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Autumn 1995

Hamming It Up In Class

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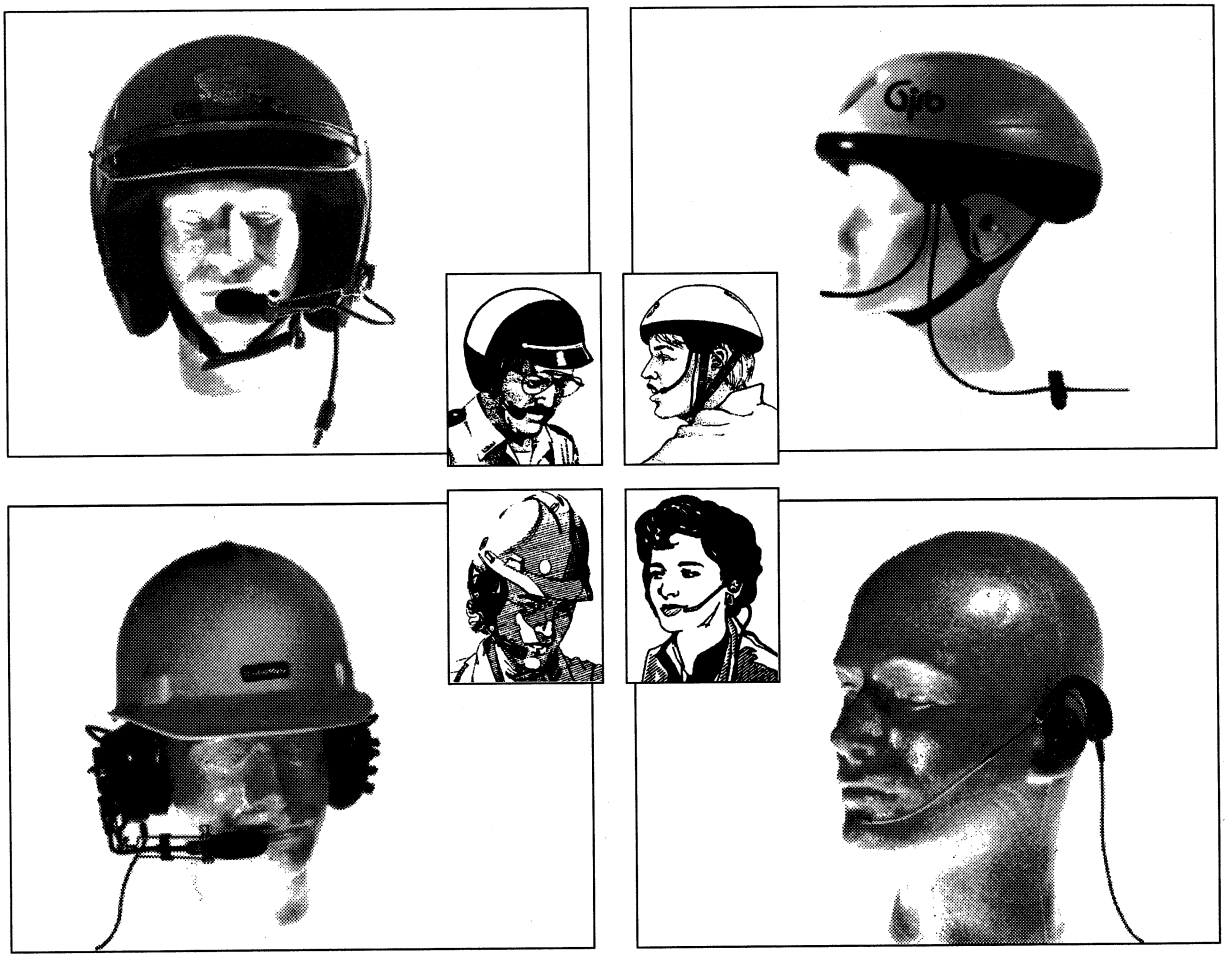

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THE RADIO CLUB OF AMERICA, INC.

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CONTENTS

Cover: Lindsay, a student at Swan's Island School in Maine, communicates with Carole Perry, WB2M6P.

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Hamming It Up In Class

By Carole Perry

As the delicious aroma of broiled lobster wafted down the hallways of Intermediate School 72 in Staten Island, NY, every child in our school wished that he or she could be in the ham radio program. When the "Eyewitness News" TV camera arrived, it looked like a rock concert crowd outside my classroom door. How did this excitement get generated? Through contacts on the radio, of course.

In early fall of 1994, Jim Wilmerding, N4MDC, and I worked out the schedule for what we believed would be some exciting school contacts that term. Little did we know the level of excitement we were igniting. Wilmerding is the project director of the Island Institute Schools in Rockland, ME. A dear friend for many years, Wilmerding and I always have shared the philosophy that using ham radio to stimulate interest in school curricula is almost always a terrific experience for the students. Since the Island Institute offers educational resources for the 14 island schools in this scenic part of Maine, Wilmerding knew that introducing ham radio to the small island schools would be a great educational experience for those students, and for mine as well.

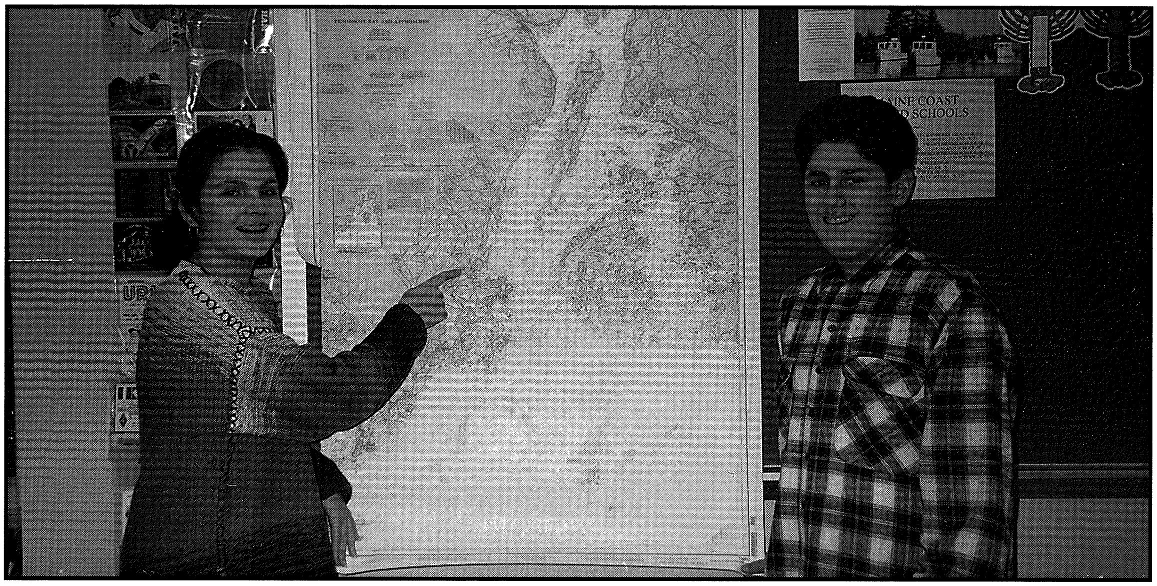
One of the first small fishing islands we spoke with was Frenchboro. This island has a one-room schoolhouse with eight children in grades K through eight. Imagine my trying to describe this to my 13 ham radio classes in grades six, seven and eight. Our total school population is 1,800-plus. When the children first made radio contact, they all appreciated the fact that even though both schools were located on islands, Staten Island was very different from Frenchboro Island. The differences and similarities became the focus of most of our contacts during the next few months.

Filling in the Picture

My students came up with the idea of sending souvenirs, videotapes of our school, scrapbooks and reports about Staten Island and New York City to their counterparts in Maine. I chose a team of students to take video footage of our physical education classes in the gym, our assembly programs, our shop classes, the school cafeteria and various classrooms.

The favorite footage of the children at Wilmerding's end seemed to be our kids speaking with them on the radio. They also received quite a dose of "culture shock" when they saw footage of 563 sixth-graders all having lunch together. Many "oohs" and "ahs" were reported from both ends as a wonderful letter exchange began between the two groups.

We have made contact with four other island schools in the Maine school system. My students have had the fun of speaking with children at the Longfellow School on Great Cranberry Island, the Islesford School on Little Cranberry Island,



Carole's sixth-grader Samantha and eighth-grade radio student Robert trace Jim's trip by ferry to the Island schools they spoke to on the ham radio.

the Swan's Island School and Chebeague Island School.

All of my students became so caught up with the excitement of the contacts each week that a spontaneous outpouring of the most wonderful scrapbooks began to arrive in my room. Students put together scrapbooks showing all the fast-food restaurants, supermarkets and movie complexes on Staten Island. Several youngsters did a project showing the various stores and attractions at the Staten Island mall. We collected maps, brochures, travel folders and family photos all depicting a young child's life on our island in New York.

One of the best projects was that of two students who videotaped a trip to Manhattan as seen from the Staten Island Ferry. Wilmerding's kids were so amazed to see that the largest ferry, the Samuel Newhouse, carries as many as 6,000 passengers. The smaller ferries carry as many as 1,280 passengers and 40 vehicles. The 5-mile ride past the Statue of Liberty, Ellis Island, the Verrazano Bridge and other famous landmarks was recorded on tape by my students.

All the children's projects were shipped out in large cartons to Wilmerding for distribution amongst the island schools. According to Wilmerding and to the island teachers I spoke with, they simply were overwhelmed at the wealth of information collected by my students and forwarded to them.

Next began the wonderful reciprocal exchange between the schools. Wilmerding sent us photos of the various island schools, along with a videotape showing the island children on board their fathers' fishing boats. My classes sat mesmerized as they watched kindergarten and first- and second-grade youngsters handling lobsters and crabs as they explained how the traps were constructed and used.

All the geography and social studies books about Maine could not have had the educational impact on my students that the letters, books, tapes and radio contacts did. They were talking about things they learned to their other classes. Other teachers reported to me how excited the children in the ham radio program were about what they were doing and learning with the kids in Maine.

Lobster for Lunch

Unbelievable schoolwide interest and excitement broke out when Wilmerding announced on the air one day that he would be sending us six live Maine lobsters. I enlisted the help of Sheilah Sukhedeo, our home and career skills teacher, to do a team teaching—and eating—lesson with me.

I chose one student form each of my 13 classes to participate in the "Lobster Fest." One of my seventh graders, Billy Daddio, volunteered his father, who is a chef, to help us out. We invited several parents from our supportive PTA to join us at the table.

The Maine Lobster Promotion Council sent us a carton of goodies that really added to the festivities that day. The council sent lobster pins, caps, posters, nutritional guides and recipe books for the children. The package included lobster crackers and an apron for the chef.

Sukhedeo and Mr. Daddio did an incredible job showing the children how to cook them. They both were so knowledgeable that it became one more incredible learning experience for my students. Three children never had seen or eaten lobster before.

A local restaurant, Real Madrid, donated colorful lobster bibs for everyone. Parents provided side dishes to have with the lobster, and a fabulous table was set. Even the photographer and reporter from our local newspaper joined us for lunch. Parents, our principal Barbara Glassman, other administrators, teachers and children, all breaking bread together as the culminating activity of a ham radio experience provided quite a picture.

After a delicious lunch prepared by the students, we went back to my room in time for the TV cameras to capture my children and the principal getting on the radio to thank Wilmerding and Ron Cote, the principal of the Chebeague Island School, for sending us the lobsters. We even had a chance to thank the man who packed and shipped the lobsters for us, on a later radio contact.

I do not know how this radio experience could have been any better from an educational and cultural point of view. I received thank you notes from some of the parents, who assured me that their children always would remember the Lobster-Radio Day and all the things they learned.

Carole Perry, WB2MGP, is a member of the Radio Club of America and in 1980 created the curriculum for a pilot program at Intermediate School 72 in Staten Island. For more than 15 years, she has been teaching "Introduction to Amateur Radio" to more than 400 sixth, seventh and eight graders every term.

Perry is the recipient of the prestigious 1987 Dayton Ham of the Year Award; the 1987 ARRL Professional Instructor of the Year Award; and the 1987 CONEX (QCWA Northeast Chapters) Teacher of the Year Award. In 1991, she was the recipient of the Veteran Wireless Operator's Marconi Memorial Award. In 1993, she received the QCWA Presidential Award for her educational efforts. She received a bachelor of arts degree in 1964 from Brooklyn College in New York and a master of science degree in education in 1974 from Richmond College, NY.

Continuing Advancements in Digital Wireless Technologies

By Gregory M. Stone, Ph.D., FRCofA
and Karen Bluitt

Now, in 1995 the digital wireless technology baseline has advanced bandwidth and spectral efficiency dramatically. Ranging from the Association of Public Safety Officials (APCO) Project 25 Phase-I standard predicated upon 12.5 kHz channel spacing and a 9.6 kb/s data rate, through Linear Modulation Technology (LMT) LTD's 128-QAM implementation, bandwidth efficiencies in 1995 range from .768 b/s/Hz with the APCO Project 25 standard to 4.66 b/s/Hz with the LMT 128-QAM implementation. In addition, LMT has announced that early next year, an adaptive system achieving data rates as high as 19.6 kb/s in a 5.0 kHz channel will be commercially available.

Predicated upon low-risk mature technologies, Project 25 advanced digital narrowband communications (ANDC) Phase-I recently was completed in the summer of 1995. Project 25 Phase-I predicated upon 12.5 kHz channeling, represents a twofold (100 percent) improvement in bandwidth efficiency. As the Project 25 standard evolves and, in Phase-II embraces 6.25 kHz channelization , its bandwidth efficiency will increase to 1.535 b/s/Hz, whilst maintaining full backward compatibility with predecessor 12.5 kHz APCO 25 systems.

In addition, the forward direction of Project 25 and similar initiatives are quite encouraging. Through the application of multicarrier linear bandwidth-efficient technologies, it is possible to deploy adaptive information transfer rate technologies in a cost-effective fashion. Thus, one could envision Project 25 protocols and formats being scaled to whatever information transfer rate (for example from 9.6 kb/s to 1.0 Mb/s) is available both in tethered cable systems or in untethered wireless systems.

In spite of these commercial advancements, detractors of narrowband and bandwidth-efficient digital technologies represent that a mobile communications channel is characterized by phase and amplitude distortions of such a degree that they make the use of "high" level very bandwidth-efficient modulations, such as 128-QAM or better, impossible.

As of September 1995, Linear Modulation Technology, LTD's (LMT) 128-QAM linear modulation product, has the highest bandwidth efficiency of any wireless product intended for mobile usage. In a hypothetical multicarrier linear system comprised of five carriers in a 25 kHz channel, the LMT technology is capable of supporting gross channel rates of 84 kb/s with usable transport capacity in the area of 72 kb/s. With many terrestrial systems operating at channel rates of 56/64 kb/s, LMT's 128-QAM offering no doubt will stimulate the proliferation of aggressive spectrum and bandwidth-efficient technologies.

Future Issues

While the science and physics of narrowband and bandwidth-efficient technologies is understood well, a number of engineering challenges persist that will determine the timeline of when cost-effective products embodying these techniques become available to the masses.

Some areas where particular advancements will occur include:

Adaptive Information Transfer Rate Technologies—Information transfer rates on demand will become the mainstay of future wireless systems that are intended to support multimedia digital services. In this regard, we foresee the migration toward wireless asynchronous transfer mode (ATM) fast-packet technologies adapted for wireless use but maintaining easy transcoding to and from terrestrial networks.

Although many assert that basic rate basic rate interface (BRI) integrated services digital network (ISDN) technologies will proliferate in the wireless environment, we do not. Basic rate interface ISDN (2B+D) with its two 64 kb/s digital access channels and 16.0 kb/s signaling channel quite simply is not good enough. We envision an environment characterized by primary rate interface (PRI) ISDN or more likely broadband ISDN, using channel rate scaled Project 25 protocols and formats, in a ATM-conducive environment.

Multicarrier / Multitone LM—Multicarrier systems will predominate in the very narrowband arena where the conveyance of information other than voice is a predominate requirement.

Multicarrier systems permit a given bandwidth (i.e. 25 kHz) to be subdivided into several segments with a size optimized to reduce the gross symbol rate. For example, with Motorola's MIRS approach, four 16-QAM carriers exist in a 25 kHz channel each operating at a symbol rate of 4.0 Ks/s and a gross data rate of 16 kb/s. Thus when combined, a gross data rate of 64 kb/s is achieved, but the symbol rate remains at 4.0 Ks/s. Current practices demand that symbol rates be minimized to facilitate symbol recovery. The use of adaptive equalization, combining and pilot symbols or carriers all are intended to facilitate symbol recovery.

In lieu of employing SONET, the untethered wireless link will employ a synchronous wireless access and transport mechanism that provides for the required amplitude and phase linear channel.

Information Compression—As substantive progress is made in the area of information compression, trade-offs must be made between the computation resource and time needed to compress and decompress and to transmit a given data set. In this regard, total processing power and delays must be evaluated and the appropriate decisions made based upon current requirements, future trends both in terms of technological progress and in user demands.

1995 Commercial Wireless Technology Baseline

This year has been exciting as far as bandwidth and spectrally efficient mobile wireless technologies are concerned. This year's highlights include the completion of Phase-I of the advanced narrowband digital communications (ANDC) Project 25 standards process.

Since graphics often assist in visualizing concepts, the following contains parametrics for modern commercially available bandwidth and spectrally efficient technologies. Spectrograms are presented that graphically depict the transmitted waveform for each of these technologies.

Linear Modulation Technology, LTD (LMT): LMT, with headquarters in the United Kingdom, has commercialized a bandwidth-efficient linear system for use in 5.0 kHz channels; LMT commercialized McGeehan's transparent tone in-band (TTIB) feed forward signal regeneration (FFSR) linear system. The LMT implementation possesses bandwidth efficiency at passband comparable to its baseband component. With TTIB/FFSR, there is a slight bandwidth expansion of approximately 600 Hz. Thus, with 16-QAM employed, its occupied bandwidth at passband is approximately 3.6 kHz at the -20 dB point. However, its Nyquist bandwidth is only 2.4 kHz supporting a symbol or baud rate of 2.4 Ks/s (kilobaud). This equates

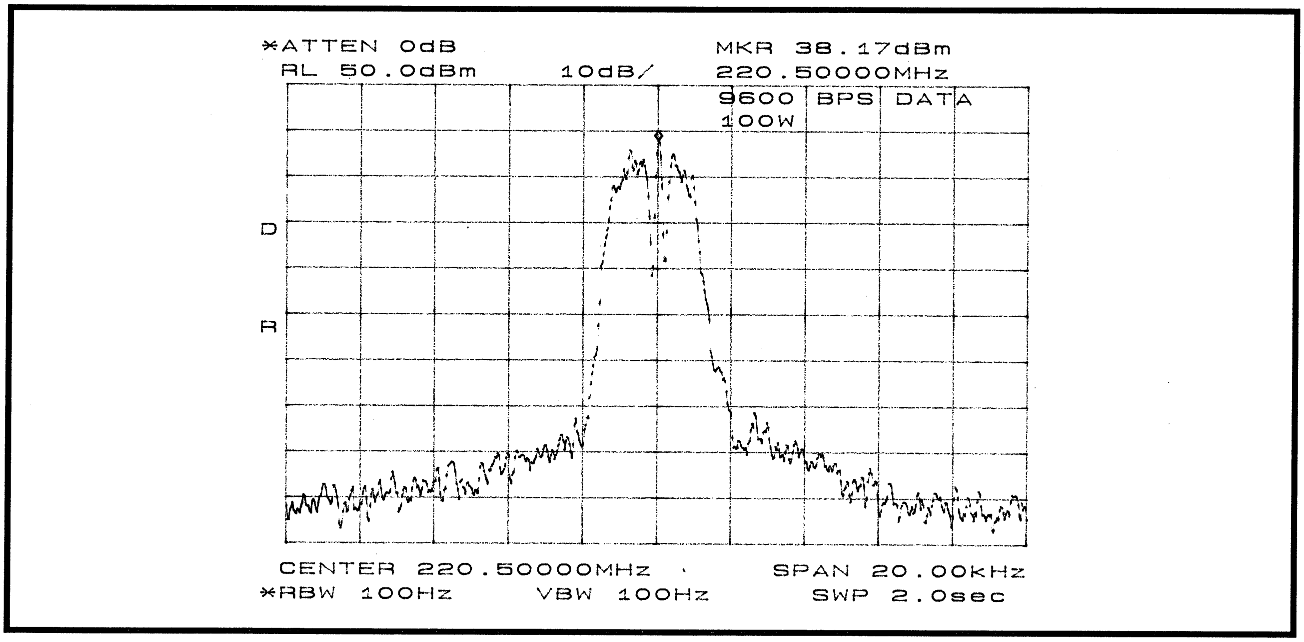


Figure LMT-1. LMT's 16-QAM Nomenclature

into a bandwidth efficiency of 2.67 b/s/Hz with 16-QAM increasing to 4.66 b/s/Hz with 128-QAM.

Technical parameters are presented in Table LMT-1 below:

Table LMT-1
LMT's 16-QAM Nomenclature

Access Methodology	FDMA
Channel Rate	9.6 kb/s (7.2 kb/s with trellis coding)
Symbol Rate	2.4 Ks/s
Channel Spacing	5 kHz
Vocoder Line Rate	4.8 kb/s IMBE
Vocoder EDAC (FEC)	2.4 kb/s
Modulation	Linear Frequency Translated 16-QAM
Premodulation Filter	Raised Cosine 0.35 alpha
C/N Static	6.0 dB
C/N dynamic @ 5% BER	14.0 dB
Peak/Mean Ratio	6.0 dB
TTIB Notch Width	600 Hz
Effective Noise BW	3.0 kHz
Bandwidth Efficiency	2.67 b/s/Hz @ 3.6 kHz occupied bandwidth 1.92 b/s/Hz @ 5 kHz channel bandwidth
Occupied Bandwidth	3.6 kHz (-20 dB point)

A spectrogram for LMT's 16-QAM implementation is presented in Figure LMT-1 at the top of this page. LMT's 128-QAM implementation employing trellis coding is presented in the spectrogram contained in Figure LMT-2 at the bottom of this page.

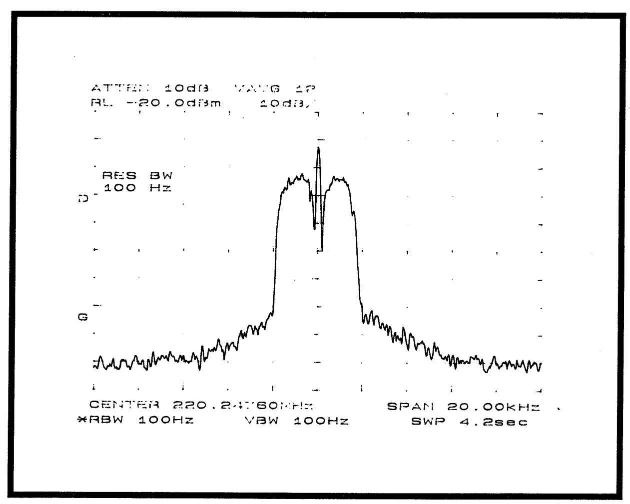


Figure LMT-2.

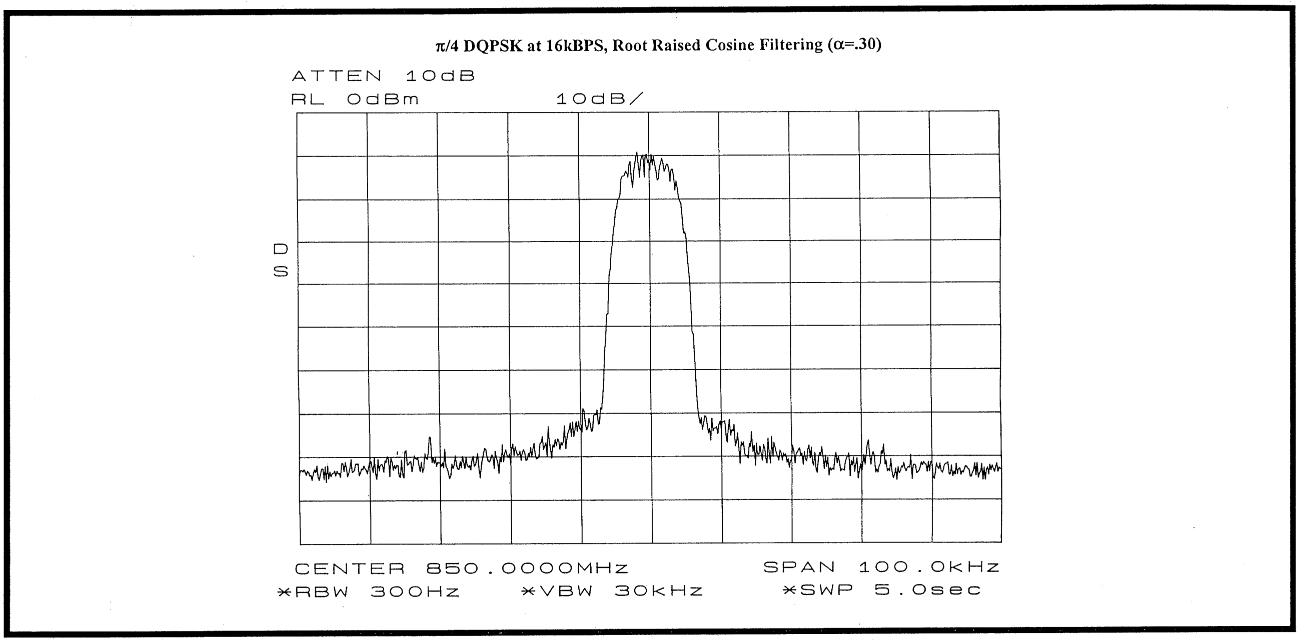


Figure Ericsson-1.

Ericsson - F-TDMA: Ericsson has commercialized a modern bandwidth-efficient two-slot time division multiple access (TDMA) technique employing pi/4 differential quadrature phase shift keying. This technique referred to as F-TDMA operates at a gross bit rate of 16 kb/s in a 12.5 kHz channel.

In the F-TDMA concept, Ericsson GE employs a high-quality vocoder, for example improved multiband excitation (IMBE), operating at a line rate of 4.1 kb/s. Vocoder error detection and correction (EDAC) comprises another 3.0 kb/s to correct for the phase perturbations commonly encountered in a land mobile environment. The occupied bandwidth is 10 kHz, and the bandwidth efficiency at the occupied bandwidth is 1.6 b/s/Hz or 1.28 b/s/Hz at the 12.5 kHz channel bandwidth. A summary of the F-TDMA parameters is presented below in Table Ericsson GE-1:

Table Ericsson GE-1
F-TDMA Nomenclature

Access Methodology	2-slot TDMA
Channel Rate	16.0 kb/s
Channel Spacing	12.5 kHz
Vocoder Line Rate	4.1 kb/s IMBE
Vocoder EDAC	3.0 kb/s
Modulation	pi/4 DQPSK
Premodulation Filter	Raised Cosine 0.3 alpha
C/N dynamic @ 5% BER	12.3 dB
Peak/Mean Ratio	2.6 dB
Bandwidth Efficiency	1.6 b/s/Hz @ 10.0 kHz occupied bandwidth 1.2 b/s/Hz @ 12.5 kHz channel bandwidth
Occupied Bandwidth	10.0 kHz (-20 dB point)

A spectrogram for Ericsson's pi/4 DQPSK implementation is presented in Figure Ericsson-1 at the top of this page.

Motorola: Motorola Inc. has commercialized two bandwidth-efficient technologies, one employing frequency division multiple access (FDMA) and a second based upon (TDMA).

C4FM: In Motorola's FDMA offering, two distinct modulations are provided. Initially for use in a 12.5 kHz channel, Motorola employs compatible four frequency modulation, a four-level FM technique that is the digital modulation format specified in APCO Project 25. It employs four-level constant envelop FM. The gross information rate is 9.6 kb/s and is transmitted at symbol rate of 4.8 kilo-symbols per second (Ks/s). A summary of C4FM parameters is presented below in Table Motorola-1:

Table Motorola-1
C4FM Nomenclature

Access Methodology	FDMA
Channel Rate	9.6 kb/s
Symbol Rate	4.6 Ks/s
Channel Spacing	12.5 kHz
Vocoder Line Rate	4.8 kb/s IMBE
Vocoder EDAC (FEC)	2.4 kb/s
Modulation	C4FM
Premodulation Filter	Raised Cosine 0.2 alpha
C/N Static	9 dB
C/N dynamic @ 5% BER	17 dB
Peak/Mean Ratio	1.0 dB
Effective Noice BW	Parametric not available
Bandwidth Efficiency	1.158 b/s/Hz @ 8.1 kHz occupied bandwidth 0.768 b/s/Hz @ 12.5 kHz channel bandwidth
Occupied Bandwidth	8.1 kHz (-20 dB point)

C4FM is compatible with quadrature phase shift keying-compatible (QPSK-c), which is specified in APCO Project 25. A compatible receiver that is designed to conform with Project 25 can recover either C4FM or QPSK-c. This compatibility extracted an approximate 1.0 dB penalty over non-compatible detection schemes but facilitates migration from 12.5 kHz to 6.25 kHz channelization. Although the Project 25 standard detection system architecture accrues the 1.0 dB penalty, coherent implementations are feasible that "buy back" the 1.0 dB. We forecast the widespread proliferation of coherent adaptively equalized schemes to provide for more robust performance, especially in areas of high delay spread (i.e. simulcast and where more reliable digital data transmission is required).

QPSK-c: For use in 6.25 kHz channels, Motorola commercialized QPSK-c. It possesses greater bandwidth efficiency than C4FM and operates at a gross information rate of 9.6 kb/s transmitted at a symbol rate of 4.8 Ks/s. A summary of QPSK-c parameters is presented below in Table Motorola-2:

Table Motorola-2
QPSK-c Nomenclature

Access Methodology	FDMA
Channel Rate	9.6 kb/s
Symbol Rate	4.6 Ks/s
Channel Spacing	6.25 kHz
Vocoder Line Rate	4.8 kb/s IMBE
Vocoder EDAC (FEC)	2.4 kb/s
Modulation	QPSK-c
Premodulation Filter	Raised Cosine 0.2 alpha
C/N Static	9 dB
C/N dynamic @ 5% BER	17 dB
Peak/Mean Ratio	4.0 dB
Effective Noise BW	Parametric not available
Bandwidth Efficiency	1.655 b/s/Hz @ 5.8 kHz occupied bandwidth 1.536 b/s/Hz @ 6.25 kHz channel bandwidth
Occupied Bandwidth	5.8 kHz (-20 dB point)

Q-QAM: In the area of TDMA, Motorola has commercialized quad-quadrature amplitude modulation (QQAM) consisting of four multitone 16-QAM carriers employing pilot symbol insertion for linearization and synchronization.. In this technique, a 64 kb/s gross channel rate is supported in a 25 kHz channel. Four-slot TDMA provides four carriers or subbands in order to keep the symbol rate down to 4.0 Ks/s. Pilot symbol insertion is provided to facilitate symbol recovery. To assist in achieving more reliable in-bound coverage, 3-branch ratio squared (maximal-ratio) combining is provided at the fixed end. This technique is a linear modulation. A summary of QQAM parameters is presented on page 10 in Table Motorola-3.

Table Motorola-3
Q-QAM Nomenclature

Access Methodology	4 Slot TDMA
Channel Rate	64 kb/s
Symbol Rate	4.0 Ks/s
Channel Spacing	25 kHz
Vocoder Line Rate	7.4 kb/s VSELP
Vocoder EDAC (FEC)	included in Vocoder Line Rate
Modulation	Multi-Tone four 16-QAM carriers
Premodulation Filter	Root Raised Cosine 0.2 alpha
C/N Static	12.5 dB
C/N dynamic @ 5% BER	17.0 dB
Peak/Mean Ratio	5.0 dB
Effective Noice BW	Parametric not available
Bandwidth Efficiency	3.0 b/s/Hz @ 20 kHz occupied bandwidth 2.56 b/s/Hz @ 25 kHz channel bandwidth
Occupied Bandwidth	20 kHz (-20 dB point)
Other	Employs pilot symbol for linearization and symbol recovery; and, employs 3-branch ratio-quared combing on the fixed end (uplink)

Spectrograms for Motorola's C4FM, QPSK-c and QQAM implementations are presented in Figures Motorola-1 through Motorola-3 on page 11.

Acknowledgments:

The author wishes to thank Messrs. Dominick Arcuri and Ed Kelly of Ericsson GE; Messrs. James Gherke and Terry Mansfield of Motorola Inc.; and Messrs. Mike Bayly and S. M. Whittle of Securicor Linear Modulation Technology Limited for their assistance in providing the spectrograms and technical contributions for this paper.

Dr. Gregory M. Stone is a consulting scientist with the professional services firm of Booz Allen and Hamilton of McLean, VA. Dr. Stone has a Ph.D. in electrical engineering and has in excess of 16 years' experience in the area of wireless communications technology with concentration in both terrestrial and aeronautical systems. Dr. Stone is a member of the Institute of Electrical and Electronic Engineers and currently serves as chairman of the Vehicular Technology Society's Propagation Committee. In addition, he is a member of the Radio Club of America and was awarded the status of Fellow in 1985 for his work performed in the areas of bandwidth and spectrally efficient wireless technologies. Dr. Stone is active in the APCO Project 25 Law Enforcement Standards initiative and serves as co-chair of TIA TR-8's Compatibility Committee. In addition, Dr. Stone currently serves as a member of the Editorial Advisory Board for *Mobile Radio Technology* and as a member of the Executive Committee of the IEEE International Carnahan Conference on Security Technology—Electronic Crime Countermeasures. Dr. Stone is the author of in excess of 60 professional papers and reports dealing with technology-related issues. Dr. Stone has served as an expert witness in the area of science and technology for a U.S. government agency before the U.S. Congress.

Karen Bluitt is a consulting scientist. She has a B.S. in computer science, an MBA and is pursuing her Ph.D. studies. Bluitt has more than 16 years' experience in software engineering and advanced system development. Bluitt is a member of the Institute of Electrical and Electronic Engineers, the Association of Computing Machinery and the Society of Women Engineers. She is on the Society of Women Engineers Magazine Editorial Advisory Board.

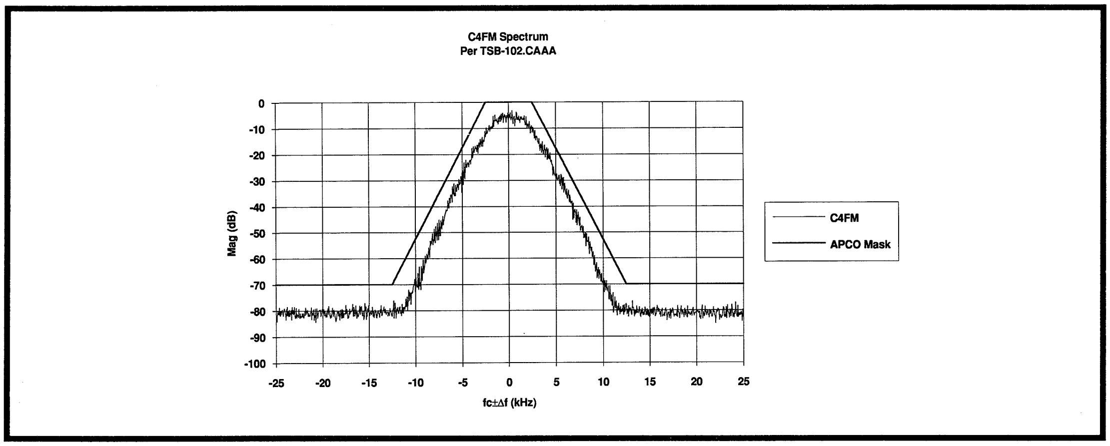


Figure Motorola-1.

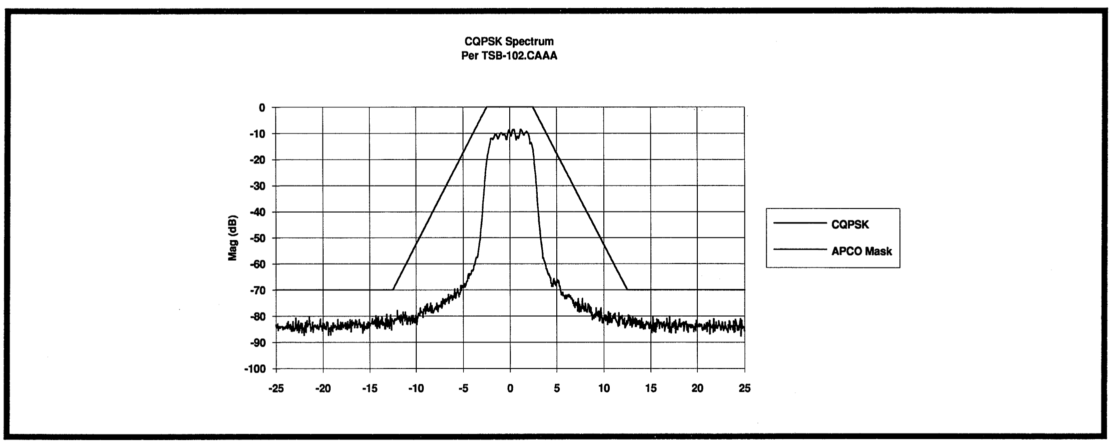


Figure Motorola-2.

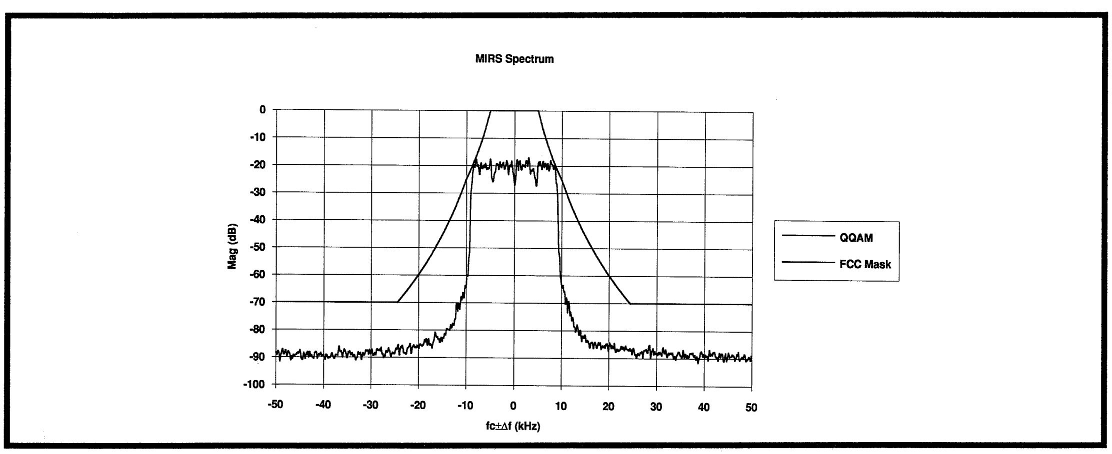
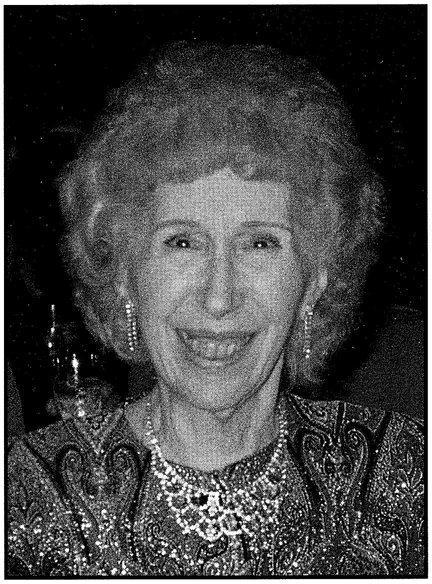


Figure Motorola-3.

Member Profile: Marguerite E. Warshaw

By Don Bishop



Marguerite E. Warshaw joined the Radio Club of America in 1974. A writer and broadcaster, she has written many magazine articles and has produced and performed on radio and TV programs for the ABC, CBS and NBC networks.

Born in Middleport, OH, in 1908, she was raised in Akron, OH, where her fascination with science began at a young age. Upon learning a new scientific fact, she would introduce it to her friends with the question, "Have you heard?" By 1933, she was writing a science program for radio called "Have You Heard?" and it attracted the attention of the U.S. Office of Education in Washington, DC. She went to work there, broadcasting "Have You Heard? and several other science programs coast-to-coast over the NBC, CBS and ABC networks.

More radio work followed, including "The World Is Yours" for the Smithsonian Institution and the Carnegie Institute. In Hollywood, CA, she met Dr. Lee de Forest, and she recorded some commercials for his Radio School. She taught script writing at the Radio Arts Academy. She produced Fur Fashion Shows, a series of programs for the Southern California Florists Association and remote broadcasts for several nightclubs. During World War II, she worked as a cryptoanalyst in military intelligence and taught at the National Academy of Broadcasting in Washington, DC.

Horticulture attracted her attention, and Marguerite started raising orchids in 1950. She has written about orchids in *Popular Gardening* magazine and has spoken about them on radio programs. A greenhouse for the orchids, called "Everglades Outpost," was built onto her home in Valley Cottage, NY. She has lived there with her husband, David, for the past 37 years.

"I went to South America to collect orchids," Marguerite said, "but I was warned not to go into the jungle because of Auca headhunters. I asked some natives called Los Hombres Ambulantes to go get me some plants, which they did for only viente sucres ($20). I didn't step foot into the jungle, so I called the trip 'Safari with Room Service.' I wrote an article by the same title about the trip that was published in *Orchids* magazine. I prepared slide lectures that were presented at garden clubs, schools and Orchid Society meetings.

"You can grow orchids anywhere," she said.

Marguerite has won first prize twice at the International Flower Show, and she appeared with Frank Blair on the "Today Show" with her orchids.

Unfortunately, "Everglades Outpost" was torn down in 1994. Ice that formed during the previous hard winter opened two large holes in the greenhouse roof and allowed freezing temperatures to destroy all of the orchids, which numbered about 450. Workers replaced the roof on the house and built a patio where the greenhouse had been. What remains of the orchids are hundreds of slide photographs.

"I went to South America to collect orchids, but I was warned not to go into the jungle because of Auca headhunters."

In the 1970s, Marguerite originated several TV programs: "The Marguerite Warshaw Show" featured geologists, herpetologists and other naturalists and scientists as guests. Elected officials appeared on "Legislative Report." "Video Soapbox" included debates about ecology, pollution, conservation and environmental controls. "Bicentennial Preview" covered the nation's history.

She started to write a book, *The Perils of Spaceship Earth*, in 1989. "I've done all the research for it," she said. But she said that health problems of her own and her husband's

have slowed its completion.

Earthquakes, volcanos and asteroids are among the natural hazards explained in the book, which Marguerite since has renamed *Annihilation Alert.*

"There is an earthquake every 30 seconds," she said. "The world is full of earthquake faults. Where I live near the Atlantic coast is the safest spot on the whole planet from earthquakes because the Atlantic Ocean is widening by 2 or 3 inches each year. There is no pressure on the coast to activate its faults."

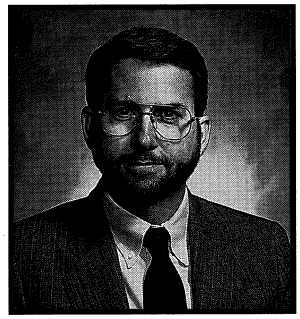
Aside from the more than 600 volcanos on land that are not considered to be dormant, the ocean floor has a 46,000-mile-long string of volcanos extending south from Iceland through the middle of the Atlantic and Pacific oceans to Alaska, she said.

Thousands of dust- and pebble-sized meteors enter the earth's atmosphere every day, only to burn up from friction. "But every day, 12 fist-sized meteorites hit the earth," Marguerite said. "In a number of instances, they have hit people and have come through the roofs of houses. We are bombarded constantly."

Whereas meteorites at their worst cause only local damage, she cites asteroids as the principle risk for widespread destruction in the earth's encounters with other objects in space. "An asteroid or comet struck in Siberia in 1908, and not many years ago, another asteroid passed near the earth," she said. "'Nuking' an asteroid on a collision course would only break it into pieces before it struck. It would have to be nudged into a slightly different orbit to prevent destruction."

Marguerite enjoys reading *Science* magazine. "Every issue is about an inch thick, and the articles go into great scientific detail," she said. "In the latest issue is an article about the Omega Point. Have you heard? The Omega Point is the opposite of the Big Bang. It is what happens when everything disappears. Scientists say the Big Bang is what happened when everything started. I'd rather call it the 'Original Miracle.'"

In 1983, Marguerite was elected a life member of the Radio Club of America; she was elevated to the membership grade of Fellow in 1986, and on Nov. 16, 1990, she received the Club's Lee de Forest Award.



Don Bishop (LF) is co-editor of the *Proceedings* and a Club director. He is a member of IEEE and a life member of QCWA and ARRL. He is the editorial director of *Mobile Radio Technology, Dealers' Product Source* and *Cellular & Mobile International* magazines.

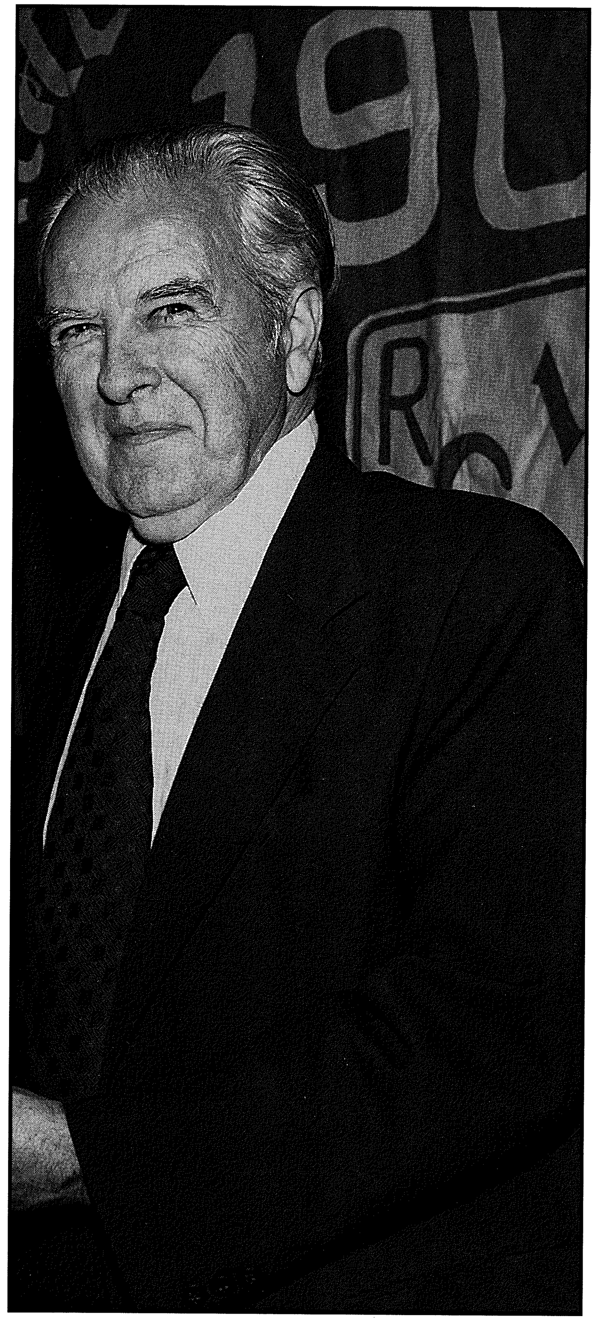
Focus On:
Jerry Burnett Minter II
An Autobiography

My first job at Boonton Radio Corp. involved working with C.J. Franks on the modification of several National type HRO radio receivers for use as Radio Noise Measuring Instruments for the U.S. Navy. My starting weekly salary was $15! I lived in a local boarding house for about eight months, and then three of us rented a house at 15 Lowell in Mountain Lakes, a neighbor town to Boonton. I stayed there for the next six years.

My next job at Boonton Radio was to design and put into production a new model of the famous "Q" Meter. This instrument was called the "Q" X Checker. It was through the sales visit to sell the new "Q" X Checker to Micamold Radio Corp. in Brooklyn that I first met Harry Houck, then the chief engineer at Micamold.

While at Boonton Radio, I continued work on my M.I.T. graduate thesis project (under E.A. Guillemin), since I had access to coil winding machines and the "Q" Meter, so I could make high Q coils myself. (My thesis coils had been made for me at F.W. Sickles by Monty Cohen.) As a result of this later work, I eventually obtained my first U.S. patent, No. 2,336,498, entitled "Selective Transfer of Electrical Oscillatory Energy," Dec. 14, 1943.

Since this invention involved a technique for making wideband filters with low phase shift, several special filters were made for use in the early Armstrong high-power transmitter that involved multiplying up from a low frequency fundamental. My filters were in the 50 kHz to 450 kHz range for the lower frequency multiplying stages.



I also made numerous I.F. filters for my ham friends with provision for variable bandwidth and steep skirt selectivity. On one occasion, we installed them in a Stromberg-Carlson radio receiver and were surprised that we actually could listen to either sideband of the broadcast stations. I distinctly remember tuning in WHOM on the sideband away from the adjacent interfering local channel; no crystals were needed for these filters.

Houck helped to pay for the patent and later, around 1947, I licensed the DuMont laboratories under this patent and built a prototype TV using my patented filters in a novel broadband I.F. system. Unfortunately DuMont started to go downhill about that time, so this system never actually was put into production.

Much of the radio work done in Boonton stemmed from the Radio Frequency Laboratories of Boonton, which originally had been founded by R.W. Seabury around 1922 to manufacture molded radio parts. They soon assembled a group in Boonton to develop improved vacuum tubes and special test equipment, such as Standard Signal Generators. In 1928, Dr. Lewis Hull went to Cambridge to General Radio and helped the company to put the first Standard Signal Generator into production. The Alfred H. Grebe Award Certificate shows Grebe standing beside one of those early General Radio instruments.

Many radio patents were issued and licensed to the industry by RFL in the late 1920s. In the early 1930s, the RFL patents were sold to RCA for several million dollars, and RFL was inactive for several years. Several Boonton companies, such as Aircraft Radio Corp., Boonton Radio Corp., Ballantine Laboratories and Ferris Instrument Corp., emerged from the staff originally attracted to Boonton by RFL.

During 1935, a new building was built on one end of the Aircraft Radio landing field near Boonton to house a reactivated RFL under Richard Seabury, the eldest son of R.W. Seabury. Dick Seabury had obtained a contract to build a small portable radio range receiver to be used for ferrying the biplanes built at the Philadelphia Navy Yard. These receivers operated in the old low frequency range band from about 150 kHz to 450 kHz. Since the planes did not have any electrical system at that time, these receivers were operated on dry batteries and were reused many times because they were very small and quite portable.

Joining RFL

I joined RFL late in 1935 to help Lester Damon design a small aircraft receiver to meet a requirement for a receiver covering 3105 kHz and 6210 kHz for use on newer tower frequencies. The older tower frequency of 278 kHz was becoming too crowded. RFL was involved with a contract from the Aberdeen Proving Ground for a remote control radio system for target aircraft.

Unfortunately, FDR inspired an IRS ruling in March, 1936 to tax all corporate surplus at 100 percent, which put us out of work since we were starting out with surplus remaining from the original patent sale to RCA. Seabury just closed down RFL, and we all had to find other jobs.

I went to work for Malcom Ferris at the Ferris Instrument Corp. on Boonton Avenue in April 1936. My first job there was to use a spectrum analyzer on the Model 16 Standard Signal Generator to check the sidebands for symmetry and adjust for minimum frequency or phase modulation by making the sidebands equal.

I next was assigned a special project for the Bell Telephone Laboratories in Whippany, NJ. John F. Morrison was working on broadcast antenna design, and he needed a Standard Signal Generator having an output of at least five volts across a low impedance to make accurate measurements in the presence of the very high adjacent channel signals present in the large antennas involved. This was designated the Ferris

Model 25A Standard Signal Generator.

After completing this project, I received a call from Houck asking for some help. It seems that Micamold was buying out the Automatic Winding Co. inArlington, NJ, and Houck wanted someone to become familiar with the automatic setup of specialized test equipment. The salesman and technical expert, Bert Smith, had designed this equipment, but it was not certain that he would continue on with the new owners of Automatic Winding Co.

I spent a few weeks commuting from Boonton to Flushing, NY, to the Micamold plant. (We called it "Mickey Mouse.") I learned a great deal about the manufacture and quality control of mica, paper, and electrolytic capacitors during this time.

The equipment was moved over to the East Newark Building, originally occupied by Clark Thread Co. I supervised the test equipment setup for a few months, but Smith elected to stay on, so I went back to the Ferris Instrument Co.

My next project was to make up a small amplifier for a pet project of Malcolm Ferris--his development of an electronic compass using the earth's magnetic field and a rotating coil to determine direction. After the system was checked and details given to his patent attorney, I went to my next project--a development for the U.S. Navy--Model 32A Radio Noise and Field Strength Meter. (Incidentally, Malcolm Ferris' patent attorney discovered that Elmer Sperry already had patented the earth inductor compass some years prior! So much for failure to conduct a preliminary patent search!)

The contract for Model 32A had stiff penalty clauses on delivery, and I recall working without sleep for several days during the check out to beat the penalty deadline. At the end of November 1937, Malcolm Ferris went into the hospital for some major surgery on his gastro-intestinal tract. It seems that he was born with an excessively long intestine that continually tangled up and caused severe stress. Unfortunately, his condition deteriorated rapidly after surgery. The employees all were tested for blood type, and several donated blood for transfusion in December of 1937. I was scheduled to do so, but Malcolm Ferris died two days before Christmas in 1937.

Malcolm Ferris dominated the little company, so his death created a problem--who should take over? John (C.J.) Franks took over for awhile but did not like the responsibility, so Mrs. Ferris selected a Mr. Barnes to assume charge of the company.

Barnes took over during 1938 and instituted severe rules. For example, he so distrusted all of us that our lunch boxes had to be inspected each day as we left for possible theft of parts, etc. Many of us had personal tools that we used both at work and at home, and we had difficulty trying to take them home. By early 1939, we had gone without a raise for more than a year, and the many months of aggravation by Barnes resulted in his firing seven employees. As a result, we decided to start a new company--Microvolts Incorporated.

We used my rented house at 15 Lowell Ave. for our place of operations. Almost immediately, Barnes notified the town of Mountain Lakes that we were using a home for business illegally, so we were forced to find temporary quarters in lower Boonton at an old dress factory building. We hurriedly designed some new instruments, such as Model 65 Standard Signal Generator by Johnny Haas; Model 58 UHF Radio Noise and Field Strength Meter by myself; Model 71 Square Wave Generator by Franks; and the 50 MHZ to 400 MHZ Model 75 Standard Signal Generator by John van Buren, who also designed the Model 62 VTVM. Later, I designed a Model 59 Megacycle Meter and Model 80 Standard Signal Generator.

At that time, there was an annual meeting of electronics at the Sagamore Hotel in Rochester, NY. Ferris Instrument Co. was a regular exhibitor there, so we planned to have a small booth to show our new wares at the November 1939 fall meeting.

Jerry Burnett Minter II

Born: Oct. 31, 1913
Fort Worth, TX

Education:
Central High School, Fort Worth, 1930
N.T.A.C. Arlington, TX, 1931
Bachelor of science in electrical engineering, M.I.T., 1934

1925—Engaged in sale and installation of radios made by Federal Telephone through Trav Daniels Sporting Goods Ft. Worth.

1925—Built crystal radios and sold RCA receivers for Bob Abbey Radio Co.,Ft. Worth.

1926—Built a portable radio with loudspeaker using type 199 tubes.

1927—Began to service radio receivers.

1928—Worked all summer as radio serviceman for a local store.

1929—Built several large radios using push-pull type 250s and mounted in consoles. Also built

Changing the Company Name

Again we heard from Barnes. This time he filed a lawsuit to prevent us from using the name "Microvolts Incorporated," so we changed our name to "Measurements Corporation."

He then filed a restraining order to prevent us from showing our equipment at the Rochester fall meeting. On appeal to the judge, we obtained permission to show our new models but on the condition that we were not to solicit or accept any orders for them.

In December of 1939, I personally appeared before the judge and finally convinced him to lift the restraining order so we could accept orders and get some income into our losing business.

Later on, Barnes filed a patent infringement suit against us, which we won in the Federal District Court in Newark, NJ. Barnes appealed, but the decision in the trial court was affirmed.

On March 2, 1940, I married Monica Hanlon of Mountain Lakes. Fortunately, Monica had a job, and we managed to share our house with another family to help pay the rent. We actually managed to limit our spending for groceries to only $2 per week during that early period of time.

Very shortly, Measurments Corp. built a small new building on Intervale Road in Parsippany, NJ, a neighbor to Boonton. We a public address system with push-pull 250s and four large horns with 12-inch drivers. Used Western Electric double button carbon mike and the Ellis double button carbon mike. Built in a mike mixer. Supplied music from phono records during the summer to various local events for pay.

1930—Supplied public address for Meacham Field for the Ford Reliability Air Tour. Sold several systems including one to a local preacher. Did first college year at N.T.A.C. because, at 16, I was too young to enter M.I.T.

1931—Enrolled for sophomore year at M.I.T. and began to service radios part time to pay expenses. Taught radio to seven high school students at the Hyde Park YMCA in Mattapan, MA. I received my first call, W1EQC, for the YMCA Station. Later, I operated from 50 Austin St. in Cambridge and from W1MX.

1932 through 1934—Continued at M.I.T. and serviced RFI problems for the local Henley Kimball Essex-Terraplane dealer in Cambridge. Also serviced radios for the local auto parts store. Installed several small audio systems in local night clubs, Elks Club, etc.

1935—Returned to Texas and built a ham station operating on 40 meters and 20 meters. I built both the 100-watt transmitter and the superhet with the Lamb noise silencer circuit. This radio shack is still intact at my old homestead in Fort Worth. From ham contacts (by the W1EQC portable call) in Fort Worth, I located a possible job in Boonton, NJ. One of my contacts in New Jersey was W3EWN, Jerry Farrel, of Pompton Plains. I arrived in Boonton on May 20, 1935 with my portable 5-meter rig on my old Model A roadster. I used to drive to the top of Sheep Hill in Boonton and work Rocky Point, Long Island. On the trip from Texas, I worked many 5-meter hams along the way.

still maintained our Boonton post office box address. Our Model 75 was used at Fort Monmouth, NJ, to finalize the design of the 268 Radar System Receiver, and this led to my visit out to Sandy Hook in early 1941 to examine the developmental model of this radar, which was under the supervision of Major Watkins.

We were asked to design a special signal generator for calibration and maintenance of the SCR 268 in the field.

I had three special passes to get through security on Sandy Hook. After using the third pass to get through the last gate, I drove all the way out to the end looking for the proper building where I would find Major Watkins. At the end of the road, I found a small service facility and was told that I had passed by the proper road. That road was not paved but was just two tracks through the heavy brush about halfway back. I finally found this little path and came up to a closed gate. As I got out to open the gate, a soldier with a submachine gun jumped out of the nearby bush. He verified by telephone that I was cleared to enter, since I had used my three passes already.

Major Watkins was at the center of a large room with people and paperwork all around. He promptly sent me down the beach to a non-metallic Quonset-type hut where I met Jimmy Moore, an engineer from RCA. He showed me the antenna and receiver, which to my amazement, was connected by an open wire transmission line using 2-inch transposition blocks to the balanced input.

On returning, we designed Model 78 with a piston-type attenuator (called a waveguide below-cutoff) and, for the first time, were concerned about pulse modulation. We delivered the pre-production sample in the summer of 1941 and about 20 early production models in October of 1941.

Also in December of 1940, I was called out to Wright Field in Dayton, OH, to discuss its need for a special pulse-modulated Standard Signal Generator for the 300 MHZ to 1000 MHZ carrier frequency range. This became our Model 84.

Devising a Pulse Generator

Wright Field also wanted a pulse generator, which became our Model 79 and, later, the 79B. The "radar" term was not used then--they called it ultra high frequency direction-finding.

Of course, both contracts were classified, and I was appointed "security officer" by Wright Field. Later on, we had a little trouble getting the Navy Bureau of Aeronautics to recognize my security clearance. Fortunately, Houck knew an admiral.

Model 79 Pulse Generator was a new field to me, so I proceeded to contact my friends. The British book by Puckle was used extensively to get started.

It was interesting that a few days after Dec. 7, 1941, we received a phone call from the Navy Bureau of Aeronautics for a pulse generator. We had several Model 79s in stock, which surprised the Navy bureau. Actually, we modified the design, and it became the 79-B with a large initial order from the Bureau of Aeronautics.

Model 84 was a joint project between van Buren and myself. Van Buren did a lot of the oscillator design, while I applied my new-found knowledge of pulse circuitry to the modulation system. Incidentally, the first Model 84 was not delivered to Wright Field. Instead, it went from Griffiths Airforce Base to England to the countermeasures lab there. I found out after the war that the countermeasures lab was staffed by my classmate John Hollywood at that time!

On the morning of Dec. 7, 1941, there lay in our incoming mail a large order for Model 78s to go with the systems being assembled by Western Electric at Kearney, NJ. Later, we received additional orders for a 78 designed for the SCR-270 being assembled in Sunbury, PA.

All of the above enormous influx required expanding into much larger manufacturing quarters in an old mill building in Boonton. Here we had very poor heating and no air conditioning, which we had enjoyed at our new small facility on Intervale Road. After the war was over, we built a much larger plant on Intervale Road next to our original building.

My first son, Claude, was born on April 6, 1942, and almost immediately Monica and I were forced to relocate from our rented home on Lowell Avenue in Mountain Lakes. We bought a relatively new house on Essex Avenue in Boonton and moved in shortly. Three of our five children were born while we lived there. We built a new home in Morristown in 1955 with larger quarters for our expanding family.

Houck joined Measurements Corp. late in November 1941 to take over the executive duties that were requiring an enormous amount of our time away from engineering the new models and getting the impending war production expansion into operation. Fortunately, as a result of contacts Houck had made in World War I, he knew a number of important people who assisted us in many ways. For example, if we had slow payment of our money from Western Electric or IT&T, Houck knew just the right vice president to call and get our check.

We had a continuous stream of people and paperwork from the WPB (War Production Board) and our various military contract officers. Much of this contact was not technical and was a distraction of our engineering time. We had to set up a much more complete machine shop and locate suitable subcontractors, etc. For a time, we leased plant space several miles away in Sucasunna, NJ, for expanded assembly line space.

After World War II started, Measurements Corp., as a small company, had difficulty in locating personnel with suitable technical qualifications. In fact, we frequently had to settle for military rejects since that was about all that was available.

One such new employee created so much trouble in our machine shop that we set up a separate company just for him and moved him out into a separate location. This was how "Components Corporation" was started in September 1943.

After two years of operation, several of us bought out this employee and when the war was over moved it to Denville, NJ, from Boonton to a location in the center of town.

Eventually, after a line of standard signal generators, such as Model 650-B, Model 80, Model 84 and Model 90, along with Pulse Generator Model 79-B and Square Wave Generator Model 71, had been developed and marketed, the principal stockholders of Measurments Corp. voted to sell the company to Edison Co. in August 1953.

Purchasing Components Corporation Stock

As a result of this arrangement, I then purchased the stock of all other stockholders in Components Corporation and entered the audio business. I always had been interested in improving the quality of audio equipment. For example, I had supplied several of my broadbanded RF transformers to Armstrong for his first high-powered FM transmitter at Alpine, NJ. I had begun work on this modification of the classical "Constant K" in 1935 at Boonton Radio Corp.

The Audio Engineering Society (AES) was founded in 1949, and I became interested in its goals for improving audio. I was elected AES president in 1954. With the help of Lewis Goodfriend, I was able to begin our publication--*The Audio Engineering Society Journal*.

At Components Corporation, I began to cut a series of special test records on my newly developed Hydraulic Disk Mastering Lathe. This was described in the *AES Journal*, and its very quiet hydraulic feed system together with its belt drive and elimination of all metal-to-metal contact provided about 85 dB of dynamic range on the 33 1/3 LP master disk produced on it.

In order to realize the dynamic range of our "Hydrofeed Lathe," we began to manufacture belt-driven turntables with a 27-pound cast iron turntable on non-metallic bearings. This was marketed under our trademarked name "Professional." Later, a less expensive model was manufactured using a cast ceramic turntable and marked under the name "Junior."

We developed an electrically heated record press and manufactured several that were shipped to Saigon and the Philippines, as well as the USA. This record press could be started up in about 15 minutes, far less than the delay time and investment required for steam heated presses.

Our stampers were held in lightweight magnesium book dies hinged and readily inserted and removed from the press. Emory Cook used this book die system for pressing records. Our preforms of vinyl powder were centered in a "biscuit" maker for ease of handling, thus eliminating the hot extruder requirements.

We had a hot section and a cold, water-cooled section of the press to speed up operation cycle since the lightweight book dies required only a short time to heat and cool. A set of two dies allowed simultaneous cooling and heating on the same cycle.

Our stampers usually were mastered on our "Hydrofeed" and then plated up by New York platers. Hot stylus cutting of the lacquer master blank disks assured a minimum of cutting noise.

High-Voltage Power Supplies

In the early 1960s, we began to manufacture some special miniature high-voltage power supplies for the operation of radiation detectors that used photo-multipliers. We were contacted by the new Goddard Space Flight Center to develop and manufacture our patented units for its earth sciences program. Our miniature supplies were used by American Science and Engineering for the first high-altitude probes fired from Wallops Island. We supplied them for use by the Air Force out in New Mexico, etc.

As a result of this work, we invented and patented a high-reliability edgeboard connector, called the "DigiKlip," for use in the space program, and a version of this connector was adopted by General Dynamics for use as the interconnect system for its SM-1 Navy missile. After more than 25 years, we still are supplying some of these special connectors to Hughes, which took over the General Dynamics missile division. We are the sole contractor to the U.S. Navy on this DigiKlip system.

We had to develop special machines to manufacture this particular connector for the Navy Missile along with a precise quality-control program. There have been no rejects or contact problems. Since we are the sole source, we have a contract with the Pentagon to maintain the machines for manufacture of this special DigiKlip connector.

The Los Alamos Lab, Argonne, US AEC and many college and private research facilities, both in the USA, Canada and France, used our miniature dc supplies for high-altitude radiation studies.

Video Facilities

We became involved in video facilities early in the 1960s. Several of our first medical video systems were installed at Montefiore Hospital in the Bronx. Our original video cameras used videcons that were quite sensitive to RF interference from the famous "Bovie" blood coagulating oscillators--which were not shielded and used the patient's body as an antenna!

We mounted our video cameras in a large copper tube which used the waveguide below-cutoff principle to reduce RF interference. Since the tube was open at both ends, the optical path from the lens was not restricted.

Our miniature supplies were used by American Science and Engineering for the first high-altitude probes fired from Wallops Island.

Modern solid-state video cameras are much less affected by strong electromagnetic fields; however, the lens metal body must be grounded to the camera metal shell to reduce stray RF input.

After the development of the video cassette recorder system, it became practical to consider use in the operating room. The ease of cassette insertion and the protection afforded by it were essential, since early experience with open reel video recorders was a disaster--the hands that loaded the tape usually were gloved and awash with isopropyl, blood, water and talcum powder (from the gloves). This really gummed up the tape during the manual threading required for loading!

There was a problem with the early cassette VCR machines. They required about six seconds to thread up from the stopped position. The cardiac cath lab doctors wanted instant start, as soon as their feet touched the foot pedal of the X-ray system.

Our solution was to modify the machines for continuous rotation of the flying drum heads at pause and to eliminate the usual head loading by providing a short pulse to move the tape slightly forward every two minutes to a fresh location on the tape. We still are doing this today, since all regular VCR machines have a stop, reverse and delayed start to allow a smooth transition between pauses. This results in a shorter delay of only two or three seconds after the foot pedal is depressed, but this is still not tolerated in the cath lab.

The improvement of video tape and a slight drop in tape tension during pause/record allows modern VCR machines to idle for about five minutes before they shut down. Of course, the two-second delay is still there when the recording is started again.

There is a special requirement for voice communication between the doctor with the patient and the tech personnel at the operating console of the cath lab today. I have developed a popular special audio system that we have installed in many local cath labs to provide hands-free, full-duplex communication. A combination of suitably placed directive microphones and loudspeakers usually solves the problem, except for some unusual areas where headphones are used by the tech personnel--particularly where privacy is required when the patient's nearest of kin are present in the tech console area. The operating area and the tech console area are separated by a radiation-protection wall with special glass that prevents direct audio communication.

Video Cameras on Surgical Microscopes

In the 1970s, we began to install color video cameras on the surgical microscopes used by ophthalmologists to be applied to teaching the modern techniques for implanting a plastic lens when a cataract is removed from the eye. Ten of our video tapes are in the Library of Congress as a record of progress in this field of surgery. We helped to show the doctors and their technicians how to edit these teaching tapes and participated in many teaching sessions during those early days. Lens implants are quite routine today, thanks to present development of new, improved lens implants and cataract removal procedures by phaco-emulsifaction.

One medical equipment requirement is the need for providing maintenance service when it is requested. This service now sometimes presents problems of collecting payment due to the tightening of finances on the hospitals.

We helped to show the doctors and their technicians how to edit these teaching tapes and participated in many teaching sessions during those early days.

During the past 20 years, our company has expanded its line of wire form connectors into a variety of test points that are much cheaper than the classic turret lugs and that provide a secure anchor for the test probe while making measurements, etc. Our most recent test point is designed for automatic installation in surface-mount applications. Two of my three sons, Mark and Byron, help to run our manufacturing and sales operation of these wire form connection products. We sell to the electronics trade through about 50 distributors and a few technical reps worldwide.

Buying an Aircraft

In 1946, I purchased a four-place, North American Aviation-built Navion aircraft that I still maintain at the Morristown

Airport. In 1986, I decided it was time to start work on a passive collision warning system—one that operates on received signals and does not need to transmit its own signal—for small private aircraft, since the FAA's new TCAS is far too costly--about $200,000.

There is really no need to have an active anti-collision warning system that broadcasts its own transponder interrogation signal in all directions, since the fact that all such signals are on the same frequency results in serious interference in busy traffic areas.

My U.S. patent No. 5,223,847 filed Aug. 13, 1990 and issued June 29, 1993 covers a system for determining the direction from which the transponder signal from another aircraft is received.

The invention uses a multimode antenna system that can locate the relative horizontal direction to another plane within one microsecond after receiving the first transponder pulse.

A pending continuation-in-part application provides additional selection of relative altitude to eliminate unnecessary warnings from other aircraft more than a few thousand feet above or below our own. This differential technology is obtained by adding another small antenna below the aircraft to provide additional precision of location of possible collision.

There are no physically moving parts in the antenna system, but instant 360-degree horizontal, and +/-7 degree vertical selection is provided by the warning display.

An additional patent application is being filed to cover the unique pilot display system that provides both visual and audible alert signal to the pilot. Four quadrants are monitored simultaneously so in theory, four different aircraft could provide simultaneous display if they were located in the four quadrants, and, in addition, were within the vertical relative altitude limitation of about +/-7 degrees.

Another patent pending provides in-flight verification by the pilot that the system is functioning properly. There is no in-flight verification for the TCAS air transport system.

Most parts of the complete system have been constructed with available components to verify practical operation. Work is continuing to complete installation in my personal aircraft for in-flight demonstration.

The pilot warning system is designed to indicate to the pilot whether the aircraft source is derived from an airline transport TCAS-equipped system or from another aircraft with only a ground source interrogated transponder response. This type of information will assist the pilot in making the proper adjustment to avoid a potential collision. The TCAS system attempts to direct the pilot, while my system provides the pilot an indication of where to look for the other aircraft, and then the pilot can make a decision as to how to avoid a collision.

—June 1995

Jerry Burnett Minter is a member of the Radio Club of America and president of Components Corp., Denville, NJ.


Grounding & Lightning Protection Solutions
DC BLOCKED 1.5MHz TO MICROWAVE 20GHz
BROADCAST & MILITARY TO 80 kW
RACK PANEL PROTECTOR 120/240Vac, 15-20A
UNI-KIT COAX CABLE GROUNDING
DATA/PHONE PUNCH DOWN BLOCK
SOLAR/BATTERY
PHONE LINE/LAN/T-1
POWER PROTECTOR 120/240Vac,15-20A
1.2 TO 20GHz MICROWAVE & DOWNCONVERTERS
IN-LINE POWER MAINS
COAX PROTECTOR WITH SAMPLER PORT
SHUNT-TYPE POWER MAINS
CELLULAR PROTECTORS TO 980MHz
STRIKE COUNTERS TOWER/POWER/PHONE
GROUNDING COMPONENTS
LAN/VIDEO
GLOBAL POSITIONING SYSTEM (GPS)
POLYPHASER
UHF COMBINERS
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The Ethereal Wire: FM and the Cellular Digital Revolution

By Jack William Whitley

Mobile telecommunications is on the verge of dramatic, revolutionary change. This is even as cellular telecommunications enters only its second decade of service and more and more people are just beginning to find that mobile phones quickly can become an integral part of their lives. With the emergence of wireless "digital" interconnection, not only will there be a fundamental change in the manner voice messages and data will be transmitted, there will be substantial improvements in both the quality and capacity of mobile telephone systems.

These improvements soon will manifest themselves in the form of the new wireless personal communications services or PCS, which the Federal Communications Commission is licensing. Moreover, the conflict between competing digital methodologies has become one of the most significant divisions in the young wireless telephone industry, with large telecommunications companies Committing great amounts of money in what is essentially an educated bet that over the lone term, one digital system will prove itself better than another.

With such changes afoot, it is sometimes difficult to appreciate the potential magnitude of the events taking place ibn the mobile communications industry. For a greater appreciation of the dynamics involved, however, an observer only needs to consider what happened the last time a technological improvement of similar significance took place in wireless communications, It occurred between the two world wars and set off one of the most brutal regulatory and judicial conflicts in the history of this country's communications industry. The whole episode was dramatically climaxed With the suicide of one of the twentieth century's great minds and inventors, Edwin Howard Armstrong. Armstrong was the first to forge an ethereal wire that could match those made of copper, silver and gold. He was the man who invented FM.

Edwin Howard Armstrong

As recounted in the recent book by Tom Lewis, *Empire of the Air*, Armstrong was already a renowned radio inventor by the close of World War I. Prior to 1913, while still a student at Columbia University, he developed the "regeneration circuit." The product of this circuit is taken for granted today as basic signal amplification. The circuit's invention, however, made two fundamental contributions.

First, it allowed wireless signals to be heard without headphones, thus allowing more than one person to listen at a time. Second, the circuit provided the first practical power source for the wireless reception of human speech. As if these contributions were not enough, during World War !, "Major Armstrong" developed the "Superheterodyne circuit." This circuit essentially made a wider range of frequencies available for use by wireless communications than previously had been possible and is used today in the tuner of most radio and TV receivers.

These inventions not only made Armstrong rich, they made him the largest non-corporate shareholder in a company set up by the U.S. government and several large American corporations to guard against foreign domination of the wireless industry. This company, Radio Corporation of America or RCA, and its leader David Sarnoff dominated the radio industry for most of this century. Ironically, both RCA and Sarnoff eventually became Armstrong's biggest adversaries.

Armstrong and the Problems of AM

The basic problem for wireless communications in 1920 was that the only method of producing wireless signals was through amplitude modulation or AM transmitting. There were a number of fundamental drawbacks to this approach. The first was fidelity. AM inherently had a limited capacity to reproduce sound. Second, and perhaps most importantly, the interference to AM signals was substantial, causing a great amount of noise and static to be received along with even the most powerful transmissions. This resulted in poor reception quality and, in some instances, unreliability. Interference was particularly troublesome in mobile applications since mobile equipment often was required to operate near automobile engines of other static-generating devices. Also portable AM transmitters were large, bulky and awkward to operate in a true mobile environment.

Armstrong organized and lead a research team in 1925 to solve the AM static problem, using primarily his own resources. The solution he eventually viewed as most promising was a new, theoretical mathematician at AT&T's Bell laboratories. According to John Renshaw Carson, mathematical calculations proved conclusively FM would not work. In fact, as Lewis indicates in *Empire of the Air*, as late as 1935, AT&T engineers believed the static in wireless communications never would be eliminated since the "song of the whirling electrons" set a "natural limit on signal clarity" and would "always be in the way."

Nevertheless, Armstrong believed FM was the answer and began to conduct experiments. After several years of work, he developed an FM transmitter and receiver that he demonstrated to engineers and industry leaders in 1933. The more astute recognized the potential of FM was enormous. It delivered a virtually static free signal with fidelity undreamed of for AM. For the first time, wireless communications could approach and even exceed the fidelity and reliability of communications by wire. Among other things, this made FM ideal for mobile applications.

Unwelcome Discovery

Despite Armstrong's breakthrough and successful demonstrations, many leading engineers of the day did not accept that FM represented a significant advancement over AM. Perhaps it was because of Carson's criticisms or the radical difference between AM and FM transmitting. Whatever the reason, the initial reaction of many radio engineers was decidedly cool. Moreover, a major force in radio had some significant vested interests in maintaining the status quo.

RCA held many of the patents for AM radio. The development of FM potentially represented a significant devaluation of those patents. Moreover, commercial broadcasting was dominated by RCA. It held some of the most valuable radio facilities in the largest markets. This included two stations in New York City and two of the three national radio networks. FM not only represented new competition to these operations, but ultimately a threat to RCA's dominant industry position. Finally, RCA's leader, David Sarnoff, did not believe in committing resources for the further development of radio. He believed the future for wireless communications was in TV and that diverting the industry's focus to a new method of delivering an existing service was unnecessary. Of course, what Sarnoff and other broadcasters failed to appreciate was the commercial potential of FM outside of broadcasting.

RCA Attacks FM

To combat the threat, RCA fought with a three-pronged strategy. First, it attempted to foster the belief that FM would not work, or at the very least, the new system did not represent a significant improvement over AM. Second, it challenged Armstrong's FM patent rights forcing Armstrong into costly and highly burdensome litigation. As it turned out, Armstrong would be fighting this litigation for the remainder of his life. Third, RCA used its significant contacts with the federal government to throw as many regulatory hurdles in the way of FM's development as possible.

This third form of attack proved successful. Initially, the FCC would not even issue Armstrong an experimental license to test FM. The most devastating regulatory blow came much later, however, after many FM broadcast stations had begun to offer service and thousands of FM radios had been sold to the public.

In 1944, possibly because of RCA and Sarnoff, the FCC took the original spectrum allocated to FM broadcast radio away and reassigned it to other services. Because broadcast FM was assigned new spectrum, in one relatively quick administrative decision by the FCC, some of RCA's most significant competition was forced off the air and the radio equipment manufactured largely under non-RCA patents was made obsolete.* (See footnote.)

Despite broadcastings resistance to Armstrong's invention, FM's use in other areas began to flourish. In one demonstration, Armstrong relayed a message more than 800 miles with the use of a series of FM stations. He did so with a fidelity equaling that of wire and at a fraction of the cost a long-distance carrier would have charged. Viewed in perspective, the demonstration was a prophecy of future long-distance competition.

In addition, police in Chicago and Connecticut began using FM radio for communicating with their units in the field and quickly were followed by other police and emergency organizations.

Perhaps the best and most extensive use of FM in a mobile environment came in World War II. FM became the radio of choice for the American armed services. It was used in tanks, jeeps, navy ships and the relatively small and lightweight walkie talkies—the great grandfather of today's handheld wireless phones. Ultimately, FM proved much more reliable in mobile situations than AM, which was what much of the opposing armies were relying on.

*** EDITOR'S FOOTNOTE:** A National Bureau of Standards member, Kenneth Norton, presented a technical paper that purported to predict that the FM band located between 42 MHZ and 50 MHZ would be impractical because of sporadic "Skip" transmission under certain atmospheric conditions that were sometimes present on the 10-meter ham radio band (28 MHZ to 30 MHZ). This paper was the reason the FCC used for shifting the band up to 88 MHZ to 108 MHZ. The 42.8 MHZ Armstrong transmitter was rated at 40 kilowatts of power output.

Armstrong's Death and Vindication

Despite these successes or perhaps because of them, the conflict with RCA became much more intense after the war. By 1953, the pressure on Armstrong began to take its toll. His personal fortune almost was depleted from the patent litigation over FM. The strain eventually worked its way into his personal life, when he separated from his wife of more than 30 years. In February of 1954, the stress apparently became too much for Armstrong; he jumped from the window of his 13th floor apartment to his death.

Armstrong's death was neither the end of the litigation nor his invention. His family eventually won all of his patent suits. The last court decision came in October of 1967 when the U.S. Supreme Court refused to overturn a judgment affirming Armstrong's patent rights against Motorola. Moreover, as time passed, FM could not be denied a central role in the communications industry.

The invention of FM lighted three fuses that would explode in different parts of the industry decades later. The first occurred in the 1970s when broadcast FM stations began to compete effectively with AM stations, This was the development with the most impact for RCA—a greatly expanded, highly competitive broadcast radio market. The second occurred around the same time when FM provided a relatively cheap, wireless alternative for creating a long-distance telephone network for MCI, which then began its historic effort to compete with AT&T. The third explosion began in 1983 and still is echoing today. FM radio became the backbone of cellular telecommunications, which is ultimately a wireless alternative to local telephone service. Thus through one invention, Armstrong helped to create new competition in three different parts if the communications industry.

Meaning to Cellular and Digital Mobile Radio

It is hard to imagine the conversion of cellular from an analog to a digital signal will involve a story as dramatic as the development of FM. After all, no one disputes the need for the conversion or the benefits of using digital signals, regardless of what system is used. The conflict is over which digital system will prove itself to be the best for the wireless industry: time division multiple access (TDMA) or code division multiple access (CDMA). Both systems break a wireless communication into fragments or packages of data at transmission. The receiving unit then reassembles the fragments back into a coherent message. The technical differences between the two transmission techniques come from how the fragments are transmitted and reassembled.

In TDMA, the fragments are sent over relatively narrow channels in a precise order. The receiver then is able to reassemble the fragments through knowing the order by which they will be sent over the channel. Essentially, the receiving unit knows that the fragments of a particular message will come over a TDMA channel at a particular time, hence the name, "Time" division multiple access.

In CDMA, individual fragments are transmitted simultaneously over a wide band of spectrum, with each fragment assigned a special "code." The CDMA receiving unit reassembles a transmission by collecting all the fragments with a common code.

Despite these technical distinctions, however, the practical differences essentially grow out of two fundamental issues: availability and capacity. TDMA technology was developed during the last decade and currently is being offered by some cellular carriers in a limited number of larger markets, such an New York, Chicago and Los Angels, which are facing severe capacity restraints under the old FM-based analog service. It is also the technology at the core of the mobile telephone system in Europe known as the global system for mobile communications or GSM standard. TDMA's primary attractions, whether in the form used by other cellular carriers in this country or in the European GSM version, is that it is a proven digital technology that is readily available.

CDMA is still in development; it should be available within some markets in the next two years, and it promises a significant increase in capacity. TDMA currently offers a three-to-one increase in capacity over analog signals, although Hughes Network Systems has announced an "enhanced" TDMA (E-TDMA) that reportedly will offer a much more substantial increase. CDMA, in contract, promises a capacity increase of 20 times or more. Although such differences do not appear to present the same clear-cut choices that were present between AM and FM, there are some interesting comparisons with the story of Armstrong and FM.

History and Predictions

First, advocates on both sides argue that the competing technologies will not work. By promoting such ideas, such advocates are using a technique pioneered half a century ago by RCA. However, these advocates risk their credibility and reputations by making sweeping statements that competing systems will nor work or will not prove practical in the long term. This is particularly the case since the full capabilities and limitations of both systems are still unknown. Carson was great scientist who made significant contributions to telecommunications. Unfortunately, he will be remembered, in part, as the person who said FM would not work. Although there were good reasons for his mistake and it was a relatively minor event in an otherwise long and distinguished career, Carson is in the unfortunate position of being mistaken at a prominent point in the history of wireless telecommunications. The Communications industry is again at such a historic point, and some advocates of the new digital systems may be setting themselves up for a position in history similar to Carson's.

Path to Industry Dominance

Another lesson from the story of FM is that, although the power of the FCC to regulate the communication industry is extensive and patent litigation can be effective in hindering new wireless system development, neither will stop the deployment of a truly superior technology permanently. When the complete history of the FCC finally is written, historians may conclude the agency reached its peak of effectiveness at protecting RCA and other industry incumbents from significant competition during the two decades following World War II. This was accomplished in pat by the commission's failure t recognize the true potential of FM and to foster the technology's development. Nevertheless, despite the significant road blocks the commission created, FM came to dominate wireless communications, particularly outside of broadcasting.

Perhaps because of what happened with FM, today's FCC is much less likely to create delays and barriers for new technologies. In fact, existing cellular rules and the rules adopted by the commission for PCS are drafted to allows licensees as much discretion as possible in designing and constructing their systems. The regulatory climate has changed so much in the last three decades that, where Armstrong once found it difficult to secure even as experimental license to test FM, cellular operators can begin to offer new digital services with virtually no significant regulatory review.

Nevertheless, in the TDMA/CDMA competition, any delay could prove significant. A delay in the development of CDMA allows TDMA to expand its foothold in the industry and perhaps become a dominant standard, especially if Hughes' E-TDMA eventually reduces the capacity differences between the two systems. Moreover, TDMA's corporate patrons have the power to produce a significant impact on the market during a delay. On the service side, TDMA proponents AT&T/McCaw and Southwestern Bell have millions of cellular subscribers between them. On the consumer equipment side, General Motors, the parent of E-TDMA developer Hughes Network Systems, can control the kind of cellular mobile unit that is installed in many of the new cars sold i n this country. On the other hand, CDMA has some formidable corporate sponsors the include almost every other major cellular carrier besides AT&T/McCaw and Southwestern Bell. These carriers have adopted variety of strategies that would allow them to wait for CDMA's planned deployment in two years. Consequently, a delay in the further development of TDMA could provide the opportunity CDMA needs to catch up.

Recently, delay was speculated as being the motivation behind a patent infringement suit against Qualcomm inc., the company primarily identified with CDMA's development, by InterDigital Communications Corp., the company that holds many of the TDMA patents. As the history of FM indicates, such litigation is not new to communications. RCA pursued such a strategy with a chilling impact.

Unlike the past, however, the current battle is between two litigants of comparable size and resources. Nevertheless, the litigation would appear to be just one more advantage for TDMA. Given TDMA's head start into the marketplace and its support by industry powers like AT&T/McCaw, Southwestern Bell and General Motors, the system would appear well on its way to dominating the industry. While RCA's patent litigation may have contributed to the destruction of FM's inventor, it did not stop the invention. This ultimately could be the case with CDMA as well.

As with FM, CDMA still can rise to be the dominant industry standard, if it proves itself to be a truly superior technology. While it still is much too early to tell how the competition will be resolved, it is interesting that a large measure of the cellular industry seems to believe CDMA will prevail despite TDMA's current advantage. Such companies as GTE, Bell Atlantic, Pacific Telesis, U S West-Newvector and others understand the mobile communications industry well and clearly are aware of the advantages that TDMA currently enjoys. Still, they all are committed publicly to CDMA's development. Under the circumstances, such a commitment is a significant vote of confidence.

Ultimately, if CDMA or any similar technology proves successful, there may be a much greater impact than the creation of a new mobile radio standard. It radically could redefine the way the electromagnetic spectrum is used. Historically, specific services have been assigned discrete blocks of spectrum. As a result, different wireless services are found on their own unique frequencies.

CDMA could add a new dimension to the frequency-allocation process. Rather than have services segregated, side by side on neighboring frequencies, with CDMA, they could be stacked on top of each other using the same spectrum simultaneously. Digital codes would distinguish wireless services rather than frequencies. This not only would mean a tremendous increase in spectrum availability, it would require a fundamental revamping of the government allocation process. Thus, if CDMA proves to be an efficient and practical transmission method, it could be an event equaling or surpassing the invention of FM. If not, the odds are against the system even becoming widely used in the mobile radio industry.

One positive contrast with the development of FM is that the cellular industry has taken an unusual step that will help to assure that no cellular user will be disenfranchised by the battle over an industry standard. With FM, when RCA convinced the FCC to reallocate the spectrum for broadcast FM to TV, thousands of consumers who had purchased FM radios were left with obsolete, unusable equipment.

In contrast, the cellular industry had been successful in fostering the development and manufacture of dual-mode mobile telephones. Such phones operate in either an analog or digital mode, depending on the kind of signal available from the local cellular system.

Dual-mode phones were developed on the assumption that, even if a single digital standard could be agreed upon by the cellular industry, not all systems could afford to convert to digital or even have the capacity demands to make such a conversion desirable. The view was that by encouraging the manufacture of phones that were capable of operating in either an analog or digital mode and leaving at least a few analog channels active in all markets, cellular users would be assured that the phones they purchased would work everywhere, even if there was no digital service available.

Presently, with competing digital standards, the backup analog mode assures cellular users of a phone that will work even if a user travels to a market using a different digital standard. Whether intended or not, the dual-mode phone helps to guard against costing consumers millions of dollars in completely obsolete equipment and allows the cellular industry to avoid at least one of the great mistakes of FM.

Greater Competition

Regardless of the outcome of the TDMA-CDMA competition, the fuse has been lighted, and it will be only a matter of time before the digital explosions hit the mobile communications industry like the ones caused by FM decades earlier. And just as in the past, what the explosions will bring are additional competition—the third lesson from the story of Armstrong and FM.

Even without digital technology, the trend in wireless communication has been greater competition in all facets of the industry. Where there once were three broadcast networks, there are now several TV and hundreds of radio networks, even without considering non-broadcast media such as cable TV. On the telecommunications side, some experts currently are speculating there will be at least three distinct local wireless telephone systems in every market, corresponding to the three existing major long-distance carriers: AT&T, MCI and Sprint. Whether this speculation underestimates the ultimate number of potential competitors once digital and other new communication technologies are fully implemented is unclear. What is clear, however, is additional competition will exist in the future, and the new digital wireless systems will make the competition even more intense.

In the past, with the limits of technology also limiting competition, companies providing wireless services often were guaranteed sizable marketshares simply by having a license issued by the FCC. With the proliferation of service providers as a result of new technologies and FCC policies that foster competition, marketshares no longer are guaranteed, and wireless communications companies are facing the same level of competition present in many other industries.

Ultimately, the impact of this competition may surprise us all. Real competition is demanding and unforgiving. It is has little regard for history, tradition or status. Although significant resources can be of great help in competition, such resources alone will assure neither victory nor even survival. RCA was one of the most powerful corporations in America for most of this century. It is held a central role in the communications industry, and few other companies could match its prestige and wealth. Today the company is gone. Its corporate logo only exists as a trademark for a French electronics manufacturer trying to give its products an American ambiance. RCA's management made a considered and deliberate decision that it was in the company's best interest to sell its assets rather than continue to compete. Such is the impact of real competition. What this impact will mean in wireless telecommunications remains to be seen.

Threshold, Anniversaries and a Trend

In 1993, the first wireless digital signals became routinely available to commercial cellular subscribers when a few large-market operators started to offer TDMA service. There is a certain appropriateness that the industry crossed the digital threshold at this particular point in time because from the fall of 1993 to December of 1996, a significant number of anniversaries in the history of wireless communications occurred. October 1993 marked the 10th anniversary of the issuance of the first cellular license by the FCC. In the following December, the 60th anniversary of the first public demonstrations of FM by Armstrong occurred, followed in February 1994 by the 40th anniversary of his death. This year marks the centennial of the invention of the wireless telegraph by Marconi. Finally, December of 1996 marks the 90th anniversary of the first wireless transmission of human speech. This event is of particular significance to the wireless telecommunications industry. On Christmas Eve of 1906, Reginald Fessenden startled amateur wireless operators near his laboratory and professional wireless operators in nearby ships at sea when they suddenly heard music and voices from their equipment. Until then, all wireless transmitting could produce was static and—what sounded to many as a close cousin of static—

the Morse Code dots and dashes. Fessenden's broadcast for the first time brought human speech to the wireless receivers. It is was the first step in the long path to where we are today.

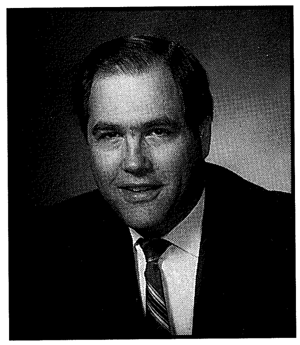
Ultimately, Fessenden's broadcast is symbolic of a trend of which all wireless technologies are part. With each advancement and improvement, the convenience and value of wireless communications becomes available to a wider segment of the public. The capacity to transmit speech eliminated an entire set of specialized skills previously necessary to communicate through the medium—the ability to transmit and receive messages in code. That single advancement alone so simplified wireless communications that using the medium to communicate suddenly came within the ability of almost everyone. Subsequent technical improvements by Armstrong and others eliminated additional barriers by lowering the technical expertise necessary to reliably operate wireless equipment. And, if the prediction of PCS advocates are true, digital will make wireless communications even more accessible by reducing the size of mobile units and the cost to use them.

From its first invention almost a century ago, the value of wireless communications was immediately apparent. It is brought safety and convenience to isolated locations of society and the world. For most of this century, however, the great value of such communications was only available to either those with great technical skills or those rich enough to employ people who possessed such skills. Perhaps the most important result of all the advanments in wireless communications and the greatest contribution cellular has made to society has been to bring the great potential of the medium literally within the grasp of the person on the street.

Easily accessible wireless communications presents a unique opportunity to more tightly weave the social fabric of our communities. It is can place everyone within a few seconds of family, friends and safety, regardless of time and place. Moreover, its worth in providing emergency assistance is priceless. Just witness the contribution of cellular in its brief decade of service. The lives and property that have been saved in the wake of floods, tornados, hurricanes, earthquakes, crime and various human disasters are testament to the service's worth.

When Armstrong invented FM, he created the ethereal wire the makes cellular's record of service possible. Moreover, the mobile communications revolution that currently is unfolding is a direct result of digital's further refinement and purification of that wire. Digital will link the mobile communications systems of the next century and be the backbone of wireless service to future generations. And its future impact to society, particularly if the history of FM is any indication, will be enormous.

The ethereal wire eventually may bind our communications together just as firmly as if it were composed of the finest grade steel. And that will be a legacy of Armstrong and all the other wireless communications pioneers.



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Communicating with the World

By Robert L. Everett, Ph.D.

"Open communications of information and ideas among peoples of the world contributes to international peace and stability...broadcasting will enhance the promotion of information and ideas, while advancing the goals of the United States foreign policy."

—International Broadcasting Act of 1934 (PL 103-236)

The elements of the International Broadcasting Bureau (IBB)—the Voice of America, Radio Free Europe/Radio Liberty, Worldnet Television, and Radio and TV Marti—have been building bridges of understanding between America and the peoples of the world for more than five decades. The bureau's unique blend of global radio and TV programs reach millions of people every day in their homes and their languages. It provides them with uncensored news and information and helps them to form a cleaner view of the world beyond their borders, as well as understand the culture and values of America and its people and learn how to build and maintain new democracies and free-market economies.

U.S. international broadcasting advances the national interest by serving as:

* An indispensable lifeline of news and information for people in countries that deny their citizens basic freedoms;

* A unique and invaluable vehicle for the presentation ofAmerican policies—as well as American institutions, products an thought—to the people of the world in the languages they speak; and

* An effective means of communicating directly to the people around the world in times of crisis.

IBB is at the forefront of a governmentwide effort to create more efficient and effective federal programs. When the International Broadcasting Act became law in April 1994, it initiated the consolidation for the first time of all U.S. government-funded, non-military international broadcasting services. The consolidation continued the dramatic downsizing and streamlining of America's overseas broadcasting. It has reduced staff, eliminated programming overlap and is laying a solid foundation for U.S. international broadcasting well into the 21st century. The consolidation has a budgetary impact: more than $400 million will be saved between 1994 and 1997 alone, and by 1997, operating costs will be almost 20 percent lower than they were in 1994.

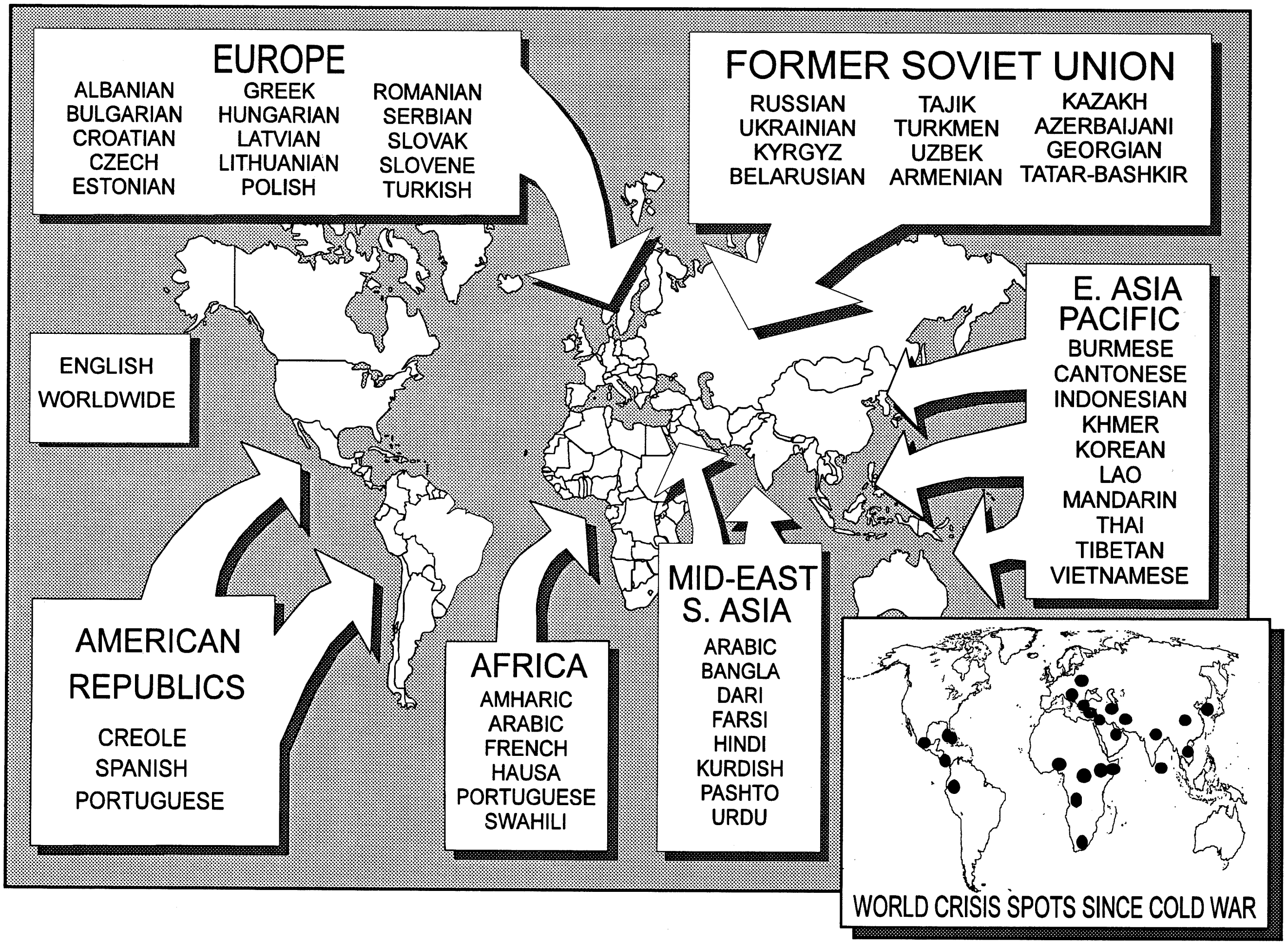

Figure 1. IBB broadcasts virtually cover the world in 53 languages and reach more than 140 million people each week. In times of crisis, its audience can increase by millions.

America Talks with the World

Using a variety of communications technologies, the bureau's broadcast services provide objective, uncensored news and information in 53 languages to more than 140 million people worldwide. Its broadcasts are a critical lifeline, especially during times of crisis, when listenership typically soars.

The map insert in Figure 1 highlights world crisis spots of the past several years, such as Russia, Chechnya, Croatia, Serbia, Rwanda, Haiti, Somalia, Israel, China, Panama, Kuwait, Iraq and Iran.

IBB operates a worldwide network of transmitting stations located strategically close to their service areas to provide optimal shortwave and medium-wave (AM) service to its extensive audience. Its worldwide satellite network distributes programs to its transmitting stations and supplies important information to U.S. embassies and consulates overseas. The bureau's broadcasting network is an effective and economical means of delivering timely news and information to the world.

Voice of America

Founded in 1942, Voice of America (VOA) broadcasts accurate and reliable news, public affairs and cultural programs in English and 46 other languages to its international audience. VOA helps the world to gain a better understanding ofAmerican society and culture and informs people in information-deprived countries with up-to-the-minute of news of happenings in the United States, their own country and the diverse world beyond their borders. VOA provides people in newly free societies with practical and important information about democratic institutions, free markets and human rights.

Nearly 100 million listeners around the world tune in VOA programs via shortwave and AM broadcasts each week. Millions more people listen to VOA programs placed on independently owned AM and FM radio stations around the world, giving VOA a vast and unequaled global reach. That VOA is heard and respected is attested to by more than 200,000 people from every race, religion and walk of life who write to VOA and more than 10,000 domestic and international visitors who tour VOA each year.

VOA Programming

VOA broadcasts are governed by a charter (Public Law 94-350), which requires its programming to be "accurate, objective and comprehensive." VOA broadcasters uphold the highest standards of journalistic integrity. They have a worldwide reputation for excellence and reliability. VOA listeners expect no less.

From the earthquake in Kobe to the South African elections to the conflict in Chechnya, VOA is on the scene to report the news as it happens, all day, every day of the year. More than 80 writers and editors in VOA's newsroom and nearly 50 correspondents at 25 news bureaus in the United States and throughout the world write and report an average of 200 news stories each day, including extensive interviews and in-country reports on developments in Asia, Africa, the Middle East, Latin America, Eastern Europe and the former Soviet union.

All VOA programming is produced at its Washington, D.C., headquarters, where reports from VOA correspondents around the world are received and recorded. VOA's original programming, which totals more than 800 hours each week, covers a broad mosaic of issues and information, including feature programs about economics, science, agriculture, literature, medicine, sports, American history and culture; music from jazz and rock to classical and country; popular English teaching programs to help listeners to learn and improve their English; in-depth coverage of conferences and events, as well as the world's first daily international call-in show, which has featured such guests as human rights advocate Yelena Bonner, astronomer Carl Sagan and country music superstar Garth Brooks.

In addition, each language service broadcasts specific programs targeted to meet the needs and interests of their regional audiences. A network of 13 relay stations in the United States and overseas transmits these programs instantly across oceans and continents via satellite, shortwave and AM to VOA listeners spanning the globe.

U.S. Policy

In accordance with its charter, VOA articulates U.S. policy, fostering understanding of America's foreign policy through editorials, presidential speeches, and statements and press briefings by the White House and Congress. VOA also broadcasts news items, interviews with policy-makers and features addressing policy issues.

Radio-Free Europe/Radio Liberty

Radio-Free Europe/Radio Liberty (RFE/RL) is a private non-profit U.S. corporation funded by grants from the U.S. government. RFE/RL broadcasts more than 700 hours each week to 25 million listeners in Eastern Europe and the former Soviet Union.

For more than 40 years, RFE and RL have served as a lifeline not only to the West but to listeners' own history and traditions. New leaders in the broadcast region consider the radios' public service programs an important form of Western assistance during their

Figure 2. RFE provides surrogate broadcasts in 7 languages to Eastern Europe. RL broadcasts surrogate services to the former Soviet Union in 12 languages.

transition period—both as a source of information and as a model for developing free, independent and responsible local media.

Its main objectives include:

* To compensate for the continued weakness of local domestic media by providing objective reporting and cross reporting on regional issues;

* To contribute to social stability by providing a moderate, alternative, non-partisan perspective on local affairs, and a counterweight to voices of extremism, thus promoting greater ethnic and regional harmony;

* To complement and amplify U.S. efforts to encourage peaceful evolution of democracy in the region.

Establishing news bureau operations in the East marked a first step in RFE/RL's adjustment to the post-Soviet world. A significant amount of programming currently is produced by free-lance journalists and stringers in the region covering local news under the supervision of headquarters-based editors. Programming continues to evolve in step with local media conditions and the information needs of the region's emerging.

In response to legislation enacted last year, RFE/RL is undergoing significant restructuring to achieve required budget cuts, including:

* Cuts in language services and relocation to Prague;

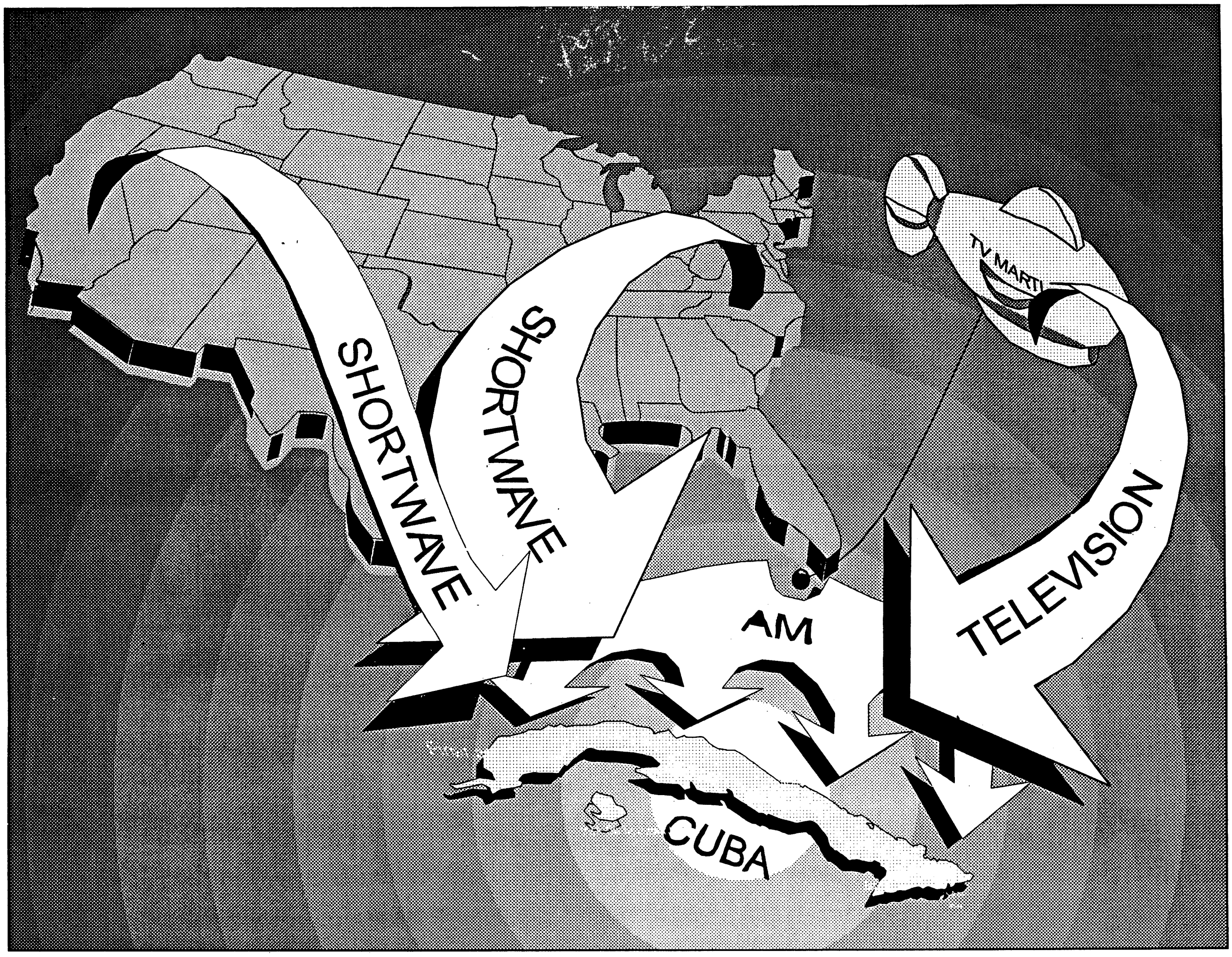

Figure 3. Radio and TV Marti's broadcasts to Cuba. AM radio is clearly received in Cuba from the Florida Keys. Television is directed to Havana from a blimp tethered over the Florida Keys. In addition, many shortwave transmissions are beamed to Cuba from several different Bureau relay stations in the U.S.

* General administrative and organizational reforms;

* Continuation of RFE/RL's grantee status under the new board of governors, which provides oversight to the bureau.

* Coordination of the management and operation of all RFE/RL transmitting stations under the bureau;

* Coordination of broadcasts between the RFE/RL and VOA to eliminate duplication.

By FY 1996, RFE/RL and VOA relay stations will be integrated into a worldwide network to improve the efficiency and coordination of U.S. international broadcasting. Technical experts from both organizations have met frequently to examine facilities and equipment and to ascertain the future technical needs of a coordinated U.S. international broadcasting operation. VOA and RFE/RL have agreed on future cooperative ventures, including pursuing joint opportunities for greater AM and FM coverage.

Office of Cuba Broadcasting

The Office of Cuba Broadcasting (OCB) oversees all government-sponsored programming broadcast to Cuba on Radio Marti and

TV Marti as illustrated in Figure 3. In keeping with the principles of the VOA Charter, these surrogate broadcasters offer their audiences accurate and objective news and information on issues of interest to the people of Cuba to promote the cause of democracy on the island.

Radio Marti

Radio Marti provides the Cuban people with news, a variety of feature and news analysis programs and music 24 hours a day, seven days a week. News and news-related programming are the staple of Radio Marti's broadcasts and comprise more than half of the daily schedule. Its objective and balanced news coverage focuses on stories with a Cuban angle and includes commentaries on politics, economics, human rights, health and social issues, as well as programs on religion, literature and the arts, women, and youth, filling the information gap resulting from 34 years of government control of the Cuban media.

All of Radio Marti's programs are broadcast from studios in Washington, D.C. Marti operates a 100 kilowatt AM station in the Florida Keys, 90 miles from Havana. Powerful shortwave transmitters complement the AM transmissions. Despite Cuban government attempts to jam its broadcasts, more than 50 percent of the Cuban population listens to Radio Marti, making it the most widely listened to radio station on the island.

TV Marti

TV Marti broadcasts news, features on life in the United States and other nations, sports and entertainment, as well as commentary and other information about events in Cuba. TV Marti's programs, which are broadcast from 3:30 to 8 a.m. daily, are transmitted to the Havana area from a transmitter and antenna in a blimp tethered 10,000 feet over the Florida Keys.

TV Marti delivers a grade-A TV signal to Havana. Massive jamming efforts by the Cuban government make it difficult to receive the signal in the city center, however, mobile monitoring shows that intermittent reception is possible in outlying parts of the city and other parts of the province. The Office of Cuba Broadcasting continues to work to minimize the effects of jamming.

Worldnet

The Worldnet TV and Film Service supports U.S. policy objectives by providing programs and services for foreign audiences. Its focus is on the promotion of U.S. national interests, including American business, international trade and U.S. security concerns.

Worldnet transmits programming by satellite to USIS posts which, in turn, record and place the programming with foreign broadcasters for mass audiences, or with cultural or academic centers for select audiences. In some regions, Worldnet packages and transmits by satellite programming designed for retransmission directly to foreign and cable broadcast systems.

The radio programs are used in more than 127 countries to assist USIS posts in their public diplomacy efforts. The principle vehicles are live interactive "Dialogues," which connect U.S. policy-makers and private experts with foreign audiences to discuss policy and broader public diplomacy issues.

Other Worldnet products include a news-related program that explains policy issues on a regular basis and provides special coverage of important presidential, U.S. government and congressional events with an international connection.

"Window on America," a weekly Worldnet-VOA magazine-format program on a wide range of public affairs issues, enjoys great popularity in the Ukraine and informs an important audience on a range of public affairs issues. "Doing Business" presents U.S. products to potential foreign buyers. "Science World" is a widely syndicated program that explores scientific developments. "Assignment Earth" covers environmental issues and tech-

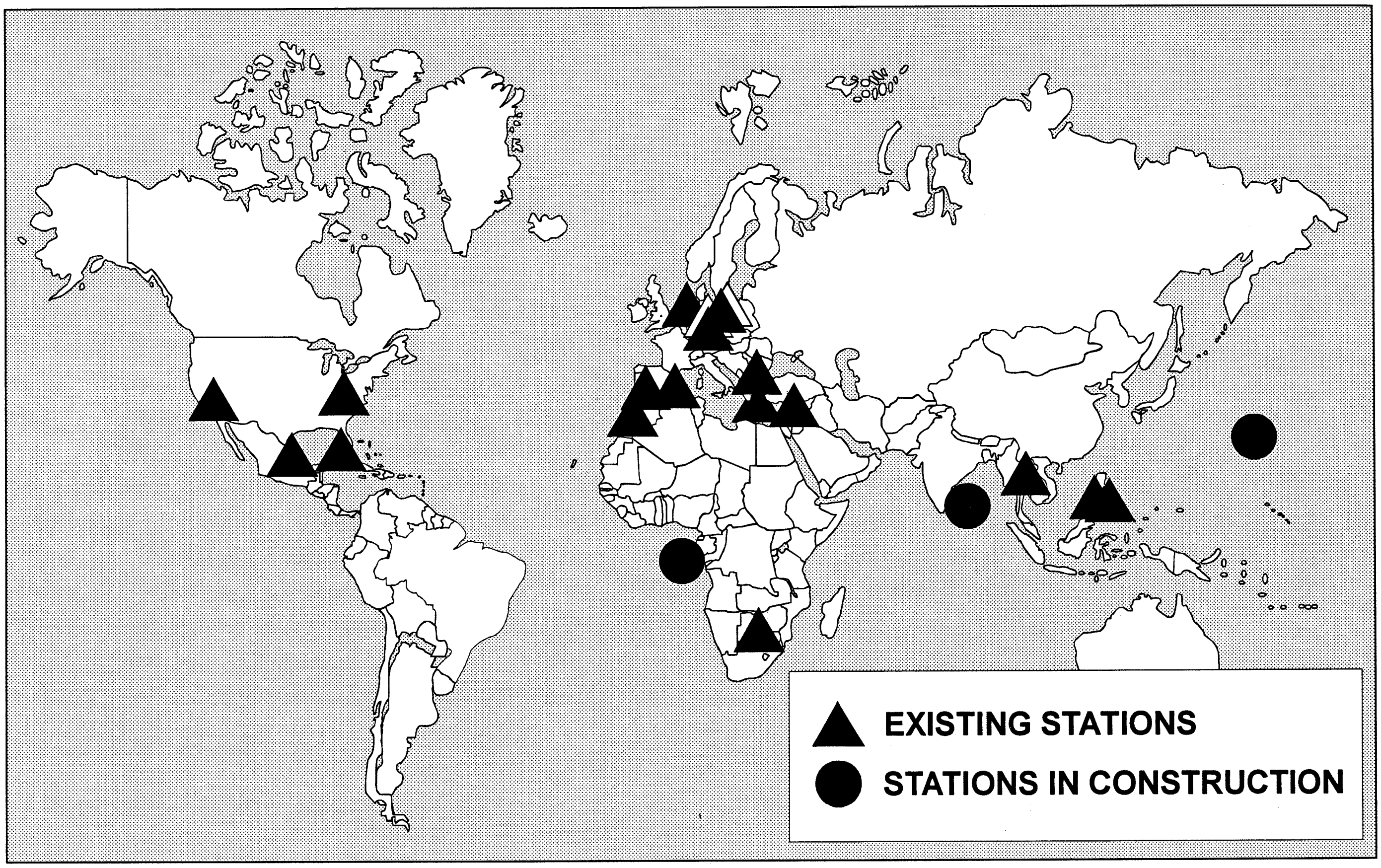

Figure 4. The locations of the Bureau's shortwave and AM radio stations are spread around the world to provide the best signal delivery to key broadcast areas.

nology, highlighting U.S. efforts and accomplishments.

Worldnet acquires public affairs, educational and informational programs that address a variety of public diplomacy issues and goals, including democratization and market-oriented economics. Included are series such as "The MacNeil-Lehrer News Hour," "Computer Chronicles," "Adam Smith's Money World," "Working Woman," "The Business of Management" and "Living With Health." Many programs are dubbed in Spanish, French, Arabic and Russian.

In addition to a range of assistance to foreign broadcasters, Worldnet works with select foreign TV producers to co-product programs covering such critical issues as market economics.

IBB Direct Broadcast Network

The bureau's direct broadcast network is its most reliable, effective and economical medium for radio program delivery. This network consists of strategically placed shortwave and AM relay stations overseas that enable the bureau to provide the best possible signal delivery.

An important feature of this network is its operational independence from exterior influences, which ensures that America's broadcasts will reach people uncensored and largely unfettered by jamming.

Leased transmitters are used to supple-

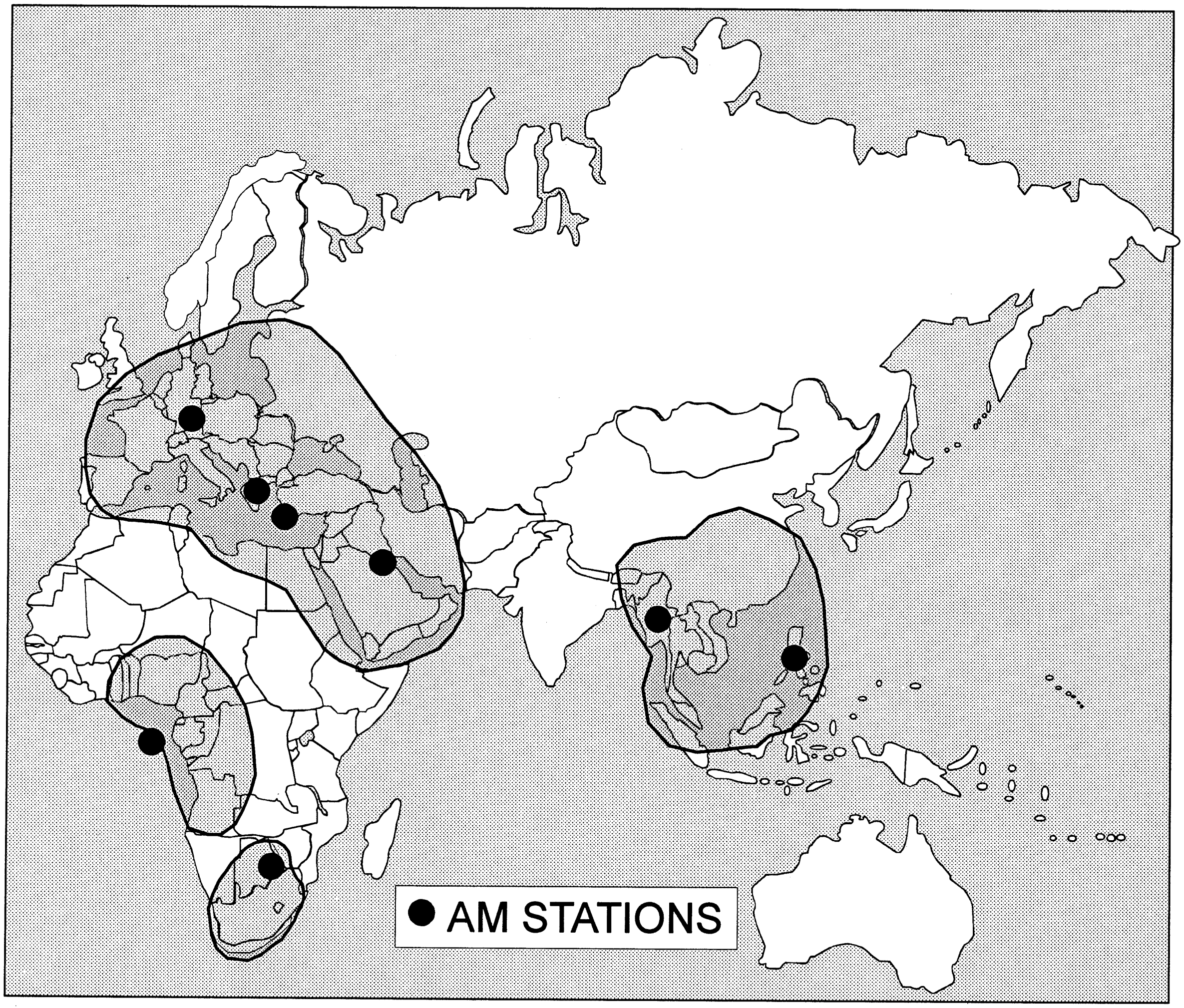

Figure 5. Bureau AM transmitting stations in Europe, the Middle East, Africa and the Far East effectively cover enormous populations in and around world crisis spots. These stations provide high-quality local spot service, while the shortwave network can provide worldwide coverage.

ment these stations in select locations to provide extensive broadcasting coverage in areas where additional signals are needed, often during crisis situations. Figure 4 shows the location of IBB stations in service and under construction.

The bureau's shortwave network is particularly valuable for worldwide coverage because shortwave remains an important communications medium in large parts of the world that are under served by local mediae or are information-deprived.

The pre-consolidation network is composed of 13 relay stations with more than 100 high-powered transmitters. These stations are flexibly configured to provide worldwide coverage, transmitting more than 800 program hours per week.

The bureau's AM network consists of 10 super-poweredAM transmitter sites. This network, whose aging components currently are being replaced with modern, energy-efficient equipment, reliably reaches hugh populations in Europe, the Middle East, East Asia and Africa. Figure 5 shows the AM network's coverage capability. Note that it covers most of the chronic trouble spots of the world. The combination of shortwave andAM coverage form the bureau's network improves the reliability of its program delivery and makes jamming of VOA programs difficult.

The bureau has made notable progress

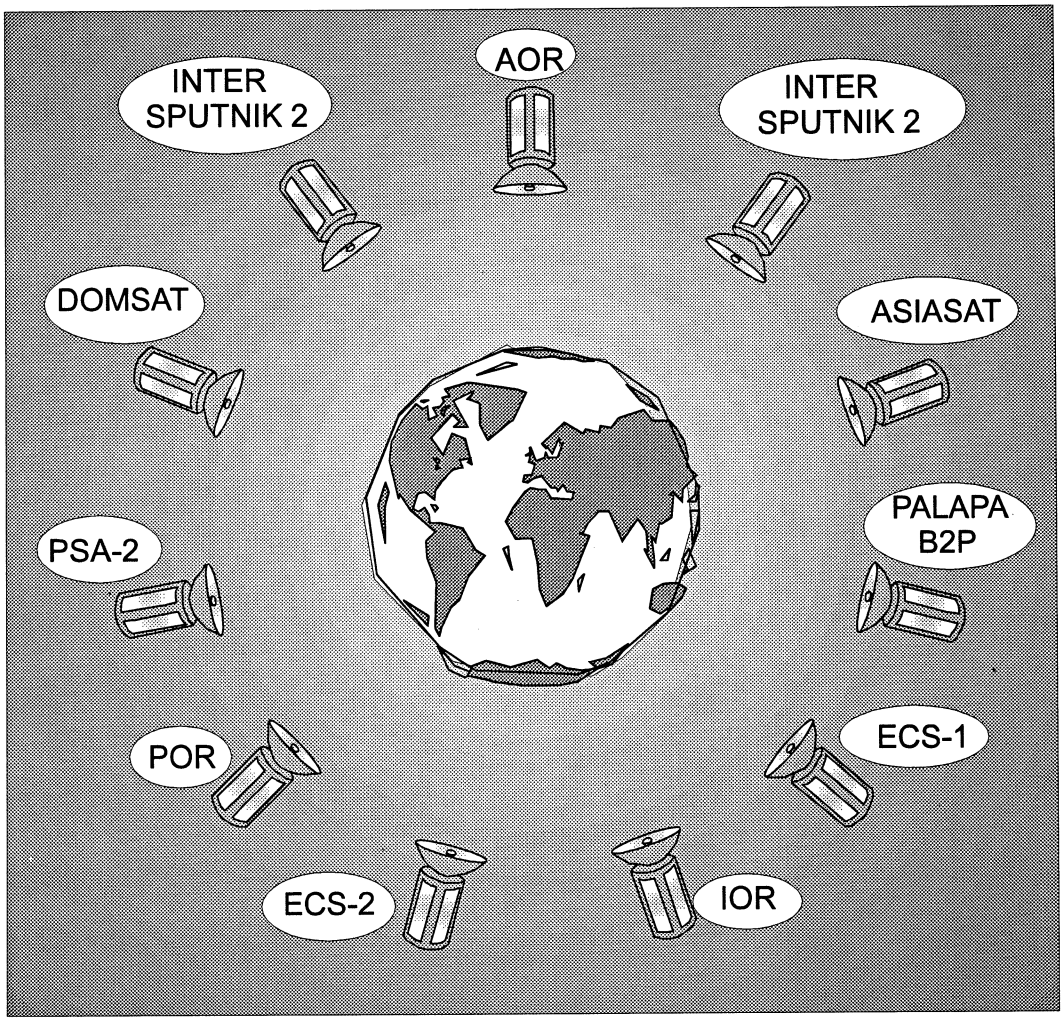

Figure 6. The IBB's worldwide satellite system distributes its programs to all clients, relays monitoring and control signals to its relay stations, and distributes USIA material to USIS posts, embassies and consulates overseas.

on its broadcast modernization program. Six new transmitting stations have been completed, and three more are currently in progress, including the key station on the U.S. possession of Tinian in the northern Mariana islands. Tinian may be the only place in the East that can provide reliable high-grade transmission as a backup for other IBB broadcasts to China and East Asia.

With the high-powered transmitters and state-of-the-art antennas newly installed in the bureau network, the program delivery quality has improved, allowing the U.S. government to broadcast directly to virtually anywhere in the world. When the modernization of the VOA broadcast network is complete, the quality and reliability of program delivery will be second to none.

The Affiliate Broadcasting Network

hundreds of local radio stations around the world are becoming affiliated with VOA and RFE/RL in order to provide their listeners with high-quality news and information in their own languages. These affiliates are generally independent AM and FM stations in nearly every part on the world with significant audiences.

With their extensive listenership, these stations make an important contribution to IBB's reach and effectively complement the more secure and reliable direct broadcast network.

Satellite Distribution Network

IBB manages and operates a global satellite distribution network, which provides major services to Worldnet for its TV programs and facilitates VOA's program delivery and communications to its relay stations and local affiliate radio stations around the world.

Satellite communications are used to forward official material form Washington, D.C., to SIS posts, embassies and consulates worldwide. This network, as shown in Figure 6, currently has more than 500 ground stations. More than 100 a year are being added to accommodate the demand.

IBB's satellite system provides superior service at a fraction of the cost incurred by antiquated telecommunications technology. The new distribution network is an effective and successful working example of how IBB is helping to re-invent the way government does business.

Internet

To facilitate access to vital material by information users outside the united States, VOA began distributing selected English tests of reports by its central news correspondence and feature writers on the Internet in January 1994.

Digitized audio in 16 languages was added in August 1994. People in more than 60 countries download more than 100,000 test and audio files each week. VOA, Worldnet and the Office of Cuba Broadcasting have made their frequencies and satellite schedules, fact sheets and press available on the network.

Looking Ahead

To fulfill the changing needs and interests of its worldwide audience, to take advantage of the continuous revolution in communications and technology, and to allow for enhanced reception and an increasingly vast global audience, IBB actively is participating in the new generation of international broadcasting technologies. This participation includes digital broadcast technology, direct broadcast via satellite, interactive communications and other new media emerging in the 21st century and beyond.

The Future Is Now

The Cold War is behind us, yet the world continues to be unstable and even volatile. Virulent nationalism, ethic hatred and competing forces of democracy and authoritarianism are staples of the world's daily news. Paradoxically, this same world offers vast possibilities for democracy, free markets, open communication and understanding among the world's peoples.

If ignorance and misunderstanding are enemies of these possibilities, communications is their antidote. IBB embodies that antidote. Indeed, its mission is just that: to enhance understanding between the United States and the world, nurture fledgling democracies, present alternatives to violence, foster dialogue among ethnic groups and serve as a living example of free and responsible media.

IBB is meeting these challenges today, effectively and economically, through consolidation and streamlining, technology enhancement and strengthened programming.

It is the people who shape world events. Revolution and change begin in the human imagination. What better or more efficient way to reach people with the story of America and its struggle for democracy, and hence to help to ensure a more peaceful world, than through these broadcasts?

Dr. Robert L. Everett is chief of the Broadcast Technology Division of the United States Information Agency, Washington, D.C.

The Radio Club of America, Inc.

Founded 1909, New York, U.S.A.

WORLD'S OLDEST RADIO COMMUNICATION SOCIETY

APPLICATION FOR MEMBERSHIP

Date:________________

TO: THE EXECUTIVE COMMITTEE

I hereby apply for membership in THE RADIO CLUB OF AMERICA, INC. and agree, if elected, that I will be governed by the Club's Constitution and By-Laws as long as I continue to be a Member.

____
Signature

Full Name:________________________
(FAMILY NAME) (GIVEN NAME) (INITIAL) (CURRENT AMATEUR CALL)

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Education and memberships in other clubs and societies: ________________

In what particular branch of the Communications Art are you most interested? ________________

Present occupation: ________________

In what year did you become interested in electronic communications?________________

Previous experience (indicate approximate dates): ________________

Please list the names of two or more members to whom you are personally known and who will sponsor you. A letter of recommendation must be submitted by one of the sponsors, and entered on the reverse side, before submission to the membership chairman.

Sponsors

____

Mail this application to the Membership Chairman, Mrs. Vivian Carr, at 645 Hoey Avenue, Long Branch, NJ 07740, with $25.00 entrance fee, plus $40 for three year's dues, in U.S. funds. made payable to The Radio Club of America, Inc.

(OVER)

The Radio Club of America was founded in 1909 by a group of the industry's pioneers, and is the oldest active electronics organization in the world. Its roster of members is a world-wide Who's Who that include many who founded and built the radio industry.

The Club's objectives include promoting cooperation amongst individuals interested in electronic communications and in preserving its history. The Club administers its own Grants-in-Aid Fund to provide educational scholarships from tax free contributions of the Club's members and business organizations.

The Club publishes and distributes its PROCEEDINGS twice a year.

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SEC. 2. The dues payable by Members, Senior Members, and Fellows shall be Fifteen dollars ($15.00) per year or, in the alternate, Forty dollars ($40.00) for a three-year period. Honorary members and Life members shall be exempt from the payment of dues or fees.

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