will convince the Indian authorities that DRM digital radio is the right standard to extend All India Radio's already established country-wide DRM services in the AM bands also to the FM band to digitize local and regional services in future. This will allow AIR to transmit many of their national FM services from a single multi-DRM transmitter at every location. It will also allow private broadcasters to finally benefit from the innovative services and revenue potential of DRM digital radio while establishing a simple upgrade path for the automotive industry, with technology designed and made in India."

In Summary

It is now expected that the report submitted by the AIR Committee is accepted and the Indian Ministry announces the much-awaited policy recommending the full adoption of DRM, including for the FM band, for public service, as well as for private broadcasters in India.

Women In Broadcast

Hosted By Samina Husain, BTS AdCom Member

The times are improving, and now we are into the next phase of pandemic recovery with global vaccine rollouts, and gradually we are starting to see a light at the end of the pandemic tunnel. We hope to meet again at the NAB Show (Las Vegas) and the IBC show (Amsterdam), for both events BTS is putting together technical sessions with industry partners. We continue to provide the latest developments in broadcast technology and have industry experts from around the globe share their thoughts.

In this edition Evgenia Grinenko, assistant professor of the Department of Television at St. Petersburg State University of Film and Television, takes us on an inspirational path from music to education. Today her students are enthusiastic about the future of broadcast technology. Elena Puigrefagut, senior project manager, Technology and Innovation at the European Broadcast Union, takes us on her career journey, and discusses the demands for broadcasting frequencies and her efforts to ensure regulatory certainty for the broadcast industry.

I want to raise another important matter; it has come to our attention that there are a number of women in broadcast, IEEE BTS members, that are eligible for Senior Member status. As aptly said on the ieee.org site: "IEEE membership enhances every stage of your career. As an established professional the IEEE membership identifies you as superior talent. Advancing your member grade can bring added peer recognition to your accomplishments." *Please reach out via bts@ieee.org, for any questions on this matter, we are happy to provide you support.*

Broadcast Technology, Education, And Music

By Evgenia Grinenko
Assistant Professor of the Department of Television
St. Petersburg State University of Film and Television
St. Petersburg, Russia

St. Petersburg State Philharmonic Society, named after D. Shostakovich, is a concert hall with an outstanding long tradition of world-class performances. Its history goes back to 1802 when the St. Petersburg Philharmonic Society, the first one in Europe, was established. St. Petersburg State University of Film and Television was founded more than 100 years ago, and it became the first University of cinematography in Russia. Having started its way from the very beginning of cinematography, today it carries on the traditions of great forerunners and leads with the times, having the latest equipment and software at hand.

I am an assistant professor of the Department of Television at St. Petersburg State University of Film and Television, and a video director at St. Petersburg State Philharmonic Society. Music is the foundation upon which I built my career, I received my Masters degree in audiovisual technologies from the University of Film and Television, following that, I received my PhD in methods and tools of image and sound processing. During my thesis work, I combined my passion for music and broadcast technologies. My work was dedicated to multimodal audio/visual quality assessment methods while watching audio/visual programs. It was found that audio and video content interact to produce the perception and quality of experience. Music and broadcast technologies are combined in my work, and new broadcast technologies have enabled me to bring these two worlds together and bring benefit to both parties.

Making Classical Music More Readily Available

Music became an even stronger part of my professional interest when the Philharmonic Society had the idea of bringing the performance experience to classical music fans via a newly developed high-quality streaming platform. The main reasons for venturing into the development of the platform were the challenges of an aging audience and the recent distortions in the music industry. Modern audiences are focused on interactive and more personalized content.

The expectations of professional musicians regarding sound and image broadcast quality are uncompromisingly high. Not only are there technological aspects that had to be overcome, but also due to the limitations of the public Internet, it is hard to control the audio and video quality. The most critical problem is audio and video synchronization. Image and sound synchronization affects the perception of the quality of experience, especially when broadcasting classical music where the performance has always relied on orchestration. Score preparation is crucial to creating a well-prepared and excellent performance. The score reader must be able to read orchestral scores during a performance and give verbal cues to the video director who also may have musical background.

Music is not a luxury, but a fundamental human need. Since 2015, the platform has provided live streaming of four to five

performances per month. Its archives are filled with more than 200 concert recordings, which now can be watched anytime anywhere.

Further development of the online platform is for educational purposes, with pre-recorded online video lectures and meetings of famous musicians performing in the Hall of the Philharmonic Society. To implement this strategy, it was necessary to find a solution that makes it possible to create a video stream quickly with high economic efficiency.

Tapping The Cloud

Analysis of television production technologies has shown that media in the cloud should become one of the technological bases of television, especially for Internet channels for target auditory that doesn't have enough staff and equipment. At the end of January 2021, the European Broadcasting Union tested cloud-based live production technology during the Biathlon World Championships. The results were very encouraging. At the same time, it became clear that the most difficult thing is personnel training and overcoming the psychological barrier of virtualization.

Combining my two jobs and the study of new technologies of television broadcasting was a good choice. The decision was made to include the study of remote and distributed television production technologies using cloud services in the educational process at the University. Students welcomed the emergence of new technologies with enthusiasm, realizing that they will have to work with these technologies after completing their studies.

Cloud television production technologies were demonstrated in action for students. The experimental TV program was a tour around the Philharmonic Society and a conversation about music, which I led, from the Philharmonic Society, and with one of my colleagues from their home. The other participant was the director of the live stream. The director controlled the program module for broadcasting from his home computer using a remote access system. It was a truly distributed remote controlled television system using cloud technology.

In a joint project of the Philharmonic Society and the University of Film and Television, students have begun to study the latest technologies, and as a staff of the Philharmonic Society, I have the opportunity to test them in action.

The Fight for Broadcasting Frequencies Continues

By Elena Puigrefagut
Senior Project Manager, Technology & Innovation
European Broadcast Union

Just a bit more than 20 years ago I arrived to the EBU as a young engineer. I remember that day: I was the youngest in the Technology and Innovation Department (probably the department even had a different name at that time), and I was the only women engineer. But I am proud to say that today there are a few more women engineers and all are younger than me!

It has been a very positive evolution, which hopefully will continue the same as the way the terrestrial broadcasting platforms have evolved during these years. Digital Terrestrial Television (DTT) was launched in the late nineties in many European countries, and it was in 2006 when the International Telecommunication Union agreed upon the frequency plan that regulated part of the UHFspectrum and the 470-862 MHz range for DVB-T in Region 1 (Europe including Russia and all Eastern Europe, Africa and Middle East). This is the Geneva 2006 Agreement (GE06). The Agreement also regulated Band III (174-230 MHz) for DVB-T and DAB.

Digital broadcasting has allowed a much more efficient use of the spectrum than analog signals; in an 8 MHz frequency channel between four to six television programs can be distributed, depending on the DTT system variant, the video quality, the reception mode, etc. The terrestrial platform extended its offer and increased competitiveness regarding other television distribution platforms. The GE06 Agreement has also allowed the platform to evolve to DVB-T2, introduce HDTV, and eventually UHDTV, and embrace broadband on-demand content via HbbTV.

The Mobile Industry's Ever-Increasing Spectrum Appetite

However, the DTT platform has been threatened all these years by the demand for frequencies undertaken by the mobile industry. The UHF spectrum, and in particular the 470-862 MHz range, is considered as the "sweet spot," as it has the propagation characteristics that provide the good balance between coverage and antenna gain. Transmitters can provide a relatively large coverage, making the networks costs manageable, and receive devices can use a small antenna, making them quite handy.

The first discussion started in 2007, just after the frequency plan for DTT had been agreed upon. At the World Radiocommunications Conference (WRC), the 790-862 MHz range (the so-called 800 MHz band or First Digital Dividend) was allocated to the mobile service for IMT applications (4G services). However, IMT and DTT applications cannot

technically share the same spectrum; in fact the reception of the uplink signals from mobile devices at the mobile base stations gets interfered with by DTT transmitters. The consequence was the release of the band by broadcasting services, as regulators auctioned the band to mobile operators. The release obliged broadcasters in Europe to move their television services below 790 MHz. The process was managed without much disruption, as in many countries it was done in parallel to the analog television switchoff.

At the next WRC in 2012, in connection with an unexpected demand from some countries in Region 1, the 694-790 MHz range (the so-called 700 MHz band or Second Digital Dividend) was allocated to the mobile service for IMT applications (4G/5G services), although this was not effective until confirmed by WRC-15. Similarly, European broadcasters had to release these frequencies, this time reducing the DTT service in many countries, with fewer multiplexes transmitted, and fewer services available. This reduced the future potential for DTT platforms in all countries.

But the mobile industry is still demanding more spectrum, and the rest of the remaining UHF band, 470 to 694 MHz, is again in the agenda of the next WRC in 2023 for potentially additional allocation to the mobile service. This trend seems to ignore the huge public value that the use of this band by broadcasters and cultural organizations returns to society. Their use allows access to universally available free-to-air media services for all citizens, as well as enabling content production and facilitating the creative industries. Today there is no other spectrum available for them nor to their innovative services under development and implementation.

The broadcast industry has engaged with 3GPP during the last years on the development of transmission technologies to address reception of broadcast services on handheld devices, including in vehicles at high speeds. This is the LTE-Based 5G Terrestrial Broadcast ETSI Standard TS 103 720 V1.1.1 (2020-12). It is a broadcast technology that can be deployed in the 470-694 MHz band alongside DTT and the creative industry usage. At the same time investments in DTT systems continue with increased use of DVB-T2 and HEVC including consideration of distribution of UHD content.

It is crucial then to provide long-term regulatory certainty to the broadcast industry to continue innovation in the UHF band. If we want to remain vibrant and attractive terrestrial broadcasting platforms for the next 20 years, please do not make any additional changes to the spectrum allocations!

From The Editor

continued from page 4

service in our already crowded and limited broadcast spectrum. I recall a story related to me a few years ago by the chief engineer of a full-power Ch. 6 station during its pre-digital existence. It seems that the region was hit by two very severe ice storms just a short time apart, with the result being nearly complete devastation of the region's electrical and communications infrastructure. The Ch. 6 TV operation was more resilient than other area AM, FM and TV broadcasters and was able to remain on the air when all of the others were silenced by fallen towers or power lines. The station broadcast round-the-clock information about emergency services and shelters, availability of food, water, and fuel, etc. Many residents of the area were aware that they could tune the station's 88.75 MHz audio carrier on their battery and car radios, and the station served as a lifeline during the crisis.

At least one full-power Ch. 6 tried operating in a hybrid digital/analog manner, but had to shut down the analog audio carrier due to self-interference issues. However, this was several years ago, and the station operated with ATSC 1.0. If KBKF-LD can satisfactorily prove to the FCC that it is possible to operate simultaneous ATSC 3.0 digital and analog FM broadcasts within its allotted six-MHz channel, this could open up new opportunities for both low-power and full-power Ch. 6 stations to better serve their communities of license. Only time will tell.

Thanks go out to Amal Punchihewa for his report on the Asia-Pacific Institute for Broadcasting Development's 5G webinar that's appearing in this issue of **Broadcast Technology**. We also appreciate Pablo Angueira's coverage of a YP webinar hosted by his university, the report on broadcasting's environmental impact provided by the BBC's Chloe Fletcher, and the story about the establishment of a new organization (NVISA) to develop and implement advanced information service delivery via 21st century television systems from Bill Robertson.

As you may notice, Doug Lung's *RF Report* column is missing from this issue of **Broadcast Technology**, as he has been sidelined by some major surgery. Doug reports that he is on the mend now and hopes to resume delivery of his column for our next issue. We wish him all the best for a full recovery.

In closing, it is my fervent hope that the end of the pandemic is now in sight and that once again we can resume our "normal" regimen of in-person technical conferences and trade shows.

Stay well!

James O'Neal
Editor
Broadcast Technology
IEEEBTSeditor@gmail.com

DAB Radio News And Views

By Bernie O'Neill, Project Director, WorldDAB

Understanding the environmental benefits of DAB/DAB+

The European Green Deal aims to make Europe the world's first climate-neutral continent by developing and leveraging cleaner sources of energy and green technologies. Every sector of the economy has a role to play, and broadcasting is no exception. Determining the environmental impact of DAB is a key priority for many of WorldDAB's members who have conducted several recent studies investigating the environmental and economic impact of broadcasting radio via DAB/DAB+ and other platforms. These studies have produced some interesting and compelling findings.

BBC Broadcasting Energy Study

In October 2020, BBC R&D published and presented a research study examining the energy footprint of BBC radio. The research included the impact of both distribution through the transmission network and consumption via radio receivers or other devices. The research found that DAB radio services have the lowest energy consumption per device hour of any platform, and determined that in the long-run, retaining DAB and IP-only would lead to the largest energy savings. [*Refer to the article on p. 19 of this issue of* ***Broadcast Technology*** *for more information on the referenced BBC energy study.*]

Using the BBC's listening figures from 2018, the research compared the energy consumption of the BBC's

Teracom Sweden

radio stations across AM, FM, DAB, IP and DTV radio services. When looking at energy consumption levels per device per hour of listening, the research indicated that DAB radio services have the lowest energy consumption compared to other platforms, at 9 Wh/device-hour, followed by FM at 13 Wh/device-hour, IP at 23 Wh/device-hour, AM at 29 Wh/device-hour and DTV at 81 Wh/device-hour. The study also found that FM radio services use approximately 40 percent more energy per hour of listening than DAB – "mainly because of the higher power consumption of the FM transmitter network," as well as the fact that "DAB radios tend to have a lower standby power [usage]".

German/Swiss Radio Broadcasters Weigh In

In 2021, the public broadcaster for Germany's federal state of Bavaria, Bayerischer Rundfunk (BR), conducted a study comparing the energy consumption required to broadcast their five radio stations on FM and DAB+. Their key finding was that on average, transmitting a service on DAB+ required only 19 percent of the energy required for a service on FM. Their study considered the energy consumption of BR's transmitters, without considering encoding, multiplex, contribution and receivers. They found that on FM, the average consumption per radio service is 1,022 MWh per year (based on total of 5,110 MWh for five FM services). With DAB+, the average consumption per radio service is 192.5 MWh per year (total of 2,310 MWh for 12 DAB+ services).

According to Swiss public broadcaster SRG SSR, the energy consumed per station on FM in 2019 was 40 GWh, compared to 3.4 GWh on DAB+. After the FM switchoff, the total energy consumption for broadcast radio distribution via DAB+ will be less than 10 percent of what it was for FM.

EBU Transmission Costs Study

An important analysis was carried out by The European Broadcasting Union in 2017 when they compared the distribution cost of FM and DAB broadcasts in the five biggest markets in the EU28.

According to their analysis, the operational expenditure of a national radio station on FM, which is absorbed entirely by a single radio station, is equivalent to 5.8M$ (€4.8M), where the cost of the equivalent DAB network (11M$ /€9.1M) is shared across the different radio stations populating the multiplex, typically up to about 18 different stations (600k$ / €500k per station).

The EBU analysis also states that although broadband has a variable cost that depends on the listening time and the population reach it sustains, it proves to be an expensive technology for distribution and not capable of competing with DAB.

The EBU analysis concludes that FM is the most expensive distribution platform, and that a transition to DAB would indisputably lower the budget required for distribution, permitting greater investment in content production and employment.

Comparing FM, DAB+ And IP

UK network operator Arqiva published a research study in 2019 comparing the cost of radio distribution using three different transmission platforms: FM, DAB+ and IP. Three different scenarios were laid out to compare the three distribution channels, considering differences in gigabyte-shifted pricing—ranging from £0.02 (€0.023) to £0.04 (€0.046)—as well as different levels of reach, which ranged from five percent to seven percent. The study concluded that FM is the most expensive distribution channel, at £0.00105 per hour, followed by IP, which cost £0.00047 per hour of distribution. DAB+ was deemed to be the most affordable means of distribution, at £0.00033 per hour. The study also found that the reduction in transmitter cost from ceasing dual broadcasting, as well as the reduction in energy costs from digital transmitters over analog, has a net benefit, with an NPV (net present value) of more than £200 million.

Additional details on all these studies and more can be found at *www.worlddab.org/resources/factsheets*.

ITU Report

By David Guerra Pereda, BTS Member

A Rather Different Radio Communication Service

In the ITU-R there is a service with a status of its own. It is a radio service, but as long as the communication remains unidirectional, it will not become a radiocommunication service. This service is responsible for many of the most fundamental advances—not the least of which is the Big Bang Theory—made in the past six decades in order to understand the universe, and it is expected to provide further knowledge about it in the future and, on the way, about radiocommunication technologies.

Radio astronomy is the subfield of astronomy that studies the universe by means of its radio frequency signatures. The discovery of cosmic radio waves, and consequently the starting spark of radio astronomy, was originally a by-product of noise measurements for telecommunication systems. As radio astronomy is based on the exploration of the weak radiations from the "deep universe" by means of extremely large and high-gain antennas and arrays—the so-called radio telescopes—or, in the case of the SETI project, on the transmission of signals that are intended to reach that universe, the success of the Radio Astronomy Service (RAS) depends on the avoidance of harmful interference. The ITU Recommendation ITU-R RA.1031-2 – *Protection of the radio astronomy service in frequency*, clearly poses the problem: the natural emissions that are of interest to RAS have much lower power levels than the other radio services with which RAS share allocated frequency bands. By the way, due to the high-gain and low-beamwidth antennas of RAS, frequency sharing is generally impossible for transmitters within direct line-of-sight.

The Radio Regulations of the ITU-R define interference as being detrimental to RAS if it increases measurement uncertainty by 10 percent. As it is considered in Recommendation ITU-R RA.769-2 – *Protection criteria used for radio astronomical measurements*, most detrimental interference is received through the side lobes of the telescope and, apart from the local sources, it comes from spacecraft, both geostationary and non-geostationary satellites, and from terrestrial transmissions reflected by the Moon, by aircraft, and possibly by artificial satellites. As a consequence, even though the RAS sites are carefully chosen, local protection cannot avoid these causes of interference, but a certain degree of protection can be achieved by appropriate frequency assignments. On the other hand, at the local level, radiocommunication services on adjacent bands can cause detrimental interference. These include mobile communications, Wi-Fi, television and radio broadcast transmitters, and earth stations used for space radiocommunications. Other electrical equipment, such as the one used by motorized traffic, can also be a source of detrimental interference.

In order to reduce interference detrimental to the RAS, the ITU-R recommends that all practical technical means should be adopted to avoid out-of-band emissions and to limit the edge of the necessary band adjacent to the RAS bands. In addition, the establishment of coordination zones around radio astronomy sites is also recommended, following the methodology of Rec. ITU-R RA.1031-2. Precisely, some radio telescopes around the world are surrounded by a so-called radio quiet zone (RQZ) that is usually enforced by regulations of the corresponding national government. For instance, in Europe, of the roughly 40 observatories accounted for by IUCAF (the Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science) only 10 are protected by a RQZ supported by national regulations. In an RQZ, often two types of zones are defined: an exclusion zone within at least one-km radius of the radio telescope, where all types of radio emissions are prohibited—even domestic Wi-Fi and microwave ovens—and where there may be severe restrictions on motorized traffic and on any type of electronic equipment, and a larger zone with a radius as great as several hundreds of kilometers where the power levels of radio emissions are limited. The specific radii depend on the probability of the mentioned sources of interference becoming detrimental to a specific radio telescope.

Radio Astronomy Protected Areas Are Numerous

The first largest RQZ around the world, with a rectangular area of 33,000 km^2, was established in 1958 by the FCC in the region of West Virginia and Maryland to provide protection to two radio astronomy facilities: the Sugar Grove Station and the Green Bank Observatory. Since 2007—although the regulations restricting radio transmissions will not come fully into effect until the end of 2021—the largest RQZ is located in South Africa in the Karoo Central Astronomy Area that includes an outer area of more than 100,000 km^2 and an inner area or exclusion zone of around 134 km^2. Other RQZ around the world can be found in Chile (the Atacama Large Millimeter Array), Brazil (the Itapetinga Radio Observatory), Australia (the Murchison Radio-astronomy Observatory), Canada (the

Dominion Radio Astrophysical Observatory, China (the Five Hundred Meter Aperture Spherical Telescope), Russia (the Pushchino Radio Astronomy Observatory), Mexico (the Large Millimeter Telescope) and Spain (the Institute for Radio Astronomy), to mention a few. Rather interestingly, these places have become a destination for those who seek to find real solitude or to go off the grid. Surprisingly, the list is not limited to places on Earth. Due to their absolute lack of human-made interference, the ITU-R has recommended two special RQZs: the shielded zone on the Moon's far side, and the Sun-Earth LaGrangian point L2.

Nevertheless, the remoteness of on-Earth RQZs does not ensure protection from high-altitude platform communication systems (HAPS), aircraft and satellites without spectrum coordination actions. Even though the operators of HAPS have made substantial concessions in the levels of out-of-band emissions, the strong downlink signal of HAPS is a matter of study for the next World Radio Conference (WRC). Another WRC agenda item is the spectrum to be used by large fixed-satellite service constellations in low Earth orbit at 37–42.5 and 47–51.4 GHz, being the band at 42.5–43.5 GHz is a primary allocation of RAS. The coordination distances with 5G services are also of concern. No effort should be spared in order to extract maximum performance of the incoming new generation of radio telescopes, the largest that the world has ever seen.

Newsletter Deadlines

The BTS Newsletter welcomes contributions from its members. Please forward materials you would like included to the editor at BTSeditor@IEEE.org. *Here are our editorial deadlines for upcoming issues:*

Issue	Due Date
Quarter 4	Oct. 31, 2021
Quarter 1	Dec. 31, 2020
Quarter 2	Apr. 3, 2021
Quarter 3	June 28, 2021

AIBD Webinar Examines 5G's Opportunities/Challenges For Broadcasters

By Amal Punchihewa

The Asia-Pacific Institute for Broadcasting Development (AIBD) organized a regional webinar on 5G and the broadcasting industry, "A Decade of Innovation and Disruption: Impact on Broadcasters."

The all-virtual event took place on March 25 at 1.00 p.m. Malaysian time, and ran for two hours. It was divided into two parts, with presentations from Chetan Sharma, chief executive officer of Chetan Sharma Consulting and Darko Ratkaj, senior project manager of the European Broadcasting Union. These speakers were followed by a panel discussion with three additional panellists, Aamir Riaz, program officer at the ITU Regional Office for Asia and the Pacific; Parag Naik, co-founder and chief executive officer at India's Saankhya Labs; and Thomas Lamanauskas, a partner at the U.K.'s Envision Associates.

The webinar was intended to educate and inform the Asia-Pacific broadcast and media communities, including AIBD members, about the potential of 5G for their media and broadcast operations in terms of the opportunities and challenges that 5G will bring to broadcasters. The two presentations from Chetan and Darko were titled respectively, "5G - A Decade of Innovation & Disruption" and "5G opportunities for broadcasters," and these provided the foundation for the panel discussion.

Chetan provided a comprehensive look at technology and innovation, and their adoption and disruptions as observed by analyzing several concepts. He noted that 5G and related innovations have been happening for more than a decade now, and stressed that in order to understand innovation and disruption, it's important to understand other technology cycles are happening at the same time. He observed that "Long waves" are generally 30 to 40-year cycles that happen all the time, and this has been true for the last 250 years, with the data gleaned mainly used by economists. He stated that there are three key elements needed in understanding innovations that center around 5G and their possible disruptions. These are connected intelligence, synchronous S-curves, and

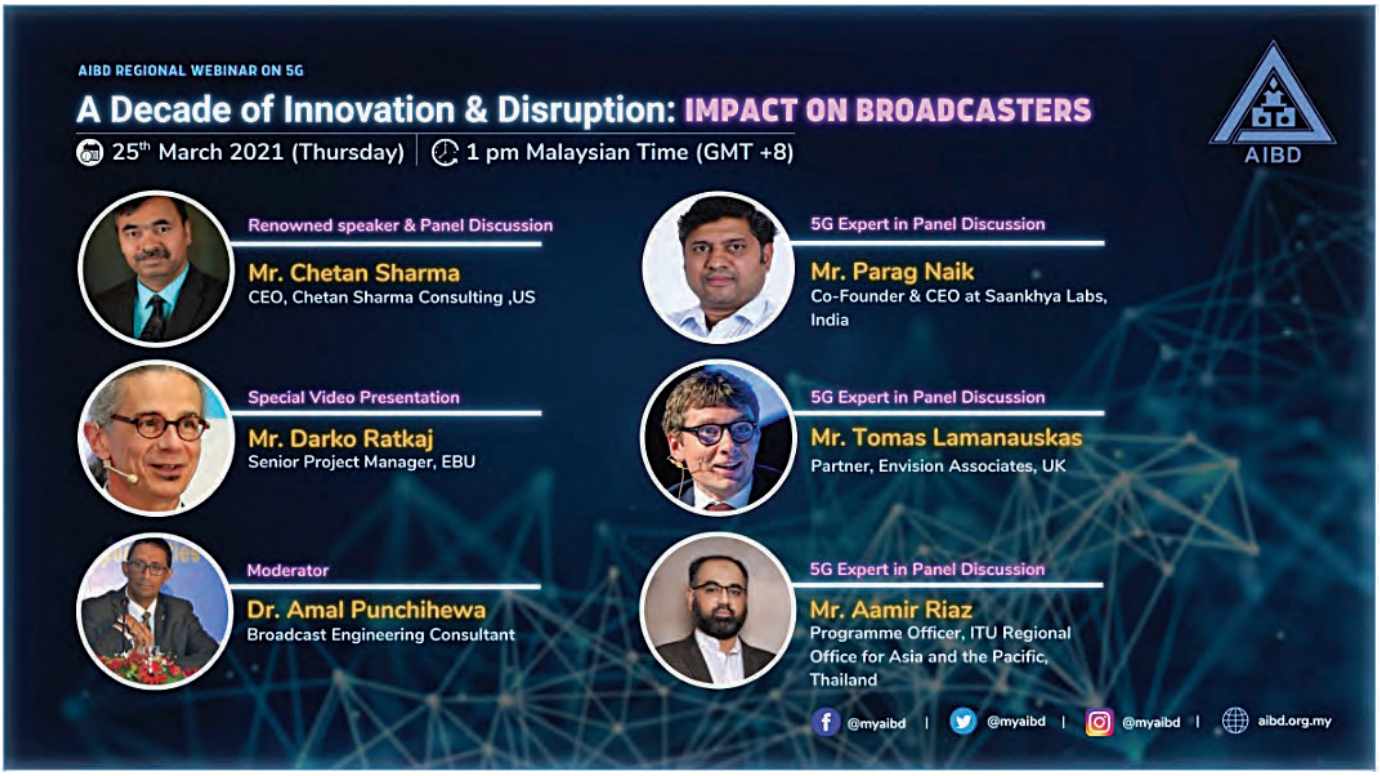


Figure 1. Presenters, moderator, and panel members of the AIBD regional 5G webinar.

the "Fourth Wave." Those three concepts help to understand and explain possible scenarios. He noted that 5G can also be seen as a platform for innovation in various industries and media is one of the dominant industries, and said that the "intelligence" means that the software and sensors that shape the global landscape and connectivity could come either from 4G (LTE) or 5G.

Cycles Follow Cycles

As explained by Chetan, the concept of a synchronous S-curve for any product follows a cycle of early adoption, growth, and then a tapering off, with a move to a new cycle. He observed that this has been true for the last 100 years in one way or another, and stated that in looking at these "S-curve" cycles for the last 100 years, it can be seen how the telephone, automobile, radio, dishwashers, microwave, and computer came into being, and the cycle has accelerated tremendously with each new decade. While it used to take 30 to 40 years for something to settle, it now only takes a few years. He observed that it's well known that cell phones really started shaping the global economy 30 years ago, but now are everywhere. He noted that in terms of 5G innovation, it's necessary to understand whether it's just the "S-curve" in action, or if it's something else going on.

Chetan proposed that it's this phenomenon of synchronous "S-curves" that's shaping various ecosystems, especially the technology ecosystem. He observed that it's important to understand that simultaneous "S-curves" influence each other's growth patterns, He mentioned that when one observes some of the patterns that took place in the Internet era, it's evident that the Internet and computer grew simultaneously. Each "S-curve" for the Internet and the computer followed the other's "S-curve."

He stated the disruption components for any cycle occur when new digital tools are introduced, notably LTE, smartphones, and the cloud, and noted that as new technology tools from 5G, AI, robotics, and blockchain have come into existence, they've brought with them new business models based on how they needed to be introduced to the ecosystem and the economy. He said that it's the combination of the synchronous "S-curves" and connected-Intelligence that shapes and transforms various industries, possibly including media and broadcast. As an example of such transformations, he observed that Uber and Airbnb emerged out of nowhere and that they transformed their respective industries.

How Broadcasting Might Tap 5G Technology

Presenter Darko noted that his organization, the EBU, carries out activities for the benefit of its membership, and among them, is an examination of several technologies, with the goal of ascertaining how they might benefit members and their operations.

Figure 2. The hosts of the webinar—Philomena Gnanapragasam, the AIBD's director, and Nabeel Tirmazi, the AIBD's program manager—are seen in the bottom row of this screenshot.

He observed that as of today, 5G can provide a physical layer for media delivery and that 5G can also technically be used to broadcast, but noted that stakeholders need to address the availability of the equipment and user adoption of the service layer. He said that currently, there are no regulatory frameworks or business models that are suitable for the distribution of media, especially public service media (PSM), as public service media in many countries comes with regulatory obligations.

Darko noted that while 5G does indeed provide opportunities to broadcasters, those opportunities will only be realized under the right conditions. Broadcasters have to realize the need to influence the developments early on in order to incorporate the necessary conditions and to work collaboratively with standardization bodies such as 3GPP and the standardization process of that organization. He observed that the industry had created a not-for-profit organization, 5G MAG, or the 5G Media Action Group, that liaises with 3GPP, which sets mobile standards.

He said that examination of 5G features, capabilities and use cases has brought about experimentation or trials, with one of the use cases that will be enabled by the technology's massive connectivity is the narrowcasting that could be carried out within a sporting or event venue or stadium. He noted that the commercial model in such a case could be a ticket that allows the spectator to enter the venue, participate in the event, and also receive content generated in connection with related productions. Darko added that such a 5G-based broadcast limited to the venue as a narrowcast could offer other value-added functionalities and features for attendees. It could be part of a premium subscription, and it could enable many different business models, as this is a very new use case generated by such massive connectivity. He said that some of the other niche markets could be eSports and gaming using multicasting and also the broadcasting community.

The key outcomes or the takeaways from the AIBD 5G webinar were creation of an awareness on how 5G can facilitate high-bitrate video services as demanded by emerging services such as UHD, the understanding that 5G can facilitate some contribution networks for broadcasting, the creation of an awareness that 5G can serve niche unicast or narrowcast services for media and entertainment such as venue-casting, especially for sports events, and also the awareness that 5G could support AR/VR immersive and interactive value-added media services.

Television, radio and new media broadcasters from the Asia-Pacific region and beyond benefited from the webinar, as it enhanced their knowledge and understanding, especially in the context of broadcasting. There were more than 100 participants on Zoom and Facebook platforms, including technologists, engineers, producers, and content creators.

In conclusion, it is felt that 5G will offer both opportunities and challenges to the broadcast industry in an increasingly connected and intelligent future, and that both mobile and broadcast industries have to work hard collaboratively to realize true benefits.

About the Author

Amal Punchihewa *is a researcher, educator, advisor and consultant in ICT, media, and broadcasting, and has nearly four decades of experience in the industry, academia, and research. He is a Chartered Professional Engineer and Fellow of IET(UK), as well as a senior member of IEEE and a BTS Distinguished Lecturer. He is also a AIBD consultant and an advisor.*

Figure 3. AIBD 5G webinar panellists discuss the opportunities and challenges of 5G in broadcasting.

University Of The Basque Country Hosts YP Webinar

By Pablo Angueira
Communication Engineering Department
Bilbao Faculty of Engineering
University of the Basque Country

Spain's University of the Basque Country hosted an April 12 webinar, "*Broadcasting: the past and the future in a connected world,*" which was organized by the Young Professionals (YP) committee and the Spanish Chapter of the IEEE Broadcast Technology Society. The event focused on recent advances in the broadcast industry and featured two main players in the broadcast standards arena, the ATSC's president, Madeleine Noland, and the former executive director of the DVB Project, Peter Siebert.

Madeliene Noland

Peter Siebert

The presenters noted that television broadcasting began more than ninety years ago, and has become the preferred medium for media entertainment in the home. They observed that broadcasting engineers in this field have faced some rather daunting challenges in satisfying growing television audience demands, with the broadcasting industry fostering may cutting-edge communication systems technologies during its evolution, including video coding and wireless transmission.

The presenters emphasized that standardization is a necessary precondition for the success of any technology that is reliant on interoperability among multiple diverse systems, stating that without such specifications, today's broadcast and consumer technology industries would not be possible. They also noted that standards development organizations (SDOs) have had to stay ahead of marketplace needs, as the world has advanced from black and white to color, from analog to digital broadcasting, and now includes mobile devices, streaming services, 5G and more.

Broadcasting: A Constantly Evolving Platform

Noland and Siebert observed that broadcasting must continue to move forward to meet the changing landscape, with a focus on how media will be consumed in the future, and also on systems for delivering information and entertainment to the consumer. They examined delivery by terrestrial broadcasting, satellite and cable, and looked at the way these delivery modalities have to evolve to bring the greatest value to businesses and consumers alike and that SDOs have an important place in this transformation.

The April YP webinar was organized as a hybrid on-line and in-person event.

The webinar stressed the importance of the standardization process in an international and connected landscape, as well as the contributions of broadcasting to the data/media delivery in current affairs, the role of terrestrial broadcasting in a mobile, on-demand world, and the future prospective of broadcasting. Attendees also learned about the relevance of standards for the industry and were provided with insights on standards development.

This IEEE BTS YP webinar was treated as a special class within the normal lecture schedule of third-year students working towards a telecommunications engineering degree program. It was a hybrid event, with the presenters connected remotely. More than 50 students attended and participated in conversations that highlighted technological challenges and benefits, technology applications, market demands and standardization, and the event was termed a great success.

If you are interested in hosting a similar event at your college or university, or are able to provide an expert-level presentation for a student group, please contact BTS's YP committee or the BTS staff.

Upcoming Events

of Interest to BTS Members

- **Oct. 9–13, 2021** – NAB Show and Exhibition; Las Vegas Convention Center, Las Vegas, Nevada
- **Oct. 9–13, 2021** – NAB Radio Show (this year co-located with the NAB Show and Exhibition in Las Vegas
- **Oct. 21–23, 2021** – Broadcast India Show; Bombay Exhibition Center, Mumbai, India
- **Nov. 8–11, 2021** – AfricaCom; Cape Town International Convention Centre, Cape Town, South Africa (*the AfricaCom website now indicates this is a virtual event*)
- **Dec. 3–6, 2021** – IBC 2021 Conference and Exhibition; *RAI*, Amsterdam, Netherlands (*note: this date has been rescheduled from the original September timeframe*)
- **Jan. 5–8, 2022** – CES Show and Exhibition; Las Vegas Convention Center, Las Vegas, Nevada (*the show's website now describes it as a hybrid in-person/digital event*)
- **May 20–22, 2022** – Dayton Hamvention 2022; Greene County Fairgrounds and Expo Center, Xenia, Ohio

(IMPORTANT NOTE: Due to the on-going global pandemic; all of the event dates and locations listed above are subject to change with little notice, with many events being cancelled, rescheduled or postponed. When making plans to attend any of these trade shows, conferences, or meetings, always confirm details with event organizers first.)

If you have information on broadcast-related events that may be of interest to other Broadcast Technology Society members, please submit them at least three months in advance to the Broadcast Technology editor at BTSeditor@ieee.org.

What's New

Broadcast Technology presents new product releases from broadcast equipment manufacturers

Wireless Link Receiver Conversion Interface

Zaxcom has announced a new offering in its lineup of digital recording equipment. When paired with the company's MRX414 or MRX214 module, the newly available RX-4 interface module creates a standalone receiver, providing coverage of either UHF spectrum bloc 20-23 or 23-26, depending on the option selected.

The RX-4 features dual-track-tuned frontend filtering with a 44 MHz tuning range, an internal passive filter to eliminate problems with overloading and interference from walkie-talkies and mobile phones. The device also incorporates an encryption system to provide highly secure "hard wired-like" communications. In addition, it includes dual OLED displays for monitoring data from as many as four associated transmitters.

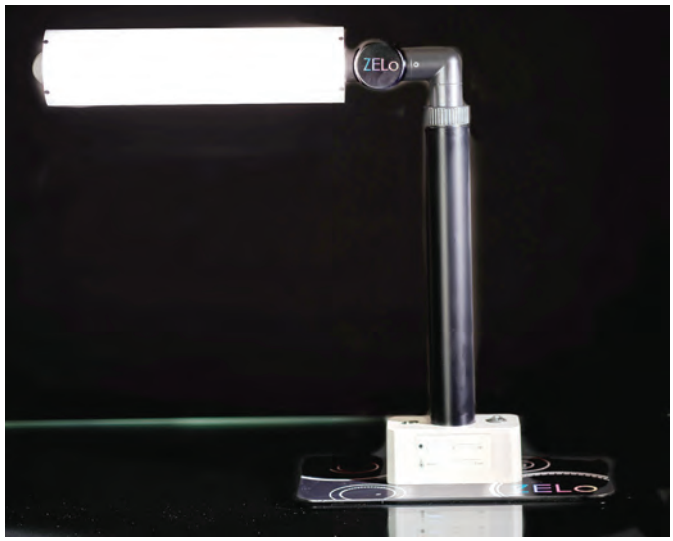
For additional information, please visit Zaxcom at *www.zaxcom.com*.

Desktop Studio Light

Brightline's new Zelo LED desktop studio lighting device was designed to meet the needs of those involved in the ever-expanding videoconferencing arena, including distributed broadcasting of news blocks and other programming from the homes of on-air talent, remote education, social media video preparation, new product showcase videos, sales meetings, and any other video application requiring the sort of professional lighting needed for enhanced production values.

The desktop instrument features variable color temperature adjustment to allow the illumination produced to blend with any ambient room light, built-in controls for varying brightness and color temperature, as well as a free application that allows adjustments to made via iOS and Android portable devices. The Zelo fixture also supports voice control through Alexa and Google Assistant Devices.

For additional information, please visit Brightline at *www.brightlines.com*.



Playout Server Newsroom Support

Playbox Neo has announced that its ProductionAirBox Neo-20 broadcast playout server product now supports the Octpus Newsroom computer system. The new MOS protocol bridge between the two systems allows character generation and manipulation of graphics and archival content to be performed directly from the Neo-20's graphic interface. The linking of the two products provides increased versatility and flexibility of operations, as the server incorporates a number of features specifically tailored to live production, including the ability to trim or reposition clips seamlessly and on the fly. Content manipulation is performed with the near-zero latency needed for news operations.

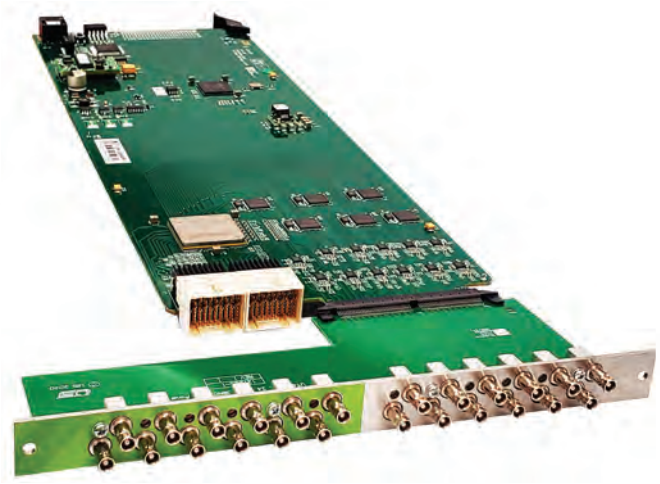
The server accommodates up to four independent users and handles as many as 16 channels of audio for multichannel/multilingual broadcast applications. It also allows mixing of multiple video resolutions in a single playlist and supports a variety of compression standards and media containers.

For additional information, please visit Playbox Neo at *www.playboxneo.com*.

Multiviewer Interface

Utah Scientific's MV-Link is designed to interface one of the company's router products to the user's choice of multiviewer. The device does not reduce capacity, as it does not utilize primary router outputs. It's compatible with Utah Scientific 144-, 288- and 528-sized routers, and provides 3G/HD/SD-SDI signals to the multiviewer, which can be conveniently located as far away as 50 meters from the router matrix.

The MV-Link resides within the router frame and provides outputs to the user's multiviewer via an HD-BNC connector panel.



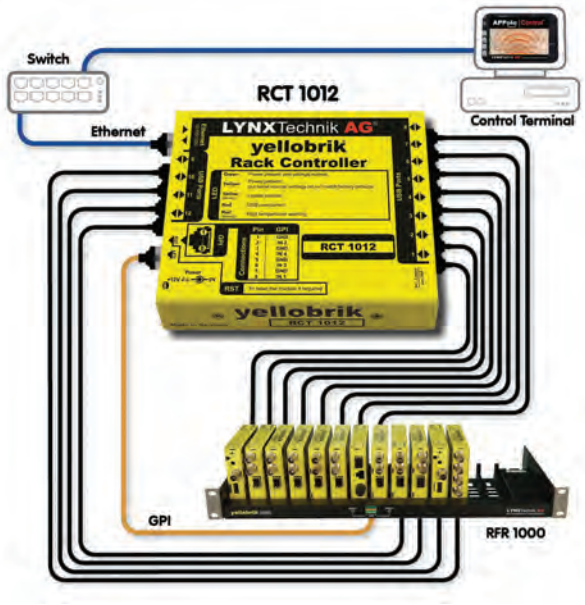
For additional information, please visit Utah Scientific at *https://utahscientific.com*.

System Control/Configuration Tool

Lynx Technik's new RCT-1012 Rack Controller centralizes the control and configuring of as many as 12 of the company's yellobrik "throwdown" devices, making it easier to adjust parameters, perform setup functions and updates on the individual units. The controller occupies only a single slot in yellobrik card frames and automatically detects various USB-connected modules in the system.

Users can easily visualize and inspect the entire system of connected yellobrik IP-connected modules via an Ethernet port on the RCT-1012 device. Control and setup functions are also handled via this Ethernet connection. When installed in a yellobrik RFR 1000-1 card frame, the controller can also provide information about the frame's main and backup power supplies.

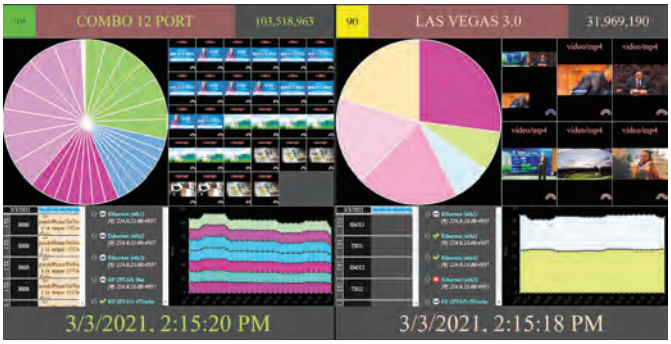
For additional information, please visit Lynx Technik at *www.lynx-technik.com*.



NextGen TV Monitoring/Analytics

Triveni Digital is now offering a newly enhanced version of its StreamScope XM analyzer that's optimized for monitoring of multiple ATSC 1.0 and 3.0 signals through the use of an integral DekTec PCIe 12-port receiver card. In addition to the 1.0 and 3.0 signals, the analyzer supports monitoring of cable TV system QAM sources. Demodulation of all inputs occurs simultaneously, providing users with real-time information on the health of their signals.

The multiple source/multiple signal capability of the instrument allows future-proof operations as broadcasters migrate from ATSC 1.0 to 3.0 operations.



For additional information, please visit Triveni Digital at *www.trivenidigital.com*.

MAM Platform Enhancement

Primestream has announced the addition of enhanced ingest access capabilities for its Xchange media asset management (MAM) platform. With the new feature, the system is now able to access and log "growing files" from live feeds as the content is being recorded, thus providing increased

efficiency in news and sports broadcast operations. Prior to the development of this new feature, live content producers have had to wait for the entire program to be ingested before accessing and logging of desired content could take place. The enhancement now allows users to initiate rough-cut editing in real time while content capture take place.

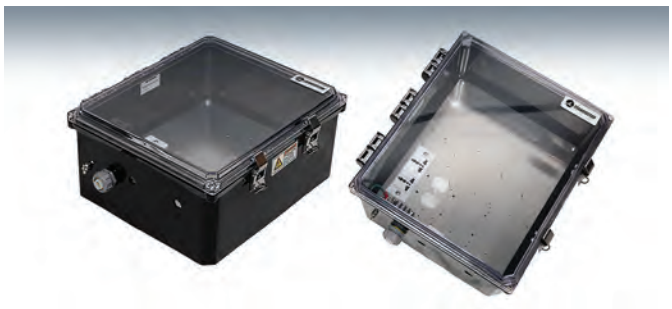
The enhancement operates in both SDI- and IP-based settings, with playback of the clip to air possible while the live event is being captured, adding color and immediacy to the live broadcast.

For additional information, please visit Primestream at *www.primestream.com*.

Polycarbonate Equipment Enclosure

Transtector's new NEMA-rated series of polycarbonate equipment enclosures provide both protection from the elements and from tampering by unauthorized persons. They're constructed with a transparent cover that facilitates identification of devices to visually inspect them without the need for opening enclosures, and include user-installable wall mounting brackets.

The enclosures are available in 14 x 12 x6-inch and 18 x 16 x 10-inch sizes, and feature a fully gasketed lid for protection in unvented and vented configurations. They're available with either blue or grey body color options and include a stainless-steel latch with a padlock eye.



For additional information, please visit Transtector at *www.transtector.com*.

Wireless Microphones

Sony Electronics has announced the arrival of two new wireless microphones designed to provide high-quality audio with low noise for content creators desiring to "cut the cord." The ECM-W2BT is a multi-interface shoe-compatible device, and the ECM-LV1 is a lavalier style mic providing stereo pickup.

The ECM-LV1 includes a windscreen for enhanced noise reduction, as well as a 360-degree rotatable clip. The ECM-W2BT is equipped with a Link lamp to provide information of the communication status between mic and receiver, along with a Power lamp to check battery charge status. The ECM-W2BT also includes a connector protection holder which can be used as a microphone stand for interviews or other stationary applications.

For additional information, please visit Sony Electronics at *www.sony.com*.

NAS Upgrade

Pronology has announced a new addition to its line of storage systems with the introduction of an updated rNAS.m4 network attached storage (NAS) solution combined with a new rTB Thunderbolt 3 interface appliance. The system was especially designed to meet the requirements of the ever-increasing remote production of content, and is optimized to read and write concurrent media streams while presenting a compact form factor.

The system is rack-mountable and features hot-swappable drives. It's quiet in operation and is available with either hard or soft customized carrying cases to provide safe transportation to and from location shooting.

For additional information, please visit Pronology at *www.pronology.com*.

HDMI Switching Matrices

RTI is now offering new HDMI 2.0 video switching matrices that are fully integrated with the company's control system. The VX44-18G-Kit, VX88-18G matrices and accompanying VRX70-18G receiver products support the HDBaseT 18Gbps standard to deliver 4K 60 Hz 4:4:4 UHD video at distances of more than 200 feet (60 meters). The devices are HDCP 2.2 compliant and also support all known HDMI audio formats, including Dolby Atmos, Dolby Digital Plus, Dolby TrueHD, and DTS-HD Master Audio.

The VX44-18G and VX88-18G provide four and eight inputs respectively, each of which can be routed to the same number of HDBase T outputs. The also include HDMI reclocking, provide video down-conversion to accommodate lower-resolution monitors, and a web browser interface to facilitate operations.

For additional information, please visit RTI at *www.rticorp.com*.

Low Voltage Power Supplies

TV One has simplified and decluttered the powering of multiple devices requiring low voltage DC inputs. The ONErack Spider eliminates the need for multiple "wall wart" plug-in supplies by providing a reliable source of power in a mix of seven different voltages: 5v, 7.5v, 9v, 12v, 13.5v, 18v, and 24v.

The device is available in either a 1RU half-rack wide version with a seven-module capacity, or a rear strip rack version with a 23-module capacity that can be installed in the rear or the side of equipment cabinets. It's Underwriter Laboratories compliant and incorporates surge and overload protections.

For additional information, please visit TV One at *www.tvone.com*.

Dante Audio Interface

For-A has announced the availability of a new Dante audio interface for its model FA-9600 multipurpose signal processing system. This FA 96DNT option supports as many as 32 Dante audio input/output channels, and includes mapping of individual channels, with gain and output level adjustments for each of the channels. With the addition of the FA-96DNT, the signal processor is able to perform interconversion among Dante, AES, HDMI and SDI embedded audio sources.

The interface is equipped with dual RJ45 ports for daisy-chaining of units or to provide redundancy in operation. When used in a redundant configuration, automatic switchover to the backup unit is accomplished if a failure is detected on the primary line.

For additional information, please visit For-A at *www.for-a.com*.

PoE-Capable KVM Devices

Black Box has announced two additions to its Emerald line of KVM signal switching and extension products that incorporate power over Ethernet capability. The new Emerald PE transmitters and receivers, and the new ZeroU Display Port transmitter are equipped with PoE powering options,

allowing operating power to be delivered via CAT-type cables, and in cases where conventional power supplies are being used, to provide a redundant power source should these normal sources of power fail.

Powering via PoE also allows users to relocate heat-producing and sometimes noisy power supplies away from operating positions to a central location, and also to provide better access to these power sources by maintenance personnel.

For additional information, please visit Black Box at *www.blackbox.com*.

IP Workflow Cameras

Marshall Electronics' of 4K PTZ cameras are designed to help improve IP-based workflows, with the CV630-IP (pictured) providing 4K30 resolution and the CV730-IPoffering 4K60 capability. Both incorporate 30x optical zoom and professional grade image sensors.

The CV630-IP is available in a 3GSDI/HDMI version (the CV630) and also with NDI|HX, the CV630-NDI.

The CV730-IP, which is equipped with a larger 1-1/8-inch sensor, is also available in SDI and NDI|HX configurations as well.

For additional information, please visit Marshall Electronics at *www.marshall-usa.com*.

Visit the BTS Resource Center

BTS PULSE Events Now Available for download

IEEE Broadcast Technology Society now offers a comprehensive on line Resource Center, providing a single location to access all available virtual content. The Resource Center is located on the home page of the BTS website, *resourcecenter.bts.ieee.org*. New content is added everyday.

The Resource Center houses the following virtual products by top industry experts, educators, innovators and influencer's;

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Calling all Chapter Chairs

The IEEE Broadcast Technology is interested in your chapter activities, but have you ever wondered how to write a chapter report. Below are some directions that can help you get your chapter noticed.

Information for submitting Chapter Reports:

• Chapter Reports ideally should run approximately 200 to 500 words. (If a really newsworthy or unusual event is being described, we can accept slightly longer Reports, but nothing greater than 800 words.) We are looking for a summary of the event program or presentation. Please keep Reports straightforward and focused on the event. When someone is mentioned in a Report, it is very important that we receive the person's full name, title or position, organization they are affiliated with, and their connection with the story.

- Please identify all recognizable persons in your photos. We need their names, with title or position and affiliation. (Example: Mr. John Smith, vice president of consumer electronics production, Ajax Corporation.) If there is more than one person in a photo, please clearly identify everyone from left-to-right; please do not assume that we know persons depicted and will be able to fill in this blanks.

•This need for complete identification also applies to place and building names. Please make sure to provide the complete location of the event. (Don't just say the meeting took place in Smith Hall, as readers will likely not know that Smith Hall of part of the School of Engineering at Jones University.) Provide complete information about meeting venues.

• Very important—submit your Report as a straight Word file with no embedded logos, pictures, etc. Please do not send PDFs.

• Pictures are a very important part of every Report; however, they need to be good quality and tell a story; i.e., if a presentation is made at your meeting, your photograph should show the presenter standing at a podium, or at a chalkboard, etc. Group photographs are nice, but we really need at least one good photo of the lecturer making his/her presentation. Image size is very important too. An image that is acceptable on a Website is not necessarily large enough for publication in a printed magazine. Images must be at least 250 kb in size (one to two MB preferred). These must be sent as .jpg file attachments—no PDF— and PLEASE DO NOT EMBED IMAGES IN REPORTS.

• Please include answers to all of the following questions in your first paragraph: **Who** was involved? **What** happened? **Where** did it take place? **When** did it happen? **Why** (what was the reason?). Further, if the event you are describing was facilitated by an institution (university, company, etc.) that provided a meeting room, refreshments, etc.. Please include this information in every Report.

• Also, when submitting a Report, please provide complete identification about yourself, including your title or position and the name of the organization that you are affiliated with.

• Lastly, Reports must be timely. They need to be received by the **Broadcast Technology** staff no later than two to three weeks after the meeting or event took place.

If these items are not received in the required order, the Editorial Assistant will contact you for a revision. The **Broadcast Technology** editorial staff thanks you for your cooperation. We look forward to receiving and publishing your Reports. If you have any questions please send an email to btseditor@ieee.org

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