Chapter 24, Inc.
Madison, Wisconsin

Society of Broadcast Engineers December 2000

Recommended Reading: Defining Vision

By Vicki W. Kipp

At the January 2000 SBE meeting, engineer Jim Edwards from Tektronix spoke to Chapter 24 about digital signal measurement. Mr. Edwards began his presentation by giving us a reading recommendation. We were advised to read *Defining Vision: The Battle for the Future of Television* by Pulitzer Prize-winning journalist Joel Brinkley. I finally followed through on Edwards' advice, and I would have to agree that *Defining Vision* is worth reading.

Defining Vision is not a technical reference. Rather, *Defining Vision* is a vivid chronological account of how the broadcast industry went from being substantially settled in the NTSC standard to shifting its resources to a new and complex technology called digital television. *Defining Vision* was entertaining and not overly complex (all of the technical history, none of the math.)

Defining Vision offers a chronology of events from 1986 to 1997. The cast of players is so numerous that you almost need a chart to keep track of whom is aligned with which government office, special interest, or engineering group. Although the book focused on recent years, Brinkley also recounts the history of the big American broadcast equipment developers and the drama of the conversion from 'black and white' to 'color' television. You'll learn the history of such early great manufacturers as RCA, Zenith, NHK's MUSE, and more recent developers such as Digicipher (formerly Videocipher.)

What started in 1986 as a lobbyist defense to hold on to unused TV channels ended as a FCC mandated conversion from NTSC to digital television. NAB Vice President Dan Abel is called the "father of HDTV" because of a political maneuver he executed in 1986 when mobile communications (land mobile) companies tried to snap up unused TV channels for land mobile use. Broadcasters did not want to give up those unused channels, so Abel

(continued on page 4)

Next Meeting:

Wednesday, December 20, 2000

Vertical Blanking Interval Systems Demonstration

Pizza and Soda at 6:00 PM

at WPT-TOC 3319 W. Beltline Hwy

Meeting and Program at 7:00 PM at WPT-TOC

In This Issue:

DTV For The Holidays

By Paul Stoffel

I mixed work with pleasure this past Thanksgiving holiday when I went home to the West Bend area. Knowing that WMVS-DT (Milwaukee Public Television) was operating their DTV Channel 8, I decided to load up my van with WHA's Panasonic DTV set-top receiver and companion D-VHS deck. My goal was to get a recording of PBS's DTV primetime programming that included three different examples of delivery: multicasting, SD widescreen, and HDTV. WMVS-DT recently returned to full power (25.1 KW) after making an antenna pattern change to reduce interference to an NTSC (Ch. 8) station in Grand Rapids, Michigan, according to Jan Pritzl, WMVS Engineering.

The Receive Antenna

For my experiment, I used an available Channel Master CHANNEL KING antenna (VHF range = 50 miles) mounted atop a 30-foot tower. The off-air antenna (with no rotor) was already pointed south toward television stations in the Milwaukee market. The coaxial cable from the antenna went to a two-way RF splitter that fed both a regular NTSC television and my DTV set-top box.

In the NTSC world, we all know that a receive antenna aimed in the direction of the transmitting antenna provides for the best signal. The same is especially true for ATSC digital TV reception. As an example, Pritzl said he had his rooftop antenna originally pointed directly at the WMVS tower. Then when trying to also receive WTMJ-DT, he found he couldn't get a good signal until he slightly rotated the receive antenna a couple of degrees toward the WTMJ tower. WTMJ's tower

(continued on page 4)

CHAPTER 24 OFFICERS

CHAIR:
Kevin Ruppert (WISC-TV)
W - 271-4321
kruppert@wisctv.com

VICE-CHAIR:
Tom Smith (WHA-TV)
W - 263-2174
smithtc@vilas.uwex.edu

SECRETARY:
Vicki Kipp (ECB-TOC)
W - 264-9631
vkipp@ecb.state.wi.us

TREASURER:
Stan Scharch (WISC-TV)
W - 271-4321
sscharch@wisctv.com

COMMITTEE APPOINTEES

Program Committee:
Denise Maney 277-8001
Steve Paugh 277-5139
Fred Sperry 264-9806
Steve Zimmerman 274-1234

Membership:
Paul Stoffel
stoffel@vilas.uwex.edu

Sustaining Membership and Past-Chair:
Fred Sperry W - 264-9806
fsperry@ecb.state.wi.us

Special Events:
Vicki Kipp (ECB-TOC)
W - 264-9631
vkipp@ecb.state.wi.us

Certification and Education:
Jim Hermanson 836-8340
jmh@execpc.com
Tim Trendt (UW-Platteville)

Frequency Coordination:
Tom Smith W - 263-2174
smithtc@vilas.uwex.edu

National SBE Chapter Liaison:
Leonard Charles
W - 271-4321 FAX - 271-1709
lcharles@wisctv.com

November Business Meeting Minutes

Chapter 24 of the Society of Broadcast Engineers met on Tuesday, November 21, 2000 at WKOW-TV in Madison, Wisconsin. There were 21 members in attendance, 16 of who were certified.

Chairperson, Kevin Ruppert, called the meeting to order at 7:00 PM. Minutes of the October meeting, as published in the November newsletter, were approved as published.

Newsletter Editor, Mike Norton, reported the deadline for the next newsletter as midnight on Friday, December 1, with the folding party the following Wednesday, December 6 at WKOW-TV beginning at 5:30 PM.

Sustaining Membership coordinator, Fred Sperry, announced that Chapter 24 remains at 23 sustaining members. Video Images, CTI, Panasonic, and Belden Wire and Cable recently renewed their membership. Fred welcomed Don Heinzen, a new sales representative with Belden Wire and Cable, a new sustaining member in our Chapter. Don's background is in data communications. He will be working with clients in Southern Wisconsin.

Program Committee, Denise Maney, announced that the guest speakers for the December 20th meeting will be Dan Maney and Mike Norton. Mike will present on the topic of the Vertical Blanking Interval (VBI). Dan will give a demonstration of remote control using the Vertical Interval to transmit data. Meeting attendees will be treated to free pizza and soda. The meeting location is the TOC, in the Wisconsin Public Broadcasting Building on the West Beltline Highway.

Certification, Jim Hermanson, reported that one person tested during the exam period that just ended. He announced that the next local exam period will be February 9 – 19, with the application due by December 31, 2000. Jim is working with others to coordinate a CBNT Course and Exam Session. He needs to know how many people would like to participate in this course so he can make plans. If you would be interested in taking the one-day CBNT course and exam, please email or phone Jim Hermanson at WISC-Channel 3.

Frequency Coordinator, Tom Smith, gave a frequency coordination update. Tom expressed the great need for a 7 GHz ENG Band sharing plan. He mentioned that Madison International Speedway (MIS) in Oregon has been gobbling up extra spectrum because almost every racecar on the track has its own transmitter. Frequency coordination on election night was rather slow. Tom did coordinate a wireless microphone for WTMJ from Milwaukee. Coach-Com coordination at the UW-Madison is underway. Tom informed us the 3rd Generation cellular phones (with Internet service) are trying to get the spectrum space currently occupied by Instructional Television Fixed Service (ITFS.) Other interests are creating significant

(continued on next page)

Meeting Minutes (continued)

pressure for spectrum availability. As broadcasters, we must defend our spectrum.

National Liaison, Leonard Charles, mentioned that the SBE had written a letter to FCC Commissioner W.J. "Billy" Tauzin, the Chairman of the Subcommittee on Telecommunications. The letter expressed the SBE's concern over the lack of action by the FCC on Rule Making (RM) 9418. A key goal of RM 9418 is to allow digital modulation in all of the TV BAS microwave bands. The FCC's lack of action on the Rule Making is delaying the roll out of digital television. Charles also informed Chapter 24 that Terry Baun will be giving a five-hour CBNT course followed by the exam as an Ennes program at NAB 2001.

Chairperson Kevin Ruppert would like to form a planning committee on the relocation from the 2 GHz ENG band. He suggests the committee would coordinate the transition with the Milwaukee Market and also the NAB Plan. Kevin has a group of memos regarding this topic. Please let him know if you would like to see the memos or are interested in the committee he is forming.

For Professional Announcements, Steve Zimmerman introduced the group to SBE member and WKOW broadcast engineer Anthony Poleski. Fred Sperry welcomed new member Larry Rusch, an engineer for Wisconsin Public Television at Vilas Hall, back to Chapter 24.

Under the topic of "Tech Tips", Tom Smith asked the group to recommend an inexpensive CAD software for home use. Suggestions included TurboCAD and AutoCAD Light.

Chairperson Kevin Ruppert adjourned the business meeting at 7:21 PM.

The evening's program was about the Vibrant Newsroom Editing System.

Submitted by Vicki W. Kipp, Secretary

AMATEUR RADIO NEWS

By Tom Weeden, WJ9H

After a wait of several years, the next-generation Phase 3D amateur radio satellite is in orbit. A new era in amateur radio communications was ushered in on November 16, 2000 (UTC) as the launch of the Phase 3D satellite from the European Spaceport in Kourou, French Guiana was successful, following a spectacular nighttime launch.

Although safely in orbit, there is much work to be done with Phase 3D before the satellite is opened for general amateur radio use. Initial housekeeping tasks are now underway to verify the health of the many complex systems onboard, followed by bringing these systems online.

Phase 3D (also known as AO-40, the 40th amateur radio satellite) is now in a transfer orbit used for geosynchronous satellites. To move AO-40 from this orbit the arcjet motor will burn intermittently (at perigee) over a 270-day period, with final inclination and apogee adjustments made by the spacecraft's 400 Newton motor. "When these maneuvers are completed and three-axis stabilization is achieved, the satellite solar panels will then be spread out to receive full sunlight," said AMSAT-NA President Robin Haighton, VE3FRH. "It is anticipated that at this time the satellite will be fully operational for use by amateur radio operators around the world."

Haighton said that "plans are in place to make Phase 3D available for a limited period of general amateur radio use possibly within a week or two." This provisional operation would involve "one or two bands at a time," said VE3FRH.

Currently, AO-40 is downlinking data at 50 watts on an omni-directional antenna located on the bottom of the spacecraft. Substantially more solar power will be available after AO-40 reaches its final orbit configuration and the solar panels are deployed.

(Excerpts from the AMSAT News Service)

Thanks to Denise Maney for arranging the Dutch Treat Dinner and the program for the November Meeting.

Recommended Reading (continued from page 1)

told the FCC that if available UHF-Television frequencies were given to land mobile, broadcasters would not be able to offer "HDTV as a free, over-the-air service to the nation." The premise seemed crazy at that time, but the idea caught on. After several HDTV demonstrations and much lobbying, the FCC got behind HDTV.

Once broadcast equipment manufacturers realized they had something to gain from this change, they also became intent on inventing the HDTV equipment and setting the technical standards. The race was on between AT&T, Digicipher (a late starter), MIT, NHK of Japan, Philips, Sarnoff Labs (formerly RCA), and Zenith. Initially, the movement was to "convert to high definition television," but it later changed its focus and became "convert to digital television."

Defining Vision not only helped me to understand how we as an industry got to where we are right now, but also educated me on how NTSC televisions were developed and improved through the decades. I found Brinkley's accounts about the company VideoCipher especially interesting. (Please see the related article, "Historical Perspective: HBO Implements Scrambling" contained in this newsletter on page 5.) Other captivating narratives include Zenith's last stand as the sole remaining American manufacturer of television sets, and a detailed log of what went on during the ACATS (the Advisory Committee on Advanced Television Services) Grand Alliance Testing period.

You can pick up a copy of *Defining Vision: The Battle for the Future of Television* through the South Central Library System. It was published by Hartcourt Brace & Company in 1997.

Postscript: While researching this book review, I learned that Joel Brinkley published a related book in July 1998 called *Defining Vision: How Broadcasters Tricked the Government into Inciting a Revolution in Television*. If you are going to read one of Joel Brinkley's *Defining Vision* novels, it may be beneficial to read the latter publication. It may contain additional information since it was published at a later date.

DTV For The Holidays (continued from page 1)

is located a few miles west of the WMVS tower. This compromise allowed him to successfully receive both DTV channels.

The DTV Receiver

After searching automatically for any available DTV signal, the set-top receiver found WMVS-DT. WMVS is feeding their DTV transmitter with PBS digital programming in a simple passthrough mode. Locally-inserted PSIP (program and system information protocol) branding parameters are generated in the transport stream ID-er. The PSIP information tells the set-top box to display WMVS-DT as channel 10. (Remember that WMVS's DTV carrier frequency is channel 8.)

The "10" number is known as the Major Channel Number. A major channel number is used to group all DTV services with a broadcaster's NTSC brand. Examples of DTV services are multiple SD (standard definition) programs, widescreen SD, HDTV, datacasting, interactivity and program guide generation. Any combination of these services must fit within the 19.4 Mbits/sec ATSC transport stream.

The Numbers

Earlier I mentioned multicasting. This is the ability to include more than one program within the broadcast transport stream. WMVS-DT was broadcasting four "minor" channels of SD programming. The set-top box displayed these channels as: 10-1, 10-2, 10-3 and 10-4. (Minor channel numbers specify a particular channel within a group of DTV services.) That's four channels of SD programming from one DTV transmission.

In the multicasting mode, each minor channel uses about 4.3 Mbps. For the four SD channels, the total is 17.2 Mbps, leaving 2.2 Mbps for other data.

Later in the evening, PBS switched away from the multicasting mode to a widescreen SD program. The widescreen SD was upconverted to 1080i. The next program fed by PBS was a High Definition (HD) program. In both the SD and HD delivery modes, 17.5 Mbps plus AC-3 at 384 kbps (5.1 audio when available, otherwise stereo) of the transport stream is needed. (To observe the bitrates of each elemental stream, a station's engineering department will need a transport stream analyzer.)

The *Chapter 24 Newsletter* is published monthly. Submissions of interest to the broadcast technical community are always welcome. You can e-mail your articles to: MNorton@ecb.state.wi.us

Historical Perspective: HBO Implements Scrambling

By Vicki Kipp

In 1982, Home Box Office (HBO) had a problem on their hands. HBO used satellites to distribute their programming to cable companies across the US. Cable companies would pick up HBO with a large dish, then scramble the signal and distribute it to paying cable subscribers. The subscribers, who paid $8/month (in 1982 dollars) for the privilege of receiving HBO, received a set top descrambler box for HBO. The problem was the two to three million people with backyard satellite dishes who received HBO without paying. A bigger problem yet was that hotels and other establishments in Caribbean and Latin American countries that received HBO at no cost, and then freely redistributed it. The paying customers became resentful of all the freeloaders. HBO was plagued by complaints, and knew they must take action. They decided to scramble their original signal at their head end. HBO released a Request for Proposal for a scrambling system.

VideoCipher, a division of M/A-Com, was one of sixteen companies competing for HBO's bid. VideoCipher had done digital signal encoding and decoding for military applications in the past, and it seemed only natural to use that same technology for HBO. HBO awarded the project to VideoCipher because they were the only company to suggest a digital system. VideoCipher went to work designing digital scrambler and descrambler boxes for HBO. This seemed quite simple compared to their previous work for NASA and the military. HBO was equipped with scrambling equipment. VideoCipher's descrambler box, VideoCipher I, had been sold to cable head ends across the country.

In January 1986, HBO began scrambling their signal. It didn't take long for bitter complaints to emerge from the backyard satellite dish community. HBO had not anticipated such fierce resistance to scrambling their signal. They had underestimated the independence and determination of the type of people who had bought backyard satellite dishes. Many of these people lived in remote areas where cable television was not available. Ruggedly individual Western Ranchers composed the majority of the scrambling resistance group. These people were not poor, nor were they without political representation. A complete satellite system could cost several thousand dollars in 1982 costs. These people had made a significant investment in the technology, and had high expectations for what they should receive. These were people who voted. In fact, one of the unhappy dish owners was US Senator Barry Goldwater.

The backyard dish owners weren't the only ones affected by HBO's decision to scramble their signal. The backyard dish owners were served by dish manufacturers, dealers, and service technicians. There was a programming industry that revolved around backyard dishes by offering satellite TV magazines and satellite TV talk shows. Sales of backyard satellite dishes dropped sharply as soon as HBO began scrambling. HBO was being bombarded by angry backyard satellite dish owners and angry satellite dish dealers.

HBO had quieted complaints from paying subscribers, but needed to do something to diffuse the rage of the backyard dish forum. They decided that they would relinquish HBO's signal to the backyard dish community for a price. VideoCipher was commissioned to create a consumer decoder box for people with backyard dishes. To receive HBO, the consumer would need to purchase the decoder box and pay a monthly subscriber fee. VideoCipher was experienced at making high-end devices for military, but were not accustomed to making devices where they had to be concerned with cost as well as function. The VideoCipher division of had to design a box that didn't cost more than a few hundred dollars, yet was more secure than the industrial quality device VideoCipher I. VideoCipher realized that people would try to break their system to pirate HBO's premium signal. Since cost was an issue, the engineers would have to make some compromises in their design.

Ultimately, the VideoCipher division chose to use complex scrambling just for the audio signal and not for the video signal. The video signal was also sacrificed, but a customer could restore the video just by juggling a few wires inside the box. The digital scrambling system created for the audio signal seemed bulletproof. It was embedded inside a single computer chip. VideoCipher expected that a few individuals would figure out how to correct the video. The engineers could accept that weakness because they felt that few people- aside from the steadfast sports fan - would settle for watching a picture without sound. The VideoCipher II box hit the market in April of 1986.

HBO may have thought that the VideoCipher II box would appease angry dish owners, but actually the opposite occurred. The backlash was not pretty. Dish owners were irate. They felt that their constitutional rights were being violated. To an objective person, it might seem that HBO and VideoCipher were being scorned unfairly. After all, HBO was paying for the right to air all of the programming that they sent out to their subscribers. But in the minds of the typical backyard dish owner, the signal fell from the sky onto their land and it was their signal. The anti-scrambling backlash included heated articles in satellite magazines and belligerence from satellite TV talk show hosts. When VideoCipher II boxes began appearing in all of the stores, VideoCipher became the prime target of all of this anti-scrambling anger. The hostility moved from vocal complaints to the goal of trying to crack the VideoCipher II box.

VideoCipher had its first scare when an ad appeared in magazines selling a pirate chip. It advised people to pull out the VideoCipher chip and insert the pirate chip. The results were supposed to be descrambled premium channels, but the pirate chip was a scam. It didn't work. The VideoCipher division breathed a sigh of relief. The VideoCipher division was a unit of MIT

(continued on page 6)

Historical Perspective (continued)

graduates with Ph.D.s. They didn't expect to be beaten by a hacker with a backyard satellite dish. Despite their confidence, whenever a report of a compromised VideoCipher II unit would surface, the lab would have the unit flown to their lab in San Diego so they could investigate.

Things were looking good for the VideoCipher division during the fall of 1986. Ten's of thousands of VideoCipher II boxes had been sold, and there were no confirmed cases of successful tampering. In September, the VideoCipher division was awarded an Emmy for technical excellence in its HBO project. VideoCipher had caught the eye of General Instruments (GI), and GI wanted to buy the VideoCipher division of M/A-Com. VideoCipher was agreeable and so negotiations began.

In November of 1986, VideoCipher received the phone call that they hoped would never come. A dealer in Phoenix reported that a man was selling pirated VideoCipher boxes. VideoCipher instructed the dealer to buy a pirated box, and send it in. When the pirated box arrived the next day, a technician opened it up. He saw wires hanging all over, and surmised that it must be another scam. He hooked up the input to the box and connected the box to a monitor. He realized that there was something wrong when he heard clear audio come out of the monitor. He switched through the other channels and found that all of them had descrambled signals. It was a dark moment for the VideoCipher division. The head engineer was quoted, "They've broken it. They've broken it, and we're *never* going to fix it!"

Further examination revealed that the hacker had pulled out the special VideoCipher coded chip and substituted a pirate chip. With VideoCipher's chip, an authorizing signal would be sent from VideoCipher, up to HBO's satellite, and then down to the subscriber's box once the viewer had paid for their subscription. When the authorizing signal reached the box, it would cause an electronic switch to turn off scrambling for HBO. The pirates based their chip on VideoCipher's theory of operation. The pirate chip was built so that if a viewer subscribed to any pay television service, they would receive all of the pay channels. All of the switches would turn off scrambling in the presence of one authorizing signal. The pirate chip was nicknamed the 'Three Musketeers chip' because its operating mode was one for all and all for one. The Three Musketeers chip spread like wildfire.

When cable company subscription reports revealed that Americans were suddenly intensely interested in the news, it wasn't too hard to identify the motivation. Satellite dish owners cancelled all of their premium pay services and signed up for CNN. CNN only cost $2 per month, and it activated all of the other pay services as well.

The VideoCipher division went into crisis management mode. At the plant, the chips being inserted into new VideoCipher boxes were coated with epoxy to make it impossible for people to pull out the chip. It seemed like a simple, inexpensive answer to a serious problem, but it didn't work for long. A few weeks later, satellite TV talk show hosts announced that you could remove the chip by putting the circuit board in the freezer. When the epoxy froze, it would crack, and then you could peel it off.

Even as VideoCipher figured out how to handle the Three Musketeers chip, other pirate chips were introduced. Pirates began advertising an instructional videotape for do-it-yourself VideoCipher box hacking. HBO was fed up with the situation. Adding to VideoCipher's' troubles, dealers began complaining about the lack of quality control in the VideoCipher boxes. Production had increased so rapidly that the manufacturers couldn't keep the quality level up. Even the hackers were returning defective VideoCipher boxes to dealers.

Complaints from all sides became so distressing, that Congress decided to held a hearing. VideoCipher Division President Larry Dunham testified to Congress, "As many as half the decoders on the market have been illegally modified."

During this same time period, GI's purchase of VideoCipher was finalized. By the time VideoCipher's problems became evident, the deal was too far along to be reversed. GI was concerned about the fate of their new purchase. VideoCipher's clients were still angry about the pirated chips, but they kept their business with VideoCipher.

After all of the problems with VideoCipher II, the VideoCipher division knew that they needed a recovery plan. They redirected their brightest engineers to invent a proprietary high definition system for satellite. If there were a happy ending to this story, it would be that the DigiCipher digital satellite signal compression encoding and decoding system was born out of this initiative.

Thanks to WISC-TV for maintaining the web server for the Chapter 24 Web page!

Thanks to WKOW-TV for providing copying and folding facilities for the Chapter 24 newsletter!

Global Positioning System Basics

By Mike Norton

The Global Positioning System has been in operation for a number of years, and allows GPS receivers to determine location and time information anywhere on the planet. We've all heard about the usefulness and accuracy of this system. You may have used one, or might even own a GPS receiver. What makes up the system, and how does it work? In this article, we'll take a look at the various components, and the basic operation of the system.

Originally designed by the U.S. Department of Defense, the system is made up of three main components: the control segment, the space segment, and the user segment. The U.S. Air Force Space Command manages the system from the Master Control Station (MCS) in Colorado, with five passive receive sites around the globe tracking the satellites. Three of those sites also transmit any data and orbit adjustments (calculated by the MCS) to the individual spacecraft. The Space Segment consists of the 24 satellites orbiting the earth, while the User segment consists of GPS receivers. Multiple GPS satellites orbit the earth, and signals from at least four of them are needed to calculate the latitude, longitude, and elevation of the receiver, along with the current time.

System History

While the first GPS satellites were launched between 1978 and 1985, Inital Operational Capability was reached on December 8, 1993. At that time 24 GPS satellites were in their proper orbits and transmitting data for navigational use. Full Operational Capability was reached on April 25, 1995, when the remaining first generation GPS spacecraft were phased out of service and the new satellites were in their assigned orbits had completed testing.

Satellite Constellation

The GPS operational system consists of 21satellites, with three in-orbit spares. Unlike satellites used for radio, television, and DBS broadcasting (which are in a geostationary orbit above the equator and match the earth's rotation), the GPS satellites are in 6 different orbital planes spaced 60 degrees apart, each with a 55 degree inclination with respect to the equatorial plane. The GPS satellties are at an altitude of 20,200 kilometers and complete one orbit just shy of every 12 hours. Contrast this with geostationary spacecraft that have an orbit height of 35,785 kilometers, with an orbital period very near 24 hours.

Since the GPS satellites are circling earth faster than the planet is rotating, each spacecraft appears to move through the sky and is visible from a single location for about five hours. By combining individual orbit information with the arrangement of the six planes, the GPS constellation allows between five and eight satellites to be visible from any point on earth.

To maintain the timing and accuracy of the system, each of the GPS satellites need to be maintained in a circular orbit. Failure to do so results in elliptical orbits which would effectively add a larger than anticipated doppler-shift to the received signal. Additional information on satellite orbital geometry and be found by referring to the five-part *Geostationary Orbits* series of articles by Neal McLain, CSBE. These were originally published in the SBE Chapter 24 *Newsletter* beginning in December of 1995. An electronic version with many illustrations is available on the Chapter 24 web site at http://www.sbe24.org/techdocs.html.

Frequency Information

There are two microwave carrier signals transmitted from GPS satellites, located in the L-band frequency range. The first frequency, refered to as L1, is centered at 1575.42 MHz. This carries the standard positioning service (SPS) code for navigation and timing which is available to GPS users worldwide. The second frequency (L2) is centered at 1227.60 MHz and carries data for the precise positioning service (PPS). Both carriers are modulated with data which results in an occupied bandwidth of 20.46 MHz. A third frequency centered at 1176.45 MHz has been proposed for future GPS satellites, to satisfy the needs of aviation. This frequency is located in the Aeronautical Radio Navigation Services band. Multiple atomic clocks on each satellite are use to maintain the proper frequency. A detailed discussion of the actual data carried on these signals is beyond the scope of this article. More information can be found at http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html.

Overall Accuracy

Since July 1991, the U.S. Air Force Space Command had intentionally injected small errors into the data transmitted by the GPS satellites. Refered to as Selective Availability (SA), this was done to deny full accuracy to non-military users. The U.S. military has now developed a method to selectively block accurate GPS transmissions in areas of conflict or where U.S. security is at risk. As a result, SA was discontinued on May 2, 2000, and the accuracy of commercially available GPS receivers increased from 300 feet to positioning errors below 60 feet.

Broadcast Uses Of GPS

There are many ways that GPS information can be implemented in the broadcast industry. Mobile satellite uplinks can use GPS information to determine location, and for azimuth and elevation data to locate specific communication satellites. The highly accurate time data (10 nanoseconds or better) can be used as a frequency reference for tranmitter carrier measurements. Studio uses can include not only highly accurate time of day, but also a reference signal for various analog and digital equipment synchronization.

Information for this article came from the following sources: Robert A. Nelson, "The Global Positioning System" Via Satellite, November 1999, page 48; www.geography.about.com; www.tycho.navy.mil/gpsinfo.html; www.mercat.com/QUEST/Intro.htm; and www.colorado.edu/geography/gcraft/notes/gps/gps_f.html.

FCC Rulemakings

Compiled By Tom Smith

PROPOSED RULEMAKINGS

IB Docket No. 00-203; FCC-00-369

Partial Band Licensing and Loading Standards for Earth Stations in the FSS That Share Spectrum With Terrestrial Services, Blanket Licensing for Small Aperture Terminals in the C-Band, Routine Licensing of 3.7 Meter Transmit And Receive Stations, and Deployment of Geostationary-Orbit FSS Earth Stations in the Shared Portion of the Ka-Band

The FCC is proposing a number of rule changes in a number of bands that are shared by both fixed terrestrial stations and geostationary satellite services in the 3700-4200 MHz, 5925-6425 MHz, 6525-6875 MHz and the 10.7-11.7 GHz bands.

The first change would allow for the use of small aperture antennas of less then 4.5 meters in the C-Band. Along with this change, the FCC would allow for one entity to license a number of earth stations under one license. An entity would license a set number of earth stations much as VSAT stations are licensed, with the provision that the stations are coordinated with existing terrestrial stations and the FCC is notified of the technical parameters before operation. A 30 day comment period is to follow the FCC notification. Stations are limited to access three satellites, and must identify the amount of spectrum to be used, and provide a description of the geographic area for each antenna.

The second group of rule changes affect the coordination of a terrestrial station with satellite earth stations. When a terrestrial station is denied, a satellite earth station operator will be required to demonstrate that it is using or will be using the spectrum in question. If they are unable to demonstrate the use of the spectrum, the terrestrial station may proceed and will be protected from the earth station uplink transmission. Also, a earth station that accepts coordination with a terrestrial station based on terrain or other shielding must accept coordination with other terrestrial stations using the same standards.

Expect to see more rulemakings that will allow for more sharing of spectrum as the FCC tries to satisfy all requests for spectrum.

This notice was adopted on October 13, 2000 and released on October 24, 2000, with the notice published in the FEDERAL REGISTER on November 24, 2000. Comments are due on January 8, 2001 and replies due February 9, 2001.

ET Docket No. 00-221; RM-9267; RM-9692; RM-9797; RM-9854

Relocation of the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1432-1435 Mhz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands

The FCC is proposing to reallocate 27 megahertz of spectrum from government use to non-government use, in accordance to the provisions of the Omnibus Budget Reconciliation Act of 1993 and the Balanced Budget Act of 1997. The FCC has heard from a number of groups requesting use of this spectrum for such uses as paired spectrum bands for private radio, traditional industrial and public safety operations, remote meter reading, and satellite feeder links. The FCC is seeking comment on possible uses. There are currently a number of uses of the 216-220 Mhz bands including the previously auctioned 218-219 MHz Interactive Video and Data Services (IDVS) and the 219-200 MHz band which Amateur Radio has use of on a secondary basis. The primary allocation of the 216-220 MHz band is for maritime use. Another concern with this band is interference to TV channel 13 on 210-216 MHz. The higher bands that would be reallocated in this rulemaking are used by the government for weather gathering systems and military communications.

There was no proposed final rules in this notice, which along with a larger than normal discussion section covering many proposals, may indicate that the FCC is open to any number of proposals. There are a large number of proposals for any small slice of spectrum and the FCC is searching for any spectrum that can be allocated and auctioned for these services.

This notice was adopted on November 1, 2000 and released on November 20, 2000. Comments are due 30 days from publication in the FEDERAL REGISTER with comments due 30 days later.

ET Docket No. 98-237; and WT Docket No. 00-32; FCC 00-363

Transfer of the 3650 Through 3700 MHz Band and the 4.9 GHz Band From Federal Government Use

This notice of proposed rulemaking goes along with the allocation of the 3650-3700 MHz band that occurred on the same day as this notice. The FCC proposed a set of rules for the 3650-3700 MHz band including power and height limits, service requirements

(continued on next page)

FCC Rulemakings (continued)

(coverage), coordination, and auction requirements. The FCC did not define any particular services for the band. The FCC also asked if technical and licensing requirements should be set for the recently reallocated 4040-4990 MHz band at the same time.

This action was adopted on October 12, 2000 and released on October23, 2000. The notice was published in the FEDERAL REGISTER on November 17, 2000.

FINAL RULEMAKINGS

CS Docket No. 00-2; FCC 00-388

Implementation of the Satellite Home Viewer Improvement Act of 1999; Application of Network Non-duplication, Syndicated Exclusivity, And Sports Blackout Rules to Satellite Retransmission of Broadcast Signals.

In this rulemaking, the FCC extends the rules covering network non-duplication, syndicated exclusivity, and sports blackout rules to satellite carriers providing video services to home viewers. These rules extend to local broadcast stations, protection from carriage of programs from stations coming into the their markets by satellite, that they have exclusive rights to. Stations previously had protection on local cable systems. The programs that stations have non-duplication protection are carried on the so called superstations such as WTBS or WGN.

If a station has a contract that gives it exclusive rights within the market it is located in, a cable or satellite operator must black out that program on any broadcast channel that they carry from outside the market. Cable operators must provide blackout protection within 35 miles of the station (55 miles in small markets) and satellite providers for all zip codes within the same area. The station or its program provider must supply the cable or satellite operator with notice of the contract giving it non-duplication rights.

The FCC is giving satellite providers time to implement the rules, so stations need to be aware of when various parts of the rules become effective. The dates are given in the notice along with details on the differences in the rules between cable and satellite. The notice was adopted on October 27, 2000 and released on November 2, 2000. It was published in the FEDERAL REGISTER on November 14, 2000.

ET Docket No. 98-237; FCC 00-363

3650-3700 MHz Government Transfer

The FCC is allocating 50 megahertz of spectrum to base station operations for a new mobile service. This service will be sharing spectrum with existing satellite earth stations (space to earth transmissions). Existing earth stations will be given a 10 mile buffer zone from the new terrestrial base stations.

The grandfathered earth stations will have primary status, with any new earth stations having secondary status only. Existing maritime radiolocation stations (radar) will be required to be located 44 nautical miles offshore. This band is adjacent to the C-Band satellite service.

This action was adopted on October 12, 2000 and released on October23, 2000. The notice was published in the FEDERAL REGISTER on November 17, 2000

From FCC Notices (www.fcc.gov) and the FEDERAL REGISTER (www.access.gpo.gov)

CHAPTER 24 SUSTAINING MEMBERS

RECENT RENEWALS:

Video Images

THANKS TO ALL OUR SUSTAINING MEMBERS:

Alpha Video
Belden Wire and Cable
CTI
Clark Wire and Cable
Harris Corporation
maney-logic
National Tower Service
Norlight Telecommunications
Panasonic Broadcast
Pinnacle Systems
Richardson Electronics
Roscor Wisconsin
Ross Video
Scharch Electronics
Sony Broadcast
Swiderski Electronics
Teleport Minnesota
Token Creek Productions
WISC-TV 3
WKOW-TV 27
WMSN-TV 47
WMTV-TV 15

SBE

SBE Chapter 24 Newsletter
2029 Greenway Cross #11
Madison, WI 53713-3000

FIRST CLASS MAIL

Newsletter edited on Pagemaker 5.0 by: Mike Norton
Contributors this month: Vicki W. Kipp, Mike Norton, Tom Smith, Paul Stoffel, and Tom Weeden.
Thanks to Leonard Charles for his work on the Chapter 24 WWW page.

DECEMBER MEETING and PROGRAM

Society of Broadcast Engineers
CHAPTER 24 MADISON, WISCONSIN
Wednesday, December 20, 2000

Vertical Blanking Interval Systems

Join us at this month's meeting for a demo of various VBI systems. Dan Maney will be on hand to show an on-air demo of Vertical Interval Remote Control by maney-logic. Bring your ideas! TV stations have the ability to control multiple relays at multiple locations using their existing video or off-air path. How many uses can we find?

Pizza and Soda provided by Chapter 24
at 6:00 PM

at Wisconsin Public Television-TOC
3319 W. Beltline Highway

Business Meeting
and Program
at 7:00 PM

Visitors and guests are welcome at all of our SBE meetings!

2000/2001 UPCOMING MEETING/PROGRAM DATES:

Day	**Date**	**Program**
Thursday	January 18	RF Measurements
Tuesday	February 20	Future of Radio
Wednesday	March 21	Youth Night

Program Committee:	Denise Maney	Steve Paugh	Fred Sperry	Steve Zimmerman
	277-8001	277-5139	264-9806	274-1234