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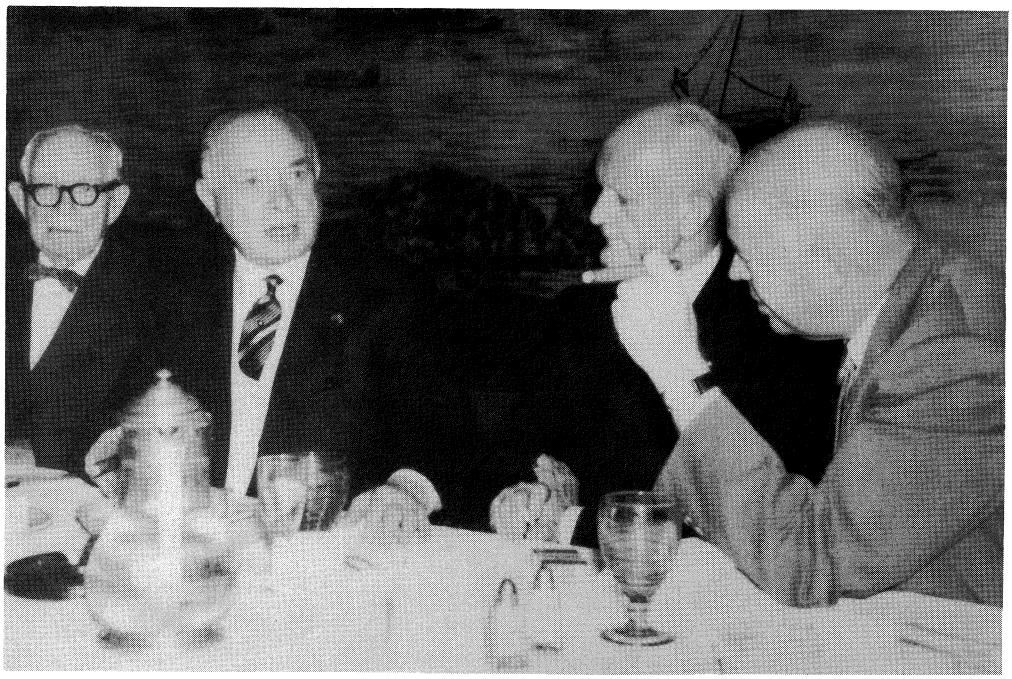

Courtesy of William D. Kelly (F)

WIZARD OF ELECTRONICS: Dr. Lee deForest, Gen. David Sarnoff, Adm. Ellery Stone, Dr. Allen B. du Mont

November 10, 1958, Fraunces Tavern, New York City

THE RADIO CLUB OF AMERICA, INC.

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The Radio Club of America, Inc.

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TREASURER'S REPORT FOR FISCAL YEAR 1988

(October 1, 1987 — September 30, 1988)

REVENUES

Dues Collected & Applied	$13,826
Other Member Fees	1,050
Sections Operations - net	58
Banquet - net	988
Advertising Sales	4,184
Pins & Plaques Sales	1,397
Interest on General & Life Funds	3,602
Miscellaneous	163
TOTAL Revenues	$25,268

EXPENSES

Publications	
Printing & Supplies	$9,490
Mailing Expenses	2,539
Meeting Expenses	2,900
Office Expenses - Rent	577
Printing & Stationery	606
Postage	735
Telephone	182
Computer Expenses	285
Consulting Fees	2,750
Legal & Accounting	750
Pins & Plaques	1,825
Miscellaneous	176
TOTAL Expenses	$22,815
NET Revenues less Expenses	$2,453

BALANCE SHEET

ASSETS

Inventory & Receivables	$ 2,374
Section & Banquet Funds	6,671
Cash in Bank - Operating	33,742
Investments - Securities	13,074
GNMA Certificates	74,190
Putnam fund	24,744
Certificate of Deposit	20,000
TOTAL Assets	$174,795

LIABILITIES

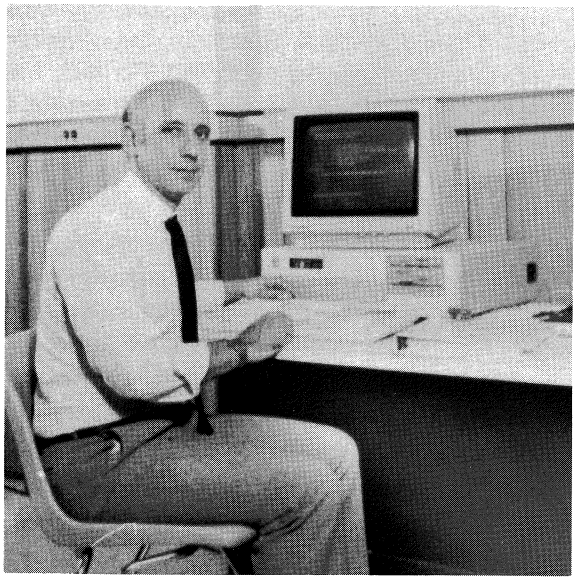
Prepaid Dues	$ 8,823
Fund Balances:	
Scholarship Funds - Principal	106,610
For Distribution	4,905
General Funds - Prior Accum	33,457
Reserve Op'g Deficits	10,465
Life Member Fund	9,698
Legacy Fund	837
TOTAL Liabilities	$174,795

SCHOLARSHIP & GRANTS FUNDS

	Capital	Available for for Distribution	Totals
Opening Balance Oct. 1, 1987	$ 92,985	$ 4,134	$ 97,119
Contributions	13,625		
Interest Earned		8,754	
Book Transfer		(1,732)	
Scholarships & Grants Awarded		(6,250)	
Ending Balance Sept. 30, 1988	$106,610	$ 4,905	$111,516

RECENT ADVANCES AND FUTURE IMPROVEMENTS IN THE AIR TRAFFIC CONTROL RADAR SYSTEM

by Albert Helfrick, Ph.D., K2BLA (M 1981, S 1984)



Albert Helfrick is a senior member of the Radio Club and the Director of Engineering for Tel-Instrument Electronics Corporation, a long-time manufacturer of avionics test equipment. He is a member of two special committees of the Radio Technical Commission for Aeronautics that formulated the performance specifications for both Mode-S and TCAS. He holds a BS, in physics; an MS in mathematics, and a PhD in applied science from Upsala College, New Jersey Institute of Technology and Clayton University respectively. He is also a professional engineer in the State of New Jersey.

THE EXISTING SYSTEM

Practically every school student knows of the important and decisive role radar played during the Second World War. Certainly, the more perceptive student knows of the equally important role radar has played in the air transport industry; for, without radar, there could be no scheduled airlines.

The principles of radar are well known, even to the layman. A short and intense pulse of RF energy is transmitted from a very directional antenna. The reflected energy, called an echo, from an object in the beam of the antenna, or target, is received. The time delay from the transmitted pulse to the reception of an echo pulse is directly proportional to the length of a vector drawn from the antenna to the target. If a narrow beamwidth antenna were used, the direction of the vector to the target would be known. Usually, a radar display is in two dimensions. In order to display in three dimensions, the antenna would have to be scanned, not only about the vertical axis but scanned from the horizon to near vertical as well. Even if such a scheme were used so that both angles of the vector, phi in the horizontal plane, and theta in the vertical plane, were determined there would be the problem of how the information would be displayed. Radars that rely only on reflected energy in the form of echoes are called primary radars.

Another radar system, called a secondary radar, is used in conjunction with the primary radar. The secondary radar antenna is rotated with the primary antenna and gathers secondary information from the targets. A secondary radar differs from the primary radar in that pulses of RF energy are transmitted but rather than receiving reflected energy, each target carries a radar transponder that receives the pulse from the secondary radar at a different frequency than the primary radar and transmits a reply on a third frequency.

There are several advantages to the secondary radar system. First, the echo is very strong as it eminates from a transmitter rather than being a very low-energy reflection. The energy received from an echo of a primary radar system is inversely proportional to the fourth power of the range. Because of this extreme loss of signal energy, for practical ranges of 100 nautical miles or more, radar transmitter radiated powers are measured in megawatts. The secondary radar system, because power is added to the return signal, has signal levels inversely proportional to the range squared and thus transmitter powers on the order of kilowatts produce ranges similar to typical primary radars.

Another advantage of the secondary radar system is that information can be transmitted from the target. In the air traffic control radar system a ground station, called the interrogator, transmits a simple pulse pair and the airborne targets equipped with transponders respond with a burst of RF energy in the form of a group of pulses. The air traffic control radar beacon system or ATCRBS which has been in operation for more than 40 years, supplies two types of information. First, the aircraft's identity may be transmitted which is called mode-A. Secondly, the aircraft's altitude may be transmitted which is called mode-C. The altitude provides the missing link for a three dimensional display when using a radar antenna scanning only one axis.

The transmission of identity has both a civilian and a military purpose. In the case of the civilian use, an air traffic controller has positive identification of the aircraft displayed on the radar screen. In the case of the military system, the secondary radar system is called IFF for identification-friend-or-foe which accurately describes its function.

The major drawback of any secondary radar system is that every target must be equipped with a compatible transponder, which is a matter of regulation and enforcement. The current laws regarding transponders allow unequipped aircraft to operate legally in the majority of this country's airspace. Fortunately, transponders are required in high traffic density areas and at high altitudes.

Another disadvantage to the ATCRBS transponder system as now installed throughout the world, is each transponder responds to practically every interrogation. This results in a problem when two or more aircraft are near the same radius vector from the in terrogator. The two aircraft will respond nearly simultaneously and there will be mutual interference between the two aircraft called garbling. When the two interfering pulse bursts are interleaved, it is highly unlikely that the result would be close to a valid reply. However, there is a finite danger that this could happen and display one phantom aircraft rather than two. A garbled reply is an extreme danger as it masks the identity of two aircraft in close proximity. Air traffic control computers are equipped with de-garbling software that requires several identical responses from an aircraft before the response is trusted. There is, invariably, some relative motion of the garbling aircraft and the nature of the received signal will change and eventually be resolved as two individual aircraft. This requires additional responses from the transponders to check the validity of the reply. In addition, other air traffic control radars may be interrogating the transponder and replies will be received by an interrogator that was not a result of an interrogation. Each radar interrogator has a unique repetition rate so that replies from another interrogator cannot remain synchronous to the local interrogations. These asynchronous garbling signals are called "fruit" and circuits and/or software, called de-fruiters, are used to eliminate this form of interference.

In the civilian ATCRBS system, there are two types of interrogations. One is an identity interrogation which results in the transmission of a four digit octal number from the aircraft as assigned by the air traffic controller. The second interrogation results in the altitude being transmitted as a 12 bit Gray code. With the exception of requesting an identity or altitude reply, the ATCRBS interrogator has no control over the replies from the transponder. In addition, only 4096 different identity codes are possible which means that identities have to be "recycled" from one air traffic control area to another.

THE MODE-S SYSTEM

A new air traffic control radar beacon system was formulated to overcome many of the disadvantages of the ATCRBS system. The major distinguishing difference between the older ATCRBS system and the new system is that the transponders can be selectively interrogated and hence the nomenclature for the new system of mode-S for select. Each transponder has a unique address with no recycling throughout the world. When a mode-S interrogation is made, only the addressed transponder will reply; all others will remain silent. There are interrogations called all-call which permit all mode-S transponders to reply. Considerable data can be reliably transmitted as data words up to 112 bits with a cyclic redundancy check, CRC, for security. In addition to the selective calling, the mode-S system has control over the replies of the transponder. The transponder can be inhibited from replying for a period of time. The probability of responding can be adjusted and so on. The mode-S transponder is the data modem for future sophisticated air traffic control and collision -avoidance systems.

Because all mode-S replies use a CRC for error detection, the validity of a reply can be determined with a very high rate of accuracy. Thus, only one interrogation will result in a trustworthy reply with a very small chance for error. In addition, the replies can contain long messages with sensitive data without the danger of misreading. If there has been garbling, the CRC will not check-out and the garbling will be detected. Because of error checking and selective addressing, transponders will transmit less and reduce the amount of interference.

The mode-S system will be phased-in over a period of several years. Therefore, the mode-S transponder must respond to all ATCRBS interrogations, as an ATCRBS transponder would, to permit uninterrupted operation with remaining ATCRBS ground equipment.

To gain an insight into how these features of the mode-S secondary radar beacon system will improve the operation of an air traffic radar system, consider a mode-S in terrogator being turned on for the first time. The radar interrogator has no data concerning the aircraft in its service volume and must locate and identify each aircraft.

The first interrogation made would be an ATCRBS mode A which causes all transponders both ATCRBS and mode-S to respond. The second interrogation would be an ATCRBS mode-C which would result in all transponders providing altitude information. The two ATCRBS interrogations resulted in identical replies from both mode-S and ATCRBS transponders. After these two interrogations, the existence of all aircraft, except those that may have garbled, is known and their ATCRBS identity and altitude are known. The ATCRBS identity is not a unique identity and is a code assigned by an air traffic controller or is one of the universal codes used by many aircraft.

After the ATCRBS interrogations, a mode-S all call is made. This causes the ATCRBS transponder to remain silent while only the mode-S transponders reply with their ad dress. After the receipt of a mode-S transponder's address, the mode-S transponders are interrogated individually and their altitudes are received.

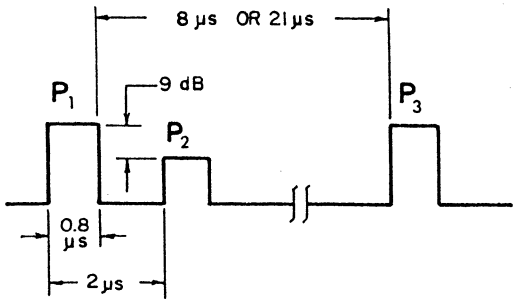
If there is no garbling at this point, the existence of all aircraft is known. The altitude is known and the mode-S transponders are distinguished from the ATCRBS transponders. If there is garbling, further interrogations are required.

If two ATCRBS transponders have garbled, there is no other method to resolve them other than waiting for the the aircraft to separate and thus self-resolve. However, if one of the transponders is mode-S, the interrogator has some control over the replies of that transponder. By interrogating with a ATCRBS- only interrogation the mode-S transponder will not reply and one of the two transponders may be identified. Likewise a mode-S-only interrogation will cause the ATCRBS transponder to remain silent allowing the mode-S transponder to be identified.

Once the identities of the aircraft in the mode-S radar service volume are estab lished, the aircraft are interrogated selectively and occasionally all calls for both ATCRBS and mode-S are made to identify new aircraft entering the service volume.

The previous sequence of events was to demonstrate how a mode-S interrogator could identify all aircraft in its service volume. The mode-S transponder is very flexible and other sequences of events could result in a similar goal. The sequence of events is controlled by the air traffic control computer and the software sets the actual sequence. This software is very sophisticated and tailored for the air traffic con trol area's special needs.

The ATCRBS and mode-S secondary radar beacon systems operate on two frequencies in the L band at 1030 and 1090 MHz. The interrogation frequency, that is the ground to air frequency is 1030 MHz, while the reply frequency is 1090 MHz. (A collision avoidance system will use the mode-S transponder for data communication and will require air-to-air interrogations and replies. Therefore, not all 1030 MHz signals will be ground to air nor 1090 MHz signals air-to-ground some could be air-to-air.)



ATCRBS INTERROGATION PULSE MODULATION

FIG. I

ATCRBS interrogations consist of three pulses, designated P1, P2 and P3, transmitted on a frequency of 1030 MHz as shown in Figure 1. P1 and P3 are the actual interrogation pulses and the time interval between the two pulses determines the type of reply expected. For civilian interrogators, 8 microseconds is used for identity while 21 microseconds is used for altitude. P2 is transmitted at a level 9 dB or more below P1 and P3 from an omni-directional antenna. This serves as a signal-level reference for the sidelobes of the rotating antenna. By definition, the sidelobe signal levels from the antenna are lower than P2. Therefore an ATCRBS transponder does not reply to an interrogation where P2 is equal to or greater than P1 or P3 as the transmission emanated from an antenna sidelobe. In the mode-S interrogations, this pulse is deliberately transmitted from the rotating antenna to inhibit ATCRBS transponders from replying. In future years when all ATCRBS transponders have been eliminated from the system, the P2 pulse will simply be one of the interrogating pulses.

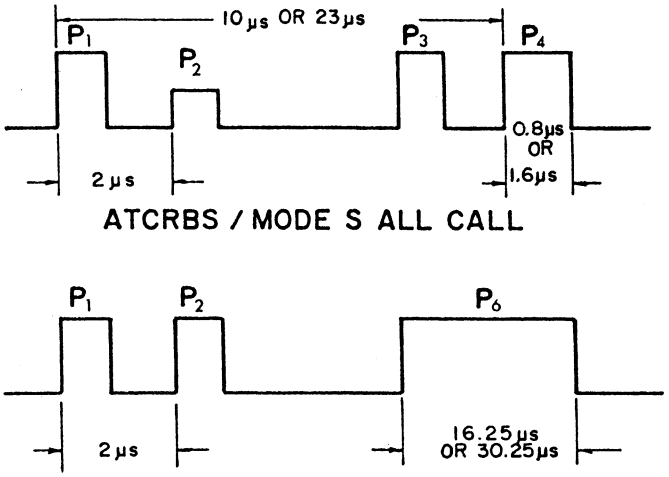
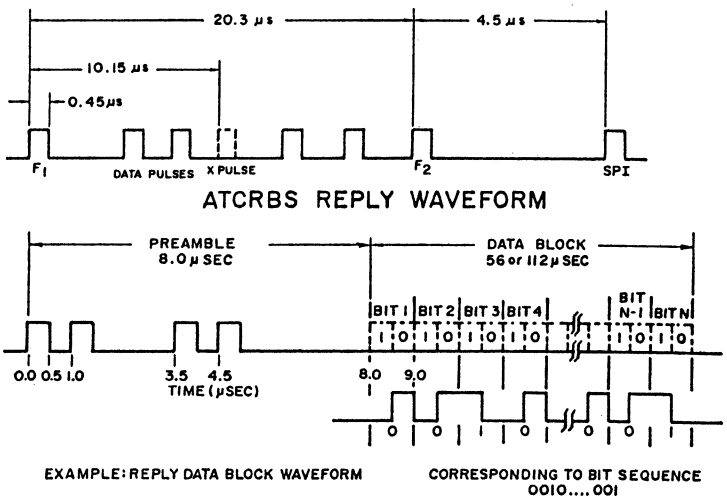


FIG. 2



MODE S REPLY WAVEFORM

FIG.3

ATCRBS/mode-S interrogations consist of four pulses, P1, P2, P3 and P4, transmitted at a frequency of 1030 MHz. The format of P1 through P3 is the same as an ATCRBS in terrogation so that the older transponders will reply. The existence of P4 has no effect on the ATCRBS transponders as these units were designed to have a dead time after P3. Mode-S transponders do read P4 and reply with either a mode-S identity or altitude depending on the width of P4. Mode S-only interrogations consist of three pulses, P1, P2 and P6, likewise transmitted on a frequency of 1030 MHz. All mode-S- only interrogations transmit P1 and P2 at the same amplitude so that ATCRBS transponders do not reply. The pulse, P6, contains data encoded via differential phase shift keying, DPSK. The 56 bits contain the 24 bit transponder address, the ad dress CRC bits and other data as required by the interrogation. A longer P6 can also contain 112 bits of data for interrogations and information transfer requiring the longer message. The DPSK phase reversals occur at multiples of 0.25 microsecond and the total pulse length when all the synchronizing and guard pulses are included is either 16.25 us or 30.25 us.

The transponder replies to an ATCRBS interrogation with a pulse amplitude modulation RF burst containing two framing pulses called F1 and F2, thirteen data pulses and a special identification pulse called SPI. The existence of a pulse in the assigned time slot is a logic one while the absence of a pulse in the assigned time slot is a logic zero. The center or seventh data time slot is a currently unused pulse that has been described as being available for future use in all specification documents since the beginnings of the system but has never been used. A logic zero is inserted in this position.

A mode-S reply is a pulse position modulated RF transmission as shown in Fig. 3. There are four pulses consisting a preamble which provides timing for a receiver and provides a unique pulse identity for the reply. Either 56 or 112 bits of information are transmitted with a mode-S reply. A logic one is designated by a 0.5 us pulse in the first half of a 1 microsecond interval while a logic zero consists of a pulse in the second half of the interval. When a logic one and zero are adjacent the two pulses merge to prevent narrow time gaps between the pulses. Like mode-S interrogations, replies contain CRC bits for error detection.

The choice of pulse position modulation for replies rather than DPSK arose from a practical consideration. Radar transponders have been an unwelcome addition to smaller aircraft. The use of a transponder was legislated into existence to improve air safety and represented an unwanted expense. The cost of an airborne transponder was kept very low by the use of a very simple transmitter that, almost universally, was a simple single-tube cavity oscillator for small aircraft. It was felt by the FAA that there would be a continued chance of a simple airborne transmitter if DPSK was not required for mode-S replies. The success of the mode-S system hinges on the widespread acceptance of the newer transponder and the installation in aircraft both small and large.

As of 1989, federal air regulations require that only ATCRBS transponders manufac tured before Jan 1, 1987 may be used in new aircraft installations. After Jan 1, 1992, no ATCRBS transponders may be used in new aircraft installations. Mode S transponders may be installed regardless of the date of installation or manufacture. ATCRBS transponders currently installed may be used as long as they can be main tained.

ATCRBS transponders may be manufactured but they must be exported as they have no useful purpose in the United States.

In addition, the FAA has expanded the requirements for the mandatory use of altitude reporting, mode-C, capability for ATCRBS transponders to practically all major ter minal areas.

The mode-S transponder will be the major vehicle for communications associated with the government-mandated traffic alert and collision-avoidance system called TCAS. (see sidebar) Over the period of several years, every mid-air collision has renewed an interest in a collision-avoidance system. Difficulties would arise in the development of the system, mid-air crashes would wane somewhat and rapidly advancing technology would quickly make a developing collision-avoidance system appear obsolete. The obituary includes ACAS, (airborne collision- avoidance system), BCAS, (beacon collision-avoidance system), and some privately-funded systems. The collision of a private aircraft and a Pacific Airways Jet in California resulted in the FAA mandating the development of a collision-avoidance system with all haste.

TCAS operates on air-to-air communications which is different than many of the earlier collision-avoidance systems. Mode-S transponders may also interact with the older ATCRBS transponders for limited collision-avoidance information.

Congress has legislated that by 1992 all aircraft with more than 30 passenger seats operated by U.S.-based carriers install TCAS. This version of TCAS, TCAS-II, is capable of providing alerts for aircraft operating with mode-C ATCRBS transponders and mode-S transponders. United Airlines and Piedmont have three aircraft equipped with operating TCAS-II systems and have logged more than 2100 hours of flight testing.

In addition to paving the way for a collision avoidance system, the mode S transponder will enhance the operation of the air traffic control system in conjunction with new ground-based equipment. The FAA in 1983 proposed, and later implemented, a general upgrading of the National Airspace system, The upgrade includes new radar equipment, new computers and new software. The enhanced air traffic control radar system will be made possible by the large-scale installation of mode-S transponders in aircraft.

To summarize, the mode-S transponder will allow more effective data communications resulting in less transmission on crowded frequencies. Longer data words are available so that aircraft identities do not need to be recycled. Air-to-air communication for collision-avoidance systems is now possible. New government regulations will cause more aircraft to be transponder- equipped.

THE FUTURE

The mode-S secondary radar system is the first major modernization of the air traffic control secondary beacon system since it's invention. Will it make the system more effective? In the congested terminal areas, probably. In the high altitude airways, the mode-S system will have little effect. The ability of the system to transmit data could be used to advantage as proposed by the air space plan but there are other communications systems such as VHF, UHF radio and satellite communications that could be used for similar purposes. The role of the mode-S transponder in the TCAS system is important, but there is some debate as to just how effective TCAS will be. There is no collision-avoidance system in operation in spite of twenty years of talk. TCAS has a chance of working and it is about time that a system be designed and implemented.

All government organizations are enamored with acronyms. An acronym is a word that is constructed of parts of words with the resulting new word being pronounceable. For example, a word used throughout this paper, radar, stands for radio detection and ranging. In some cases the pronunciation of an acronym is not evident from the spelling. Thus, the accepted pronunciation of the acronyms used in this paper given below.

ATCRBS = at-crabs

TCAS = tee-kass

ACAS = a-kass

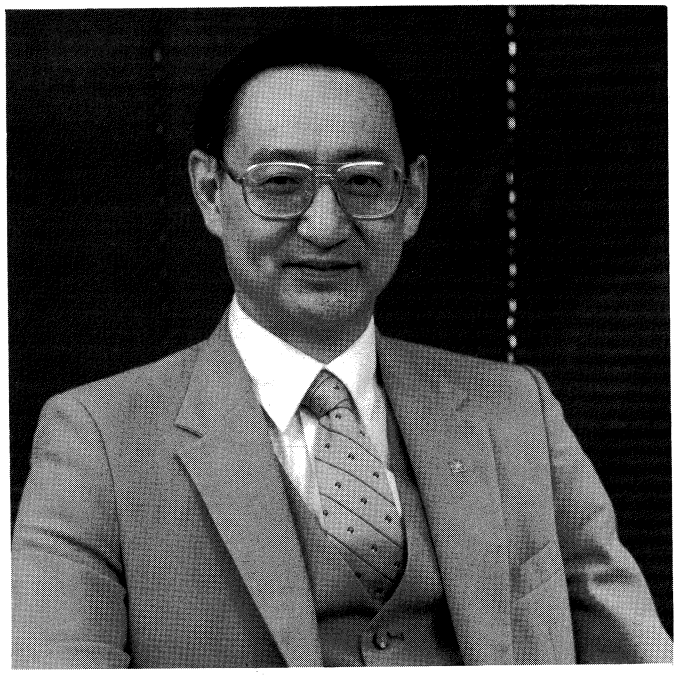
BCAS = bee-kass

Yes, they may sound silly, but if you spoke of A-T-C-R-B-S to the FAA, no one would know what you were talking about.

DIGITAL CELLULAR RADIO IN THE FUTURE

by William C.Y. Lee, Ph.D.
Vice President – Technical Planning & Development
PAC*TEL Personal Communications

Today, the cellular radio industry is growing very rapidly, but the FCC has no intention of allocating more than 50 MHz to the present cellular industry. As a result, analog cellular systems are starting to face capacity problems.



System Performance Parameters

Splitting 30 kHz channels in analog systems does not provide an increase in the spectrum efficiency because, in analog systems, the bandwidth reduces while the C/I (carrier-to-interference) increases when maintaining the same quality of voice transmission [1]. We have proven that digital cellular can provide an increase in capacity [2]. Based on six co-channel interferers as shown in Figure 1, and a path loss of 40 dB per decade, an equation called "radio capacity" is introduced by Lee [1,2]:

$$m = \frac{B_t}{B_c \cdot K} \quad \text{channels/cell} \qquad (1)$$

where m = radio capacity,
B_t = total bandwidth,
B_c = channel bandwidth,
K = $[(2/3)(C/I)_s]^{1/2}$, the number of cells in a frequency re-use pattern,
$(C/I)_s$ = required C/I from subjective test.

For analog systems, we can compare two cases: B_c = 30 kHz and B_c = 15 kHz. When B_c = 30 kHz, the required $(C/I)_s$ = 18 dB. For the same voice quality when B_c = 15 kHz, the $(C/I)_s$ = 24 dB. Therefore, even though the number of channels is doubled, the required $(C/I)_s$ increases. The spectrum efficiency in cellular systems is calculated based on both $(C/I)_s$ and B_c, and no difference is shown between these two cases in the following table.

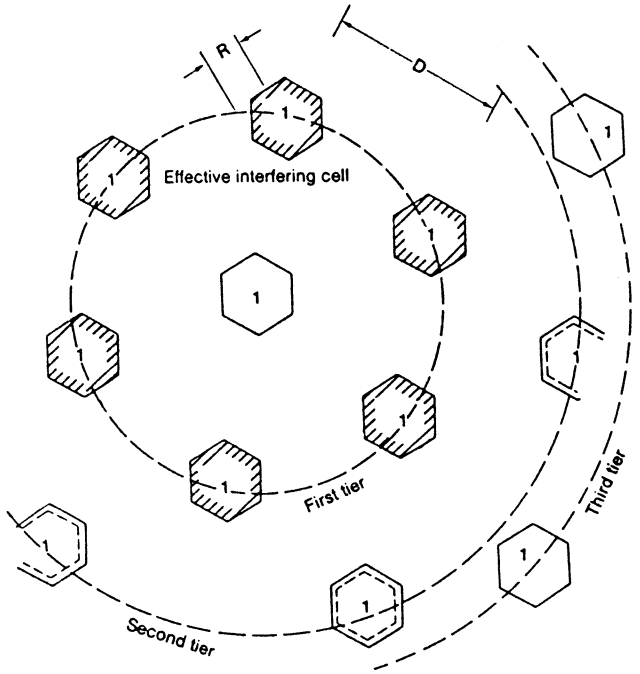


Figure 1 Six effective interfering cells of cell 1.

Assume B_t = 12.5 MHz, and substitute the numbers in Equation 1 yields:

B_c (kHz)	$(C/I)_s$	m (# of chs/cell)	Remarks
30	63 (18 dB)	64	present bandwidth
15	251 (24 dB)	64.4	hypothetical bandwidth

For maintaining the same voice quality in digital cellular systems, we have found that when B_c = 10 kHz, $(C/I)_s$ = 18 dB; when B_c = 30 kHz, $(C/I)_s$ becomes 10 dB. A table follows:

B_c (kHz)	$(C/I)_s$	m	Remarks
30	18 dB	64	present analog cellular
30	10 dB	161	proposed digital cellular [3]
10	18 dB	192	proposed digital cellular [4]

From the above table, we see that the digital cellular is more spectrally efficient than analog cellular.

Key Points in Digital Cellular

There are a number of key points which should be considered for digital cellular service. These include the characteristics of the human voice, digital communication performance, and spectrum sharing methods.

The human voice is an analog form which covers a frequency range from 300 to 3000 Hz. By changing from an analog form to a digital form, the digital voice bit rate requires a frequency range at least three to four times that of the analog form for the same voice quality. If the bit rate is lowered for the digital voice, the degradation in both speech recognition (intelligibility) and speaker recognition (fidelity) will be noticeable.

With the digital form, information is represented by either ones or zeros, called "bits." To detect a "one" or "zero" for every bit in a digital bit stream, the received signal is simply compared to a threshold level. If the signal is above the threshold, a "one" is recorded, a "zero" being recorded for the opposite case. An analog system on the other hand needs a precise voltage level at each instant of time. So, even in an environment of heavy noise or interference, it is relatively easy to correctly detect the information in digital form and to restore the original bit stream. Consequently, digital is less susceptible to noise and interference.

It is necessary to select a good scheme to reduce the frequency bandwidth of a digital voice channel while transmitting in a mobile radio environment. Two schemes are considered. They are the constant envelope modulation and the linear modulation. The former is naturally fitted to transmit the signal in the fading environment, whereas the latter is used to further reduce the channel bandwidth.

Digital transmission can use either Time Division Multiplex Access (TDMA) or Frequency Division Multiple Access (FDMA). With analog transmission, however, only FDMA can be used. TDMA means that a digital form can be chopped into many segments and each segment can be sent in designated time slots. As far as the spectrum efficiency is concerned, we have proven that both schemes are equally efficient. Because digital transmission has these two multiple accesses to chose from, we should select one of them based upon many other cellular applications. Sometimes, the degree of risks and availability of development should also be considered. As of January 1989, TIA (Telecommunications Industry Association) has decided to adopt TDMA as the U.S. standard [5].

Digital cellular radio has a number of advantages over analog systems:

(1) All co-channel cells require either less separation or smaller $(C/I)_S$;
(2) it uses less power;
(3) the messages are easily encrypted;
(4) it is lower cost than analog; and,
(5) it is compatible to ISDN for many new applications and services; it provides many new features.

In conclusion, by reducing the channel bandwidth from 30 kHz to 10 kHz, digital cellular systems can increase the number of available radio channels by three. However, the system capacity, i.e., the number of customers, can be increased by a factor of four to ten dependent upon the innovation of the systems' designs. Additionally, digital cellular radio systems possess many desirable characteristics which analog cellular systems do not.

REFERENCES

1. Lee, W.C.Y., "Spectrum Efficiency: A Comparison Between FM and SSB in Cellular Mobile Systems," presented at the FCC Commission meeting room, Washington, DC, August 2, 1985.

Lee, W.C.Y., "New Concept Redefines Spectrum Efficiency of Cellular Mobile Systems", *Telephony*, November 1985, p.82

2. Lee, W.C.Y., "How to Evaluate Digital Cellular Systems presented at FCC Commission meeting room, Washington, DC, September 3, 1987.

Lee, W.C.Y., "How to Evaluate Digital Cellular Systems," *Telecommunications*, December 1987, p.45.

3. AT&T demonstration of a Proposed Digital Cellular System in Chicago, IL, held in March 1988.

4. Swernp, J. and J. Uddenfeldt, "Digital Cellular Personal Communications", *Technology*, May 1986, pp 6 - 12.

5. TIA debate meeting on FDMA vs. TDMA held in Denver, CO, January 12, 1989. TIA voted to adopt TDMA on January 19, 1989.

*In Los Angeles, the nation's densest cellular 'phone market, the cells have shrunk to cover a single intersection. The smallest cell operated by PAC*TEL has a radius of only 3,000 feet, just large enough to cover a short section of the Santa Monica freeway. With rush-hour traffic averaging less than 20 mph, the only thing there is to do is talk.*

The big problem in Los Angeles now is in adding subscribers to the jammed cellular systems. The FCC has allocated 437 channels to each carrier. When those frequencies get used up, the carrier has to get creative. The trick is to re-use frequencies in non-adjacent channels while avoiding interference.

*Some problems, like interference, are solvable with money and new ideas. For example, PAC*TEL has extended coverage into the remote Laguna Canyon in Laguna Beach, CA by using solar cells to generate power for repeaters. To carry calls through the 3/4 mile Caldecotte Tunnel from Oakland to Walnut Creek, PAC*TEL blasts signals from antennas installed at either end. A "leaky" coaxial cable that acts as an antenna will be used in expanding services underground from subways to parking garages.*

*Where does PAC*TEL go from here? "We've pretty well stretched the current technology about as far as it will go," says James Proffitt, director of network projects for PAC*TEL Cellular. "To build smaller cells, we need new techniques to confine the signal to smaller areas. We're experimenting."*

A solution to these problems seems near. in a new technology called digital cellular — one in which radio interference is virtually eliminated, in which privacy from eavesdropping is assured, and in which computer data can be safely and inexpensively transmitted between a home office and a vehicle.

The Cellular Telecommunications Industry Association and the Telecommunications Industry Association agreed during January 1989 on a way to triple instantly the capacity of any cellular system. By the time that a full standard has been agreed to, the cellular capacity might grow tenfold.

The coming digital transmissions will improve cellular reception by facilitating error detection and error-correcting mechanisms. Unlike existing analog signals, digital signals are easy to distinguish from background noise, and can be reconstructed.

The major manufacturers of cellular radios have taken a step toward agreeing on industry-wide standards by selecting "time division multiple access" as the way to squeeze signals from several 'phones into one cell over one frequency. This is a time-sharing scheme that takes advantage of the ability of a channel to deliver about 48,000 bits of data per second while each 'phone conversation can be transmitted accurately with only 16,000 bits per second.

High-capacity integrated circuits are necessary for this operation; they have to freeze-frame a voice message several thousand times per second, encrypt the resulting data to foil the eavesdropper, transmit the data in bursts, and then undo all this at the receiving end to reconstruct the sounds.

The switchover to digital cellular probably will take place gradually and will operate in tandem with the existing analog system. After that, it may be able to switch to digital by retrofitting.

*The technical article by Dr. William C.Y. Lee, of PAC*TEL Cellular tells you of the future of cellular radio as viewed by PAC*TEL.*

RADIO - YESTERDAY AND TODAY

by Ralph A. Haller, N4RH (F)

(From an address at the joint luncheon meeting of the Washington, DC Section of The Radio Club and the IEEE Vehicular Technology Society on April 19, 1989. Mr. Haller is Chief of the Private Radio Bureau of the FCC.)

I am truly honored to be asked here, today. The roster of the past and present members of The Radio Club reads like a *Who's Who* of American communicators. Similarly, the Vehicular Technology Society attracts today's major players in the field of mobile communications. But where did all this begin? How has it affected our lives? And, what does the future hold?

In my view, ha nessing fire, inventing the wheel, and controlling the electromagnetic spectrum are the three most significant events in the history of mankind. Because development work on fire and the wheel occurred in my very early youth, my memory is somewhat hazy, so I'll concentrate on the spectrum.

The origins of wireless communications —that elusive magic carpet that conveys human thoughts through the ether—are buried in antiquity. For example, the word telegraph may date back to 300 B.C. It is believed that it comes from the Greek words *tele* meaning "afar off", and *graph* or "to write" together we have "to write afar off." The Greeks are also credited with having invented the first telegraph. Torches were arranged to represent letters of the Greek alphabet to convey messages between military units.

Fire and smoke signals have played important roles in the development of numerous civilizations throughout history. Signaling flags or semaphores have also been used through the centuries to narrow distances between communicators. In Switzerland, Alpine horns served a similar purpose. All of these systems, however, had limitations. Strong winds, for example, could carry the sounds of horns far from the intended receivers. The other systems relied on visual contact. Yet, for centuries, mankind survived with these crude tools.

While early civilizations had no concept of how electromagnetic waves might be used to communicate, they certainly became aware of these mystical forces through early experimentation. The Chinese may have developed the magnetic compass before 2000 B.C. Unfortunately, no practical use was made of the compass for almost 3000 years. Dr. Gilbert, of England, demonstrated that the Earth acted as a giant magnet and a compass would respond accordingly. Aside from its use as a navigational instrument, some scientists around 1600 A.D. suggested that compasses magnetized by the same lodestone would all react to each other even if separated by considerable distances.

Thus came the first thought of wireless electromagnetic communications. In fact, they were almost right because moving a magnet through an arc does produce an electromagnetic field. Early mechanical transmitters employed that technique. For the next hundred years or so, experiments continued with magnets, static electricity and primitive electrical generators. Scientists began the hard job of harnessing electricity for the good of all.

The Leyden jar provided the first practical means of storing electricity. This fact actually came as a shock to its inventor who was attempting to store electricity in water. It took some time before the scientists understood that it was not the water but the conductor plates in the jar that stored the charge. Thus the first building block of modern radio was born: the capacitor.

Others, such as our own Benjamin Franklin, worked with static charges to try to master this dangerous business known as electricity.

In 1800, Volta discovered that different pairs of metals in contact produced a supply of electricity. He also found that an electric current caused water to separate into hydrogen and oxygen. Others advanced the art of the chemical battery —another building block of radio, for electricity had finally been harnessed through chemistry.

Events began happening at a faster pace. Scientists found that current in a wire affected a compass needle. In 1825, one scientists discovered that a coil of wire exhibited all of the properties of a magnet when an electric current flowed in the wire, and that the "electromagnet" would react to a permanent magnet based on the level of the electric current. Thus, another building block of radio: the voltmeter, was discovered, and this was followed by a series of other measurement instruments, and the inductor.

Faraday experimented with inductors in close proximity and found that a current made to flow in one coil could be detected by another coil. The transformer was thus humbly discovered.

In the 1830's, Samuel Morse, an artist, became interested in using electromagnetics for communications. In 1837, he applied for a patent on his telegraph system. We can credit Morse, additionally, with bringing politics into communications. Morse haunted Congress trying to secure funding to build a Washington-to-Baltimore telegraph line. Considered by many to be a crackpot, his funding bill failed year after year. Finally, in 1843, the bill was passed and work began.

He initially decided to bury the cable at great effort and expense. Unfortunately, the cable failed and above-ground lines were installed. Morse used his telegraph to relay from Annapolis to Washington the news that Henry Clay had been nominated for President by the Whig Party. The telegraph brought the news to Washington an hour before the railroad.

This historic event marked the beginning of electronic journalism and spurred increased work in electrical communications including a transatlantic cable.

Another turning point came in 1867 when Maxwell quantified and predicted radio waves through a series of equations. Edison continued with experiments related to electron movement through space and succeeded in inventing the electric light although he was close to finding the secret of the vacuum tube. Unfortunately, neither Maxwell nor Edison succeeded in transmitting electromagnetic waves; that task was left for Hertz. He confirmed Maxwell's theories and paved the way for radio.

Finally, Marconi made radio work at the turn of the century. His efforts led to a transatlantic contact in 1901. Almost immediately, people began to grasp the importance of radio, especially for ship communications. The sinking of the Titanic in 1912 and subsequent legislation to mandate the carrying of radio equipment aboard vessels, assured the success of radio.

Alexander Bell thought of using electromagnetics to help the deaf. By accident, in 1876, he and Thomas Watson developed a method to transmit sound by wire. Bell, like Morse, saw tremendous commercial value in his telephone. He lectured to promote the idea and, along with three others, formed the Bell Telephone Company in 1877. Although the telephone and telegraph changed our way of life, as our society became more mobile people still longed for wireless communications.

Continuous-wave technology replaced the spark transmitters. Voice transmissions evolved out of Morse code. The advancements were made possible by the development of the vacuum tube by Lee deForest. His work made possible amplification and electronic oscillation, the final building blocks of radio. But, for his efforts, he stood trial in 1913 for mail fraud; he was charged with using the mails to defraud the public into investing in a worthless device.

The country began to see names like General Electric, Westinghouse, and Western Electric. The Radio Corporation of America was formed. These companies meant dollars—big dollars—would be available to advance the radio art.

In 1916, David Sarnoff predicted that radio would be a "household utility." By 1921, KDKA — Pittsburgh, was transmitting broadcasts intended for public reception. Big business in radio brought big dollars to research. The Navy promoted research for safety of its vessels at sea.

Some companies specialized to advance a specific part of the art. DuMont, for example, specialized in electronic television receivers. The first DuMont TV receiver was sold in 1939 for $295.00.

Along with this success came regulation and litigation. Patent infringement wars raged as new developments came rapidly. The crystal detector, the vacuum tube, the heterodyne receiver—everyone wanted a piece of the action.

I've spent considerable time talking about early events leading to practical use of radio. There is a significant point to be made here. People lived for centuries without electronic communications. It took hundreds, even thousands of years for people to understand electromagnetism, but only 60 or 70 years for us to consume the resource.

Since 1920, developments have come faster and faster. In 1927, a five-member commission was established to administer the spectrum. In 1928, the Detroit Police Department began using radio to dispatch patrol cars. Congress adopted the Communications Act in 1934 and established the Federal Communications Commission. Radio broadcasting stations expanded; wirelines grew; networks were created. Litigation by ASCAP over the use of copyrighted music over the air led to the payment of royalties for use of the products. Radio had become a business, no longer an experimental science.

As radio matured, emphasis was placed upon transmission of pictures by the "wireless." Other uses, including radar, began competing for spectrum. Mobile radio caught on in the post World War II era. In 1947, Motorola displayed the "Dispatcher" radio at the American Taxicab Association meeting in Chicago. Suddenly taxis, police departments, railroads and, in fact, all business began to want radio. In 1948, the FCC even granted approval for a citizens-band radio to serve the average citizen. In 1952, the UHF-TV spectrum was allocated. Color television, satellites, fixed microwave stations soon followed, needing more spectrum.

Technology advanced to allow more information and data to be relayed in the ether. Technology also raised the maximum usable frequencies. Unfortunately, few inventions have decreased the demand for spectrum. Just think about your typical day.

You wake up to a clock radio, turn on a light that derives power from a grid controlled by radio, and use water distributed with the help of radio. Breakfast is cooked in a microwave oven while you watch television pictures delivered by satellite, to see the weather radar. You open your garage door with radio. Radio clocks your speed on the way to the subway terminal. As you commute to work on the subway, radio links the train to a master computer. Traffic lights on your walk from the subway are controlled by radio. Elevator music delivered by radio greeted you at the office. Your desktop computer uses radio frequencies to help you do your work. Sensors utilizing radio frequencies detect intruders. You may use light bulbs excited by radio energy to conserve our petroleum and coal supplies.

Radio controls cranes at shipyards and new office buildings under construction. Radio saves lives hundreds of times daily through emergency medical systems. Radio monitors petroleum storage and transmission facilities. Meter readers now merely drive down the street to read your gas, electric and water meters through the use of radio. Oh, and I don't want to fail to mention your pager and cellular phone keep you in constant contact with customers.

Are you beginning to get the picture? Let me state again; we've consumed this valuable resource within less than a lifetime. So what's next? Clearly, more and more demand for spectrum.

High definition TV, advanced cellular, wireless local area networks, wireless office buildings, wrist radios, moon maids (with apologies to Dick Tracy fans), direct broadcast satellite, nationwide private radio systems, more home appliances based on radio technologies...where's it going to end?

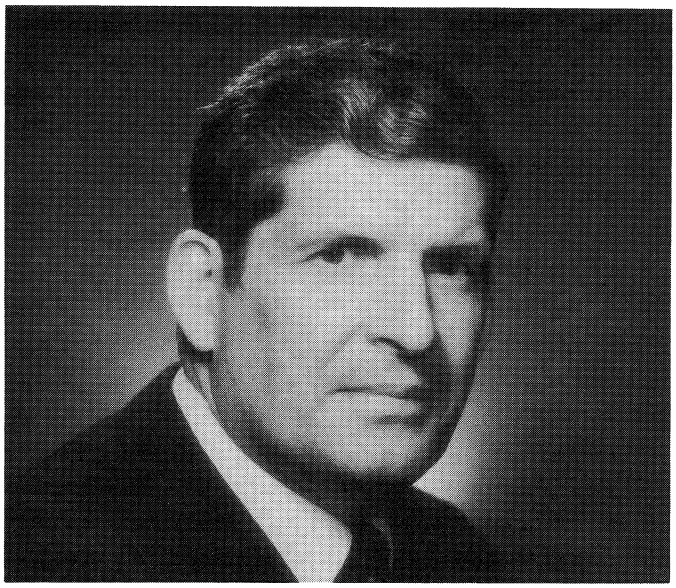
We have two choices. One is to keep on our current path with each class of user promoting only its narrow interests. This is the restrictive approach. The other option is to begin working together to find ways to make the spectrum accommodate all the services. A move away from analog transmissions and the transmitting faster bit rates in narrower bandwidths will help. Use of cable instead of over-the-air transmissions will help. Cable television and digital fiber optics offer more potential than almost anything else to ease spectrum congestion. Unfortunately, many of the regulations in this country are geared at inhibiting such technology while they promote existing spectrum uses or communication services.

The solution can come only when we all recognize the value of the spectrum, when we begin to make the hard choices about what deserves spectrum space in tomorrow's World—and what doesn't.

These decisions never are easy and I don't pretend to have the answers. But, the quality of our lives will depend on our ability to cooperate as passengers on this flying rock—and the time for that cooperation to begin is today!

FROM RIDING WAVES TO MAKING WAVES:
The Need for Leadership in Mobile Communications

by William O. Hunt (M 1987, F 1988)



William O. Hunt (M 1987, F 1988) currently is a private investor after recently serving as Chairman of the Board and CEO of Alliance Telecommunications Corporation. Prior to that, he was President and CEO of Communications Industries, Inc. from 1977 to 1983. Previously, he served 12 years with Texas Instruments, Inc. as group and division comptroller, and had prior management responsibilities at Collins Radio Company.

I want to thank Fred Link and The Radio Club Board for the high honor of being selected to speak to you this evening. This is a very big thrill for me.

My message is to all of you Radio Club members, guests and all 1988 Radio Club Award winners. For the last hour, I have felt like General George Patton with all these heroes.

Many members of the Alliance management team are in attendance tonight. They represent 900 fine employees in five outstanding Alliance companies. Their loyalty, dedication and commitment have been a source of inspiration to me, and I thank them.

We have another special guest out there in the audience. This person is my personal CEO, CFO, counselor and partner. This person has stood by me through thick and thin, through good times and bad times, and through all of my exploits for almost 29 years. I have never acknowledged in a public forum the true value of this person in my life. I do so now. Ladies and Gentlemen, please meet the *Boss*, my wife, Grace.

The shortest distance between two points is well known as a straight line. To that point, October 19, 1987 was a very black day for America as the stock market headed south with the largest drop in the Dow Jones Industrial Average since the great market crash of 1929. Much has been said and written about that day over the past year. We were all holding our breath to see what would happen on October 19, 1988. Leading up to the 19th, I had been working with the managers of Alliance to improve on the 1989 financial forecast. On the 19th, my relationship with Alliance was terminated.

My lawyers tell me that's all I can say on the matter. Nevertheless, the result of all this was a quite different October 19th than I had expected or anticipated as I crashed, and the stock market didn't miss a beat. Just like a cat dropped from the 14th floor, I have landed on all four feet running like Hell. I have worked at a feverish pitch every single day since my dismissal and will have something to say about my next move in due course. After all, if you're as young as I am, you shouldn't let any grass grow under your feet.

As all this unfolded, I called Fred Link to give him an out on tonight's speech. He rejected that notion and I am now ready to roll up my sleeves and get into the subject of *From Riding Waves To Making Waves: The Need For Leadership in Mobile Communications.*

Mobile radio communications are playing an increasingly important role in every facet of America's social and economic life. Marconi demonstrated that messages could be sent without wires, and the era of "wireless" communications emerge. It has grown at a tireless rate ever since. Every phase of our lives involves radio communications. Over the last thirty to forty years, we have witnessed enormous changes in every part of the business: the customers, vendors, technology and regulatory activities.

To provide a proper foundation for a discussion on the need for leadership, let me touch on a few of the broad changes that have affected our industry:

We have seen a steady increase in customers or subscribers for the whole gamut of service offerings. In addition, demand for services has shown a similar increase. At the same time, customers have become more discriminating and shown an appetite for a broader range of service offerings.

The industry has changed from an environment of monopoly to a deregulated or more *laissez faire* competitive playing field. Four items bear this out:

- there was the 1956 AT&T consent decree;
- the continuing saga over the years on interconnection;
- Federal and state regulatory activities; and
- the bust-up of AT&T in the early eighties.

The FCC has continued to increase channel capacity for all forms of communications services. At the same time, market entry barriers have eased as deregulation finds its way through the fabric of our industry and society.

Perhaps the most dramatic change has been seen through the eyes of technology:

- Semiconductor technology has paved the way for new products, services and improved features.
- The move to digital from analog and the advent of ISDN (Integrated Service Digital Network) has opened the door for limitless future applications at the fingertips of wireless customers.
- Cellular, mobile data, fax and video are only a few of the applications brought about by technical advances.

All of the items that I have outlined have created markets of increasing size and more competition. A *free market* has emerged over the years.

The real beneficiary in all of this is the customer who has seen prices for equipment and monthly fees show a steady decrease.

Enhanced services in every form is the order of the day as product and service differentiation drive technology advances for new, innovative applications. I still expect to see Dick Tracy radiotelephone in the next few years.

As the markets and industry have grown, we have seen Wall Street take note particularly in the cellular area, and a new set of competitive participants have emerged as players. Many of them can be classed as portfolio or "money players" as contrasted to the more traditional operators. I classify this evolution as "riding waves" until the early eighties, and "making waves" from that period until today.

Change creates opportunity. If that is true, then opportunity abounds for everyone. Hopefully, I have outlined most of the reasons and environment that demands the need for leadership in mobile communications as we move into the next decade. The nineties will be tougher and more challenging due to the following reasons. These thoughts are from a recent article in *Managing Now for the 1990's:*

Facts to make decisions will be at our fingertips as everything will be in real time. Lightning speed will be a must.

Information technology will take a front seat as a platform for changing the boundaries of operation.

Organizations and the way we manage will see a dramatic change. "Lean and mean" staffs will prevail.

The whole world will be tomorrow's playing field. In order to stay in the race, companies must go global.

Customers will probably become competitors and strategic alliances will play an increasing role.

People and motivation programs for the work force will take on a renewed importance.

Financial accounting for tomorrow's needs will undergo a face-lift to provide managers with the information to manage.

Tonight my main message is on the essence of leadership and the leader. Webster defines leadership as "the position or guidance of a leader. The ability to lead." It is the ability to turn a dream or vision of the future into reality through the team work and cooperation of people.

Vance Packard said: "Leadership appears to be the art of getting others to do something that you are convinced should be done." Someone once said: "The pain of decision is constant for the chief executive officer." The same can be said for the leader.

He must demonstrate all the attributes of leadership at all times. They include leading, pushing, shoving, getting his hands dirty, motivating, inspiring the troops to action, taking mistakes in stride, facing problems head on, showing fairness, being decisive, managing by walking around or kicking tires daily this list could go on all night. The leader must show the right measure of humility at all times, and park his ego and subordinate his personal needs when it comes to serving the interests of his constituency whether it be customers, shareholders, managers, employees, friends or family.

Can leadership be learned? My answer to that question is a resounding "Yes!" Thousands of books have been written on the subject of leadership. I have read a few, picked out certain past and current leaders to emulate and tried to practice being a good leader for the past thirty years of my business career. Let me outline the framework of my message.

The best foundation to speak from is personal experience. Early in my career at Communications Industries, management adopted written *Corporate Commitments and Management Guidelines* fashioned from similar *Basic Management Concepts* by Chuck Ames who was then president of Reliance Electric. As Chief Operating Officer of CI at that time, I drew the short straw, along with other managers, to implement and execute this program. During the subsequent eight years, CI progressed from a company with $15 million in sales and a market capitalization of $25 million, to $100 million in sales and a sale to PAC*TEL for a $430 million market capitalization. We built a leader in mobile communications. Everyone won. For the past three years, I have pursued a similar course in the development of Alliance Telecommunications.

How did we do it?

These guidelines outlined three basic commitments:

- to provide customers with quality products and services at fair prices customer oriented;
- to provide a maximum rate of return on invested capital shareholder oriented; and,
- to provide attractive work environment and opportunities for employees employee oriented.

A cornerstone of these guidelines is a commitment to integrity, honesty and fairness.

- As leaders, you should never act unfairly or lack integrity.
- Fairness and integrity are full time principles that can't be turned on and off to suit our desires at the moment.
- Edward R. Murrow said: "To be persuasive, we must be believable; to be believable, we must be credible; to be credible, we must be truthful."
- In my book, honesty, integrity, fairness, and candor are all #1 leadership commandments.

Let me deviate briefly and talk about what followers expect of their leaders, from the book *The Leadership Challenge.* So listen up, all you leaders out there. The characteristics of superior leaders are:

Honesty	Loyalty
Competence	Fair-minded
Forward-looking	Broad-minded
Inspiring	Straightforward
Intelligent	Imaginative

and many more.

Our guidelines were aimed at inspiring a vision of what we wanted the company to be. Leaders must inspire a vision of the future and have a sense of what is possible if the team is marshaled to work together to achieve a common purpose. Leaders must enlist the support of all around them to implement a shared vision. Leaders make the vision happen by breathing life into supporters as if the vision were their own through warmth, friendship and persuasion. Leaders communicate their vision of the future in a manner that allows others to clearly understand it and accept the vision as their own.

Leaders hire and surround themselves with winners. They hire the best people and aren't intimidated by hiring people who are smarter than they are. Leaders understand that people are the most important asset on the balance sheet. Leaders understand that customers' needs and expectations are fulfilled through dedicated people. People at lower levels are most important because they do all the work.

We had twelve ground rules at CI which were intended to help managers face up to and resolve tough people decisions that are critical to a company's success, particularly in a rapidly changing, high-growth, competitive environment. Here they are:

1. Recognize that people, not structural changes, are what make an organization work or fail.
2. Provide for a successor.
3. Deal with tenure problems fairly but candidly.
4. Communicate expectations; measure and act on results.
5. Don't put up with marginal performers.
6. Criticize only in private.
7. Weed out misfits.
8. Cultivate individual ambition and drive.
9. Focus objectively on personal accomplishments, not on personal differences.
10. Let people know their status and prospects.
11. Provide training but stress self-development.
12. Create and maintain an attractive, healthy company environment.

These guidelines weren't hard to agree to; the difficulties came in following them.

Our guidelines also embodied a strong commitment to planning and execution:

A good leader must run his business by developing plans, approving plans, and then achieving results.

While planning is essential, the leader understands that planning alone never accomplishes anything somebody has to do something to get results.

Strong execution is crucial.

When actual results depart significantly from plan, prompt leadership involvement should be expected.

Commitment to planned results is the key to successful execution.

Good planning and execution require keeping priorities straight.

Every leader must strive to keep surprises out of his operations. All future surprises should be pleasant.

No leader should grab the credit for good results. The whole team deserves the credit.

The leader knows that fact-based decisions are crucial to good business planning.

Lee Iacocca and General George Patton are two of my favorite leaders of all time. I have drawn from both in terms of leadership and management principles. First from Iacocca's book, *Thinking Straight*; here he offers eight commandments of management:

Hire the best people.

Get your priorities straight.

State your objectives plainly.

Remember that staffs don't generate profits.

Set parameters but not procedures.

Keep mavericks around.

Don't forget short-term earnings.

Remember the fundamentals. Second, remember the fundamentals. Good business fundamentals are the fuel to take a company into the future from a platform of strength.

Next, from Williamson's book on Patton's principles:

Keep a quick line of communications talk with the troops.
Select leaders for accomplishment, not for affection.
Every leader must have authority to match his responsibility.
Protect the troops first. The wishes of superior officers are secondary.
Never take counsel of your fears.
Never make a decision too early or too late.
The way to win is never to lose.

Ladies and Gentlemen. By now you know that leadership is a passion to be felt, touched, seen, heard, breathed, and smelled. When the going gets tough, the leader gets going. He looks inside and down deep, and draws from his inner strength and confidence to handle any situation confronting him.

In the final analysis, we all have primary control over our individual destiny. Leadership is not only important in your everyday dealings with others but to your own life and career. It is the leader who reaches Mt. Everest in any field of endeavor. Since leadership development is manifest in personal development, then leadership is a 24 hour a day personal challenge. A good analogy for all of you leaders in "the practice of what you preach" is, "as you swallow your own spit, make sure you don't choke to death on it."

In closing, there are several morals to all of you out there in Radio Land:

- Watch out for October 19th.
- Take care of your customers.
- Take care of your shareholders.
- Take care of your managers and employees.
- Practice leadership every day, and be a good leader.

I now rest my case for the need for leadership in mobile communications. My fondest hope is that each of you will retain one good thought from my message tonight. As you leaders drive into the sea of change in our industry and society, and on into the future at warp speed, be sure to keep an eye glued on your two sets of rear view mirrors to see if anyone is catching up particularly competitors.

Thank you, Fred, The Radio Club Board, and guests for the privilege and honor of speaking to you, tonight.

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The annual meeting and banquet commemorating the 79th anniversary of The Radio Club of America was held on Friday, November 18, 1988 at the New York Athletic Club. Two hundred eighty-five members and guests attended.

Mr. William O. Hunt was the keynote speaker at the banquet and addressed the audience on the development of leadership in the mobile communications industry.

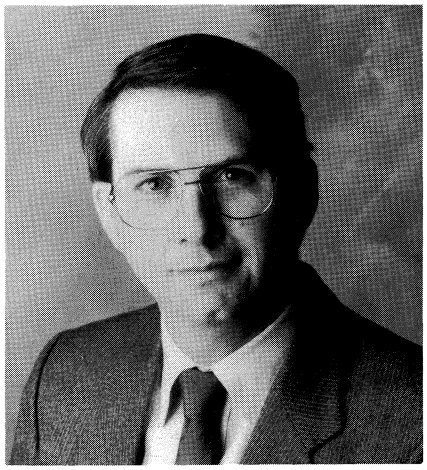
The annual meeting held during the afternoon included a technical seminar directed by Stuart F. Meyer, Executive Vice President. The speakers were: Joseph J. Fairclough, WB2JKJ (M), of the New York City Board of Education, who spoke on the use of Amateur radio in the teaching of English in Junior High Schools; Herschel Shosteck Ph.D. (F), who discussed the future growth expected in cellular radio applications; Samuel R. McConoughey (F), an executive advisor to Panasonic, who presented a paper on digital modulation for future cellular radio systems; and Leonard R. Kahn, WB2SSP (F), President of Kahn Laboratories, Inc., who described the POWER-side (tm) system used by AM broadcasters to improve coverage, reduce selective fading and antenna null distortion. A reception for members and guests followed.

The meeting concluded with the formal announcement of the election of directors for the 1989 - 1990 tenure.

The achievements of 35 members of the Club were recognized by their advancement to the grade of Fellow. Twenty-four were present at the Awards Dinner and received plaques from President Fred M. Link. Awards and citations also were made to Club members for distinguished services to the art and science of radio communications; those receiving recognition were: Luther G. Schimpf (F)-Armstrong Medal; Mal Gurian (F)-Sarnoff Citation; Francis T. Cassidy (F)-Busignies Memorial Award; Fred M. Link (LF)-Lee deForest Award; Stuart F. Meyer (LF)-Fred M. Link Award; William D. Kelly (F)-Allen B. DuMont Award; Dr. Ralph W. Muchow (F)-Ralph Batcher Memorial Award; Francis H. Shepard, Jr. (LF)-Pioneer Citation; David Talley (LF)-President's Award; and Jerry S. Stover (F)-Special Services Award.

Once again, the successes of the meeting, reception, and banquet resulted from the generous contributions of 28 industry sponsors and friends of the Club plus the hard work of the Banquet and Meetings Committees.

DON BISHOP RESPONDS FOR FELLOWS



Don Bishop is the editorial director of ***Mobile Radio Technology*** *magazine. He has served as the chief executive of a broadcast engineering consulting firm. He previously was involved in broadcast station ownership and management, and worked as a radio personality. He was elected a Fellow of The Radio Club in June 1988, in recognition of his contributions to the art and science of radio.*

It is a delight to respond on behalf of the 35 members elected to the Grade of Fellow in 1988. To be recognized by the Radio Club is to be recognized by "The World's First Communications Society," as it is often called.

The Club was organized for the interchange of knowledge of the radio art, for the promotion of good fellowship amongst its members, and for the advancement of public interest in radio.

Our Club president, Fred Link, has observed that "almost every important personage in the history of radio communications was or is a member of The Radio Club of America."

In 1984, the Club's Diamond Jubilee Year, Charter Member and President Emeritus, W.E.D. Stokes, said that what began as a "small body of Amateur radio enthusiasts has gradually changed to a large scientific organization of recognized standing, before which the leading lights of the radio world are glad to deliver papers."

Members of the Board of Directors: by giving us the grade of Fellow, you have given us new recognition before a distinguished society, and we are at once humble and proud for the Honor.

What President Emeritus Stokes said about The Radio Club's standing remains true, as evidenced by the presentation this afternoon of five papers on broadcasting, commercial communications, and Amateur Radio.

Interest in Amateur Radio led the founding members to start the club. Roughly half of the current members hold Amateur licenses, as do a third of the new Fellows and half of those receiving medals, awards and citations tonight. For many of us, early interest in Amateur Radio started us on our career paths.

That was true for me. I remember my first night as a freshly licensed, junior-high-school aged Amateur. Using a telegraph key, I called out: *dahdidahdit dahdahdidah.*

That is Morse code for: "Can anyone hear me?" Someone did. An Amateur in Brooklyn, New York answered. From the vantage point of tonight's banquet in the New York Athletic Club, reaching someone in Brooklyn may not seem like much. But for a junior high school student in Boulder, Colorado, it was like reaching another planet. In fact, were it not for the universal language of the Morse code, we might not have understood one another.

What a thrill it was! It was fascinating.

For many of us amongst the newly designated Fellows, an early fascination with radio brought us into radio communications and radio and television broadcasting, among other pursuits. We are the radio *fascinationists.*

Many of the newly designated Fellows are here tonight. They have distinguished themselves in the military, public or commercial sectors. After receiving the grade of Fellow, where do they go from here?

THIRTY-FIVE MEMBERS BECOME FELLOWS

Twenty-four of the thirty-five members who were elected to the Grade of Fellow in 1988 were present at the Annual Awards Dinner and appear in the photo above. Seated (L to R): Harry J. Mills, Hendersonville, NC; Gene F. Smith, East Brunswick, NJ; Ms. Minnie M. Adams, Houston, TX; Ake L. Lundqvist, Stockholm, Sweden; William O. Hunt, Dallas, TX; Ms. Jacqelin H. Ericksen, Ph.D., Albuquerque, NM; Don Bishop, Merriam, KS; and John S. Sawvel, Jr., Cuyahoga Falls, OH.

Standing (L to R): Ms. Connie Conte, Rutherford, NJ; Jay R. Huckabee, Snyder, TX; Norman D. Hawkins, Pickering, Ont. Canada: Ms. Antoinette P. Kaiser, Buffalo, NY; John E. Brennan, Old Tappan, NJ; Clive H.K. Moffat, Newmarket, Camb. England; George Graul, Jersey City, NJ; Harry L. Schmidt, Scarborough, Ont. Canada; Robert I. Elms, P.E., Budd Lake, NJ; Joseph F. Marshall, P.E., Hyattsville, MD; George W. Weime, P.E., Lewisville, TX; Lloyd A. French, Sacramento, CA; Anthony Natole, Malba, NY; Arthur L. Greenberg, Wading River, NY; and Herschel Shosteck, Ph.D., Silver Spring, MD.

1988 Fellows not in photo: Hugh. G.J. Aitken, Ph.D., Amherst, MA; George K. Burton (deceased); Earl H. Flath, Jr., P.E., Dallas, TX; John R. Galanti, Basking Ridge, NJ; Scott R. Goldman, Los Angeles, CA; Ralph A. Haller, Fairfax, VA; Homer N. Harris, Aguanga, CA; Gerald M. Howard, Esq., P.E., Dallas, TX; John A. Linton, Jr., Carroltown, OH; Ms. Ethel M. Smith, McLean, VA; and Edward J. Warner, P.E., Bethesda, MD.

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For some, becoming a Radio Club Fellow is the capstone of a career.

For others, it is a spotlight that directs attention to individuals with promising futures. They will find new opportunities for personal and career growth, thanks to the recognition given them by the Board.

Where one group of previously designated Fellows went was easy to find out; I checked the addresses in the Membership Directory. A third of those who were designated Fellows before 1960 went to live in New Jersey.

The message to new Fellows who continue their careers is clear: Go on to greater accomplishments, or go to New Jersey.

With deference to Club president Link and vice president Mal Gurian, among others, fairness requires me to say that it clearly is possible to go on to greater accomplishments *and* live in New Jersey.

Wherever they go from here, you can rely on the new Fellows to go on to greater accomplishments.

Would the new Fellows please stand so that our members and guests may see who you are? Let's congratulate them.

On behalf of the new Fellows, thank you for favoring us with the grade of Fellow of The Radio Club of America.

RADIO PIONEER - George E. Sterling, W1AE

by Jay R. Huckabee, W6EPJ (F)

The coast of Maine is rugged anytime. As my wife, Patsy, and I walked down the ramp to board the 10:30 AM car ferry for Peaks Island, I glanced over my shoulder and noticed a temperature reading of 36 degrees: a brisk Fall morning but not too uncomfortable for October 14, 1988. In less than 45 minutes, we would be across Casco Bay and seeing George Sterling for the first time in over 37 years.

The ferry tied up at the Peaks landing and, after vehicles and freight were unloaded, the passengers made their way up the rocky incline to the taxi stand. In a few minutes, the only public transportation on the island arrived; we boarded the van and asked the driver, Lloyd Hamilton, if he knew where George Sterling lived. He replied: "Sure. George is my buddy. Everybody knows George. We'll be there in five minutes.

Although we had corresponded by letter and, occasionally by telephone, I admit that I had a feeling of anticipation as one feels as a kid on Christmas morning—or when you nervously opened that envelope containing your first Amateur radio license.

After a couple of stops, Lloyd pulled up in front of the Sterling's summer home and their daughter Patricia, up from Baltimore, came out to welcome us. It was a most happy reunion: George, Margaret (Mrs. Sterling), daughter Pat, my Patsy and me. We talked, reminisced, and looked at scrap books that Mrs. Sterling had put together over the years detailing the many events of George's career. After a lobster lunch (George had cooked the lobsters; said that he used to run his own traps but now buys them from his fishermen friends), we took photographs and notes of our afternoon's conversation:

I asked George when he first became interested in radio.

He said, "I was first bitten by the 'wireless bug' when a 9th grade schoolmate, Ray Hutchins, showed me his copy of Hugo Gernsbach's Electro Importing Company catalog. Ray and Alfred 'Deac' Ranger, the minister's son who lived next door, and I formed a dedicated trio determined to learn more about wireless. We were living in Springvale, Maine then. Components were hard to come by in those days so we scrounged for parts and materials to construct every item excepting our headsets. Deac and I had a joint antenna, a four wire aerial strung between two trees with a lead-in off each end to our receiving sets."

Jay Huckabee: Could you buy antenna wire and insulators locally at that time?

George Sterling: We didn't have much money. The antenna that Deac and I erected was made from telephone wire that we 'borrowed' from an abandoned gravel pit. Thinking the wire had to be bare in order to pick up signals, we proceeded to burn the rubber insulation from it in the furnace of the church parsonage. The malodorous black smoke seeped up through the air ducts into the pastor's study where Deac's father was preparing his Sunday sermon. Did we catch it! For insulators, we used bottle necks.

JH: How successful was the antenna?

GS: It worked. Having completed the building of our receiving sets, many hours night-after-night were spent in adjusting cat whiskers, changing taps on coils, and moving the plates on our home-made variable condensers, and then straining our ears for some recognizable signal. One night I heard a signal—it was one of the greatest thrills of my life. I had picked up the Navy station 'AB' at Kittery, Maine. We used our joint antenna until we got our transmitters, then we had to put up separate antennas. Once, Deac and I tried to dig a tunnel but we were unsuccessful ...we got detected.

JH: Sounds like good material for a Mark Twain tale. What was your first transmitter?

GS: Eventually we got our transmitters built. I had been able to buy a 1/2 inch spark coil from the proceeds of my newspaper route...and my first DX was accomplished when I worked 'CS', Charlie Spinney, in Sanford, Maine, some two and a half miles away. Prior to this, we were able only to communicate between the three of us, up to a mile. We used our initials as call letters: mine was GS, Ray Hutchins was RH, Alfred (Deac) Ranger was AR. We enjoyed many a rag-chew and became proficient with the code. Charles Spinney was chief electrical engineer for a manufacturing plant in Sanford, and more advanced than the rest of us. I heard my first radiotelephone signals on my crystal set when he modulated his arc transmission and called me by name over the air. It was 'mushy' but readable. That was also a great thrill for me.

JH: I know it must have been. Those were great times for you and your friends.

GS: Yes...Ray also could read Morse code from the impulses. The Boston & Maine Railroad telegraph wires hung low over rises along the right-of-way and Ray would choose one of those rises where he could reach the wire, then wet his fingers, touch the wires and read the train reports. He was quite a brilliant lad. Then, too, I'll never forget the cold Winter evenings and sitting up listening and waiting for the big Marconi coastal station MCC, at Wellfleet on Cape Cod, to begin: *V V V TO ALL SHIPS EQUIPPED WITH MARCONI OR DEBEG APPARATUS AND SUBSCRIBING TO THE MARCONI PRESS SERVICE...*

JH: Apparently there were no government regulations of Amateur wireless at that time.

GS: Right. On August 13, 1912, a new Radio Act was passed to go into effect during the following December, making licensing of Amateur radio stations mandatory. I received notice from the radio inspector in Boston, Harry Gawler, to appear at the Custom House in Portland, Maine an take an examination. I passed the test and became one of the first four wireless Amateurs in Maine, receiving the assigned call letters 1AE.

JH: When did you go into commercial work?

GS: In the Fall of 1916, I went to sea as a commercial wireless operator and, excepting for military service during World War I, I remained in the Merchant Marine until 1922 when I went ashore to become Marine Radio Inspector for RCA in the Port of Baltimore. Later, I became the U.S. Radio Inspector in District 3 (Baltimore), Bureau of Navigation, U.S. Department of Commerce.

JH: Recently, I added a Kolster Decremeter of that era to my antique wireless collection; do you remember them?

GS: Oh, the old one...the direct reading type! As I remember the one we used to carry aboard ship probably weighed 45 pounds, and I would have to climb up those rope ladders to get on board with it. I would slip the handle over my arm and climb the Jacob's ladder and it would be swaying back and forth, you know. I learned to climb ladders off balance.

JH: Do you remember any of the ships that you sailed on?

GS: Oh yes. The last one was the SS Conehatta built at Hog Island right below Philadelphia about the end of World War I. They were quite individualistic ships in their design. At that time, there was an organization called the United States Shipping Board and they would authorize different companies and assign them so many ships to be built. The SS Conehatta was in the W.L. Blake Line out of Baltimore; that's when they were taking supplies to Europe after the war.

JH: I've read about the emergency ship building program sponsored by the government at that time, to build up the U.S. Merchant Marine fleet. One of the new shipyards and the most elaborate was the one at Hog Island. The ships that they turned out became known as 'Hog Islanders,' with names chosen by Mrs. Woodrow Wilson.

GS: Yeah...built at Hog Island. There was the Connella, the Conehatta; I've forgotten the names of others. I never knew how they were named...some had strange names.

JH: Do you remember the call letters of the Conehatta and any unusual adventures aboard her?

GS: KUQQ. Interestingly, our oldest granddaughter Meg is married to a young man named Jeff Elseroad. While visiting in Baltimore recently, I was sitting on the porch of our daughter's home and telling Jeff about this eccentric captain that I sailed with. He never would write out a message but always would say: "Sparks, tell 'em this; tell 'em that." Well, I got an SOS one time and we went and picked up the disabled ship, the Suweid; I notified the shipping board through Cape Cod, and waited.

Irving Vermilya used to send out press from Cape Cod at 10 each evening, but he would precede it with the call letters of ships for whom he had messages so you had to be on the lookout. KUQQ was on his list the following night, so I got the message that told us to tow the Suweid to Halifax, Nova Scotia. I called the 'Old Man' and gave him the message.

He said, "Sparks, tell them to go to Hell; we're going to tow this ship to the Azores." I said, "Captain, I can't tell them to go to Hell but I will tell them where you're going to tow the ship." He was that kind of a man. He was lame from having been torpedoed in the Bay of Biscay during World War I. Well, I was telling all of this to Jeff, and he hollered for his wife Meg and said, "Come hear this...that was my grandfather!"

Breeden was his name, Captain George Breeden.

JH: Your granddaughter Meg and Captain Breeden's grandson Jeff are married—what a coincidence. What happened to the Suweid and the Conehatta?

GS: We continued to the Azores and, upon returning, she was claimed for salvage. The Conehatta, I understand, 'came a cropper' on the rocks of Norway.

On one of the trips to Manchester, England, I met Margaret, my future bride.

JH: In all of your years of dedicated service, what do you feel was the most gratifying accomplishment?

GS: The organization and direction of the Radio Intelligence Division, and its accomplishments. Plus my time as Commissioner; I shouldn't underrate that. Also, I represented the United States at international conferences: the North American Broadcast Conference in Havana; and the High-Frequency Broadcast Conference in Mexico City. I had just been appointed Commissioner by President Harry Truman, and I went to Mexico City for a six-month stay.

I co-chaired the conference with our Ambassador; that's the one where I drove the Russians out when I accused them of 'jamming' the Voice of America. We had identified the jammers (transmitters) which the Russians had taken from the Germans, and had all of their characteristics analyzed and photographed. When I accused the Russians of jamming the VOA in controversy of free speech, the Chief of their delegation started thumping on his desk. All of his little satellites did the same and when he got up and walked out, his satellites, like ducks in a row, did the same thing. The next day, the head of the British delegation sent a representative to ask whether I objected to the Russians returning to the conference. I told him: "No, not as long as they behave themselves."

JH: And did they return?

GS: They did. It was interesting in this respect. 'Broadcasting' magazine wrote quite a story about me. It was Christmas time and all the Latinos wanted to adjourn the conference for two weeks; I objected saying that we couldn't afford to stay another week...we want to keep going...we're on a good path here—and darned if the Russian delegation didn't approve my recommendation. So 'Broadcasting' wrote an editorial and said that I should be sent to the United Nations. Later, I was a member of the U.S. delegation to the Aids To Navigation Conference, held in London in 1946.

JH: You were still Chief Engineer of the FCC then, in 1946?

GS: In '46—let me think. Yeah, I was Commissioner from '48 to '54. Right; I was Chief Engineer, then.

JH: When you were a Commissioner, did President Truman give you a special assignment to travel with him during any state of national emergency?

GS: No, it was a little different from that. When I was appointed Commissioner, the Commission itself made me Security Officer and Defense Commissioner. It was the Defense Commissioner that would go with the President in time of attack. It was Truman's idea of having communication facilities restored as rapidly as possible so that the President, the governors, the mayors and so forth could talk to the public. I was on that assignment, and we used to make one or two runs just for practice.

JH: You probably deserve honors that have never been bestowed upon you.

GS: Well, one of my friends here on Peaks—I don't think you've met him, Dick Hersey—when I told him that the American Legion was going to present me with an honor from the Republic of France for helping to drive the Germans out, he said: "My Gosh, where are you going to put it? There's no room left in your house."

JH: Is this presentation for your services during World War II, and your work in the Radio Intelligence Division?

GS: No. It was for service with the U.S. Signal Corps during World War I and our radio intelligence work then. I don't know whether it will go through or not. There are two of us left from World War I in the Peaks Island Post of the American Legion: Captain McVean and myself. Cap was in the Navy.

JH: I hope that the American Legion and the Veterans Administration will make the necessary arrangements for you to have this recognition from the Republic of France.

What do you think of the progress made in communications and the sophisticated electronic equipment in use today?

GS: Well, I'm not too well acquainted...of course, I've been amazed about the satellites and the use of them, and of fiber optics. I knew about fiber optics when AT&T was first trying it out in New York between two office buildings. Of course, size and weight reduction...and miniaturization techniques.

JH: How do you feel about the 'No Code' proposal for Amateur radio?

GS: I have always been in favor of the code because of the military need for it. Several of my friends wrote very good articles supporting the code but I never did get into it. I could have written something about the necessity for it. I don't read anymore; have several copies of QST still in covers. I can read large type and newspaper headlines but not the fine print.

I haven't been active with CW in over two years but still can copy 40 words per minute in my head. I had my tower and 20 meter beam taken down; now, I have only the trap dipole and occasionally get on 75 meter sideband and join the 'Barnyard Net' group.

JH: The Radio Club of America will be holding its Annual Awards Banquet in New York City, next November, and I know that everyone would be immensely pleased to have you attend.

GS: No, Jay. It is too difficult for me to travel. I am now 94 and reaching for 95. Please convey my sincere thanks and appreciation to President Fred Link and the members of the Board of Directors for the honors given me. My friend, Fred Link, is truly the 'Father of Mobile Radio.'

JH: It will be my pleasure to do so, and I can't tell you how much this visit has meant to Patsy and me. I hope that we can come again.

GS: Jay, plan to come back...Margaret and I will be looking for you and Pat.

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All too soon we heard Lloyd drive up and honk for us. We had to scramble to gather our things, say our good-byes to George, Margaret and Patricia, and get back to the dock in time to catch the last ferry to Portland. Our visit had been an unforgettable and heartwarming experience.

George will be 95 on June 21, 1989. Wish him the best.

P.S. The April 12, 1989 issue of *The Portland Evening Express*, of Portland, Maine reported that the government of France awarded their Certificate of Appreciation to George Sterling on Monday, April 10th, as a part of the **George Sterling Day** celebration in Portland. A copy of the newspaper article appears below, courtesy of *The Portland Evening Express.*

Nota Bene:

My association with George Sterling began in 1940 when I entered government service with the Radio Intelligence Division of the FCC at Grand Island, Nebraska. George was Chief of this division with offices in Washington, DC. I transferred to the Dallas field office and later to Kingsville, Texas to assist with the planning and construction of the Primary Monitoring Station GSP (Gulf States Primary.) Joe McKinney was supervisor at both of the latter locations. We always looked forward to George's visits to GSP.

During my tenure at the Naval Research Laboratory, I had the opportunity to visit with George both at his offices in Washington and at his home in Maryland.

During April 1951, the annual conference and trade show of the Petroleum Industry Electrical Association (P.I.E.A.) was held in Dallas, Texas. Among the hundreds attending were George Sterling and Joe H. McKinney of the FCC, Fred M. Link of the Link Radio Corp., Jerry S. Stover and Tom McMullin of Communications Engineering Company, and Jay and Patsy Huckabee of the Jay Huckabee Company.

Jay R. Huckabee
March 31, 1989

PORTLAND EVENING EXPRESS
PORTLAND, MAINE

APRIL 12, 1989

France honors Peaks Island man, 94

Margaret

By MICHAEL NORTON
Staff Writer

PORTLAND — Peak's Island resident George E. Sterling, well known for locating spies during World War II, has been honored by a foreign government for his deeds from an earlier era.

The French government this week gave the 94-year-old Sterling a Certificate of Appreciation for the 18 months he spent in France fighting the Germans in World War I.

Sterling, best known as a wireless radio expert and former Federal Communications Commission member, said even his Army days before the trip to Europe were adventurous.

He recalled spending part of 1916 on the Mexican border looking for Pancho Villa, the Mexican bandit and revolutionary who had raided a New Mexico town and killed 16 people earlier that year.

Gen. John J. Pershing gave Sterling a second lieutenant's commission and, even though he wanted a job as a Navy wireless radio operator, Sterling ended up staying in the Army for the duration of World War I.

The wireless was Sterling's hobby and the area of expertise where he would achieve his greatest fame.

He became one of the first licensed wireless operators in Maine in 1908. By the 1940s, he was ready to turn that lifetime of radio work against the Germans and Japanese as the chief of the government's radio intelligence division. He officially was credited with detecting and closing more than 360 illegal radio stations that were attempting to broadcast information to the Axis powers.

After the war, President Harry Truman appointed Sterling to the FCC.

Today, Sterling still has his wireless set and his call letters, W1AE, or the "American Eagle." He and his wife, Martha, winter at the Sonesta Hotel in Portland and summer on Peak's Island, where he was born.

Mary Zazzaro, a neighbor and director of sales at the Sonesta, believe's they are the hotel's best-known and classiest guests.

"He is the ultimate gentleman and she's the first lady," Zazzaro said.

The Sterlings have been married for 63 years and he still brags about "my imported wife." She was a ballet star in England and he was a radio operator with the merchant marine when they met in 1925.

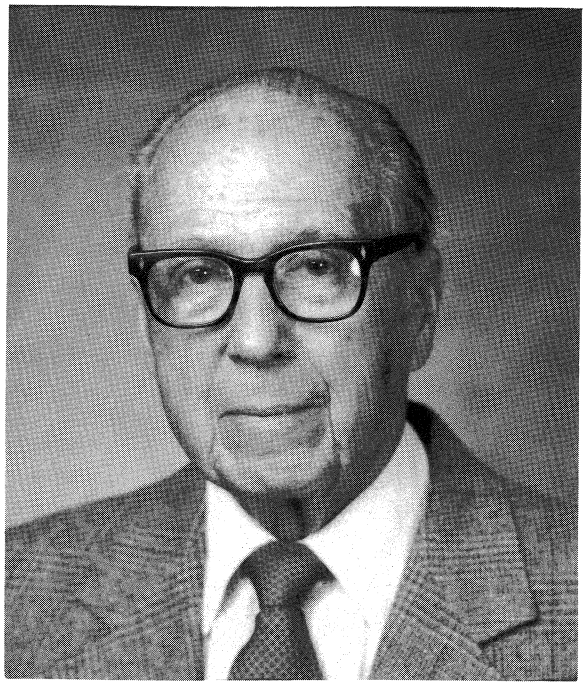
In addition to the award from France, presented at the Sonesta by Doug McVane, adjutant of the American Legion Randall/McVane Post 142 on Peak's Island, City Councilor Peter E. O'Donnell read a proclamation declaring last Monday as George E. Sterling Day in Portland.

as commission

Monday, April 10th - "George Sterling Day"

REMINISCENCES OF AN ENGINEER

by Loren F. Jones, KR3Q (F)



(Loren F. Jones was educated at Washington University and Stanford. His professional career encompassed 42 years at the Radio Corporation of America where he was responsible for TV development in its pioneering stages, broadcast engineering, heading the New Products Division, and foreign service. During World War II, he was a member of the radar and communications divisions of the Office of Scientific Research and Development (OSRD), a consultant to the Secretary of Defense, and a member of the Scientific Advisory Board of the U.S. Air Force. He is a Fellow of the IEEE and an Associate Fellow of the AIAA.)

Many engineering careers provide stimulation and broad experiences. This paper describes some of the experiences of an engineer working in one company: RCA. It illustrates the romance in engineering.

U.S.S.R.

The Russians had found RCA to be a world leader in electronics.

In 1929, RCA entered into an agreement with the Soviet Union to initiate an exchange of technical information. This had been approved by the Army, Navy and State Departments.

In 1930, I was sent alone to Moscow and Leningrad. Arriving in Moscow, I hired a sleigh to get to the hotel. Communication with the driver was difficult; I was better understood by the horse.

The Russian scientists' and engineers' curiosity about electronic developments was insatiable. They knew the political importance of radio broadcasting and supported the development of broadcast stations. Their 500 kW station near Leningrad was of brute force design; I judged that it did, in fact, put out about 500 kW. That would make it the most powerful in the world, predating RCA's installation at WLW in Cincinnati by many years.

UNDER STALIN

The Russians did not carry through on their half of the original plan for the exchange of information and it soon was terminated. However, in 1936, the Russians again approached RCA to buy technical information. David Sarnoff agreed with the proviso that they also procure about $1,000,000 of equipment. The Army, Navy and State Departments promptly approved. The Russians decided to order a complete TV station for Moscow (its first TV), with the equipment to be patterned after that in use by NBC in the RCA and Empire State buildings.

As I had previous experience in Russia and later at the Empire State installation, I was elected to install Moscow's first TV station. We also were to teach them how to manufacture TV receivers and radio tubes in Leningrad, and radio receivers in Veronez.

That required 12 engineers altogether. All commitments were completed within eleven months, and was paid for in full before Wally Poch and I, the last two of the RCA group, left in May 1938.

Incidentally, the equipments that were installed were of a slightly improved version of those at NBC/Empire State. The Russians could honestly say that their TV was as good as any in the World. They managed to refrain from mentioning that it was imported.

Locally-provided items were of a somewhat primitive design. The transmitter antenna was installed atop an old radio tower made of discarded and rusted railroad rails, 330 feet high and very strong. During the winter's bitter cold, it was virtually impossible to get to the antenna for performance checks.

TV receivers were shipped from RCA Camden. The Russians placed most of them in public places, and viewers were greatly impressed. A few receivers were placed in the homes of the privileged class, and Wally Poch and I were permitted to enter the homes to adjust the receivers. Under Stalin, there was such a pervasive fear of foreigners that they were excluded from Russian homes. Through our entries into homes, we became a source of information for press and Embassy personnel.

My notes tell of one quite different receiver location: "We wanted to see the picture at a more distant location and, for that purpose, a receiver had been installed in an engineer's cottage about 30 kilometers from Moscow. We first drove on a good road, then on a small country lane in deep snow; after leaving the car, we donned boots and walked through beautiful snow-covered woods for a kilometer. Then, in that little cottage in the middle of a Russian forest, we watched by television the excellent reception of one of Russia's newest and best feature films. It was weird." And that in the winter of 1937.

A word about Russian engineers: seven came to Camden to learn how to install and operate the equipment; they were basically capable and friendly. When we traveled to Moscow, two were missing and our inquiries evoked embarrassment and silence (indicative of imprisonment.) With the other five, we worked on a friendly basis but not once did any one of them invite any of us to his Moscow living quarters or to meet his wife. That would have been too dangerous for them; they had been exposed to the capitalistic world —a security risk. Such were engineers' lives under Stalin.

Upon one occasion when entering the transmitter building, I encountered fear on the engineers' faces. They knew that a high ranking official would arrive that morning to ascertain why the installation was a month behind schedule. Normal procedure would be for him to pick one or two engineers for imprisonment thereby "eliminating the cause," inducing the others to work harder, and gathering credit for himself.

Yes, there was reason for fear. When the official arrived in the intense environment, my interpreter began to shake and, within a minute, became semiconscious. He was not an engineer, he was not in danger but, in the presence of that man...! So I, in my limited Russian, explained to the official that the engineers were very good and that the problem was due solely to a two-week delay while the equipment sat on a dock in Leningrad and then two weeks in Customs in Moscow. The official was unprepared to deal with a foreigner, evidenced apprehension at doing so, and probably saw merit in the explanation. He left without taking action against anyone and I undeservedly became a hero.

We met fascinating foreign officials and I will cite two examples. One was Count von Stauffenberg, the German Ambassador whom I met at times at the U.S. Embassy. In 1944, when back in Berlin, he attempted to assassinate Hitler for the good of Germany and the world, by placing a time bomb near Hitler. This brave attempt was publicized world-wide. Hitler was slightly injured and von Stauffenberg was executed. I liked him.

Another fascinating person was Charles Bohlen with who I formed a friendship that extended for many years. He became Ambassador to France, Ambassador to the U.S.S.R., and advisor to Roosevelt at the meetings with Stalin and Churchill in Teheran and Yalta, and to Truman at Potsdam. He warned Roosevelt against concessions to Stalin.

From notes carried out by diplomatic pouch upon leaving Moscow: "We encountered unforgettable fear everywhere; bureaucracy; frustration; isolation from Russians, and yet—absolutely beautiful frigid weather, fabulous ballet, and contacts with fascinating international characters—altogether for us a dynamic life with almost daily stimulation and excitement, and pity."

ROME

In 1930, I was sent to Italy to install Italy's first 50 kW broadcast transmitter, and RCA invited Mussolini to talk to the United States via short-wave radio. That would be Italy's first transatlantic broadcast. Propagation conditions would be most favorable during the afternoon, U.S.A. time, so the invitation was set for New Year's Day afternoon (1930) when there would be a sizable holiday audience.

Our meeting with Mussolini in his enormous marble office reached a congenial basis as soon as he realized that we were offering something that he greatly desired. We explained that we would have the famous composer, Pietro Mascagni, and his orchestra take over at the completion of Mussolini's talk so as to complete the rigid NBC time allotment.

His gruff response: "No one tells me how long to talk!" Luckily, we knew Mascagni well. So we told Mascagni that he would have to play a symphonic selection of unknown length—which he did—and the broadcast was a great success.

EMPIRE STATE BUILDING

The installation of NBC's TV transmitter in the newly-built Empire State building, in 1934, was a major step in the long history of TV development. A bit of good luck resulted from the strength of the building's tower. It had been designed to withstand 100,000 pounds of horizontal pull in anticipation of becoming an anchorage for transatlantic dirigibles. (One did dock there, briefly.) That reserve strength easily held the antennas without need for expensive reinforcements.

The NBC transmitter and my office were located on the 85th floor, the highest in the building—thereby literally giving me the highest office in the world. That didn't produce any detectable material benefit but it was fun. One of my paper airplanes was seen through binoculars to cross the East River and land in Brooklyn. A world record for that era?

There was a tragedy one foggy Saturday morning when a two-engine bomber flew directly into the building several floors below ours. Persons were killed, and an elevator fell 70 floors after its cable was severed by a loose engine and propeller.

WORLD WAR II

It was during World War II that the vital, unique and irreplaceable role of scientists and engineers became universally recognized. To cite one of the developments: Dr. Merle Tuve of the Department of Terrestrial Magnetism (an organization unknown to me, but a part of the Bureau of Standards) called and asked for the development of a vacuum tube that would withstand 25,000 g! Soon, tubes and other components were being produced by several companies to make possible the unbelievable proximity fuze. The security at the production locations rivaled that of the Manhattan project.

At first, only the Navy was permitted the use of the proximity fuze as a precaution to prevent a dud from falling to the ground and being recovered by the enemy. But soon it was needed urgently to destroy bombers and buzz bombs over England. Its success was immediate.[1]

The romance of the fuze was indelible. Vanevar Bush, the top science coordinator of the United States, said in his postwar book *Scientist Against Time* that the three technically outstanding and critically vital technical achievements were the atomic bomb, radar, and the proximity fuze.

GARDEN STATE RACETRACK

During the lend-lease days of World War II when U.S. industry was providing assistance to Russia, arrangements were made by Russian officials for several Russian Army heroes to visit the U.S.A. and witness the war efforts of American industry as exemplified by RCA.

RCA hired the entire Garden State Racetrack and presented an impressive show which, incidentally, included some captured German tanks. The Russians became extremely agitated the instant they heard the sound of the approaching tanks —to them, the sound of death.

The leader of the Russian group was a woman, a colonel about 30 years old, who had personally killed six Germans. At the conclusion of the program, we left Sarnoff's box and I (as I spoke some Russian) drove them to the train station. The colonel had been quiet during the afternoon, tough and skeptical. But when we were waiting on the platform for the train she seemed to suddenly realize that the entire show was genuine and that American industry was indeed going all-out for war victory. She emotionally broke down and told me of her realization, wept and kissed me —that from a tough girl who had killed six.

DAVID SARNOFF

A little known Sarnoff fact: he had a hidden longing to be a scientist. He learned how to associate with, support and understand scientists. He yearned to invent something, to receive a patent. He succeeded.

His invention had to do with a radar relay method for oceanic defense. I helped him with the application and a patent was issued. Although it was not actually used during the war, he was indeed proud to have become an inventor.

His major source of pride was in his dynamic role in the development and introduction of television, supported and spurred on by Vladimir Zworykin. Today, the political and cultural impact of world-wide TV is almost immeasurable. Another source of pride to Sarnoff (and there were many) was the giant 1,000 kW transmitter at Jim Creek, Washington, made for the Navy in the early 1950's. It operated on VLF into an antenna stretched between two mountain tops. Sarnoff, at the formal inauguration, sent the opening message using his gold telegraph key.

Drs. Zworykin and Irving Wolff, and I owned a biplane together. Perhaps it was Wolff's flying that induced him to develop the radio altimeter. One is now on every airliner. Zworykin's exuberance as a scientist was matched by the appeal of his old-Russian courtesy and charm.

COMPUTERS

During 1948-1949, there was intense studying and planning within RCA on the subject of data processing. In 1949, I had an opportunity to address the Board of Directors and to say that within the history of the electronics industry, the first era was that of wireless communications, the second era (which became larger) was that of radio broadcasting, the third era (still larger) was war work, the fourth era (largest) was TV to be followed by color TV, and that the fifth era would be computers. Sarnoff accepted this concept and allocated $10.6 million as a start.

Our first sale of data processing equipment was to the Army Ordnance Tank and Automotive Corps (OTAC). We produced a "Bizmac" data processing system and installed it in Detroit. It contained many thousands of vacuum tubes, and it worked! It saved money for OTAC by controlling its enormous inventory of tanks, vehicles, and spare parts.

Through authoritative channels, it was learned that IBM's directors anticipated that RCA would become their most serious competitor. Quite a thought! But RCA's progress was slow because of the financial burden of developing color television.

Also, it became apparent to some that RCA should acquire or join with a firm having mechanical expertise in business machine design and marketing experience. RCA management did not understand the need, funds were still limited, and nothing transpired.

Some years later the need was fully understood and conversations were initiated with the very-well qualified Burroughs Corporation. Burroughs' president, Coleman, said that Burroughs could be acquired by RCA! He was confident that he could carry this through his Board of Directors. But a heart attack intervened.

RCA's top people flew to Detroit to visit him in the hospital. He again expressed confidence in achieving this major corporate consolidation. But, next day, he died—ending the matter.

On the return trip from Detroit, the RCA DC-3 crashed at the Westchester airport. It skidded off the runway, hit a pole and literally cracked in half. Luckily, the RCA top people were seated in the back; there were no injuries except to the pilot's ego when he immediately joined the unemployed.

RCA eventually invested large sums and facilities in a program that attempted to meet IBM head-on (a fatal goal at that stage.) Eventually RCA's commercial data processing business was terminated with a $250 million write-off. It is fascinating to conjecture about what might have transpired if the Burroughs acquisition had been carried through.

TV SYSTEMS

There was engineering romance in the development over many years of monochrome and color TV. It involved massive teamwork seldom equaled in the world of science and technology. There was humor, too, as when the FCC was skeptical about the RCA system's color rendition. Finally, in a demonstration of the colors of a bowl of fruit, the FCC and RCA people were aghast—the bananas were bright blue and no one could adjust the picture otherwise. George Brown then carried in the bowl of fruit and revealed that he had painted the bananas blue! That ended all doubts about RCA's color.

The pioneering days brought together many engineers at their best and many formed life-long friendships with their associates. I did. Perhaps these anecdotes and experiences are illustrative of the fun and stimulation potentials within engineering careers.

REFERENCES

1. The Radio Club of America, Inc., *Diamond Jubilee Yearbook*, pp. 182-198.

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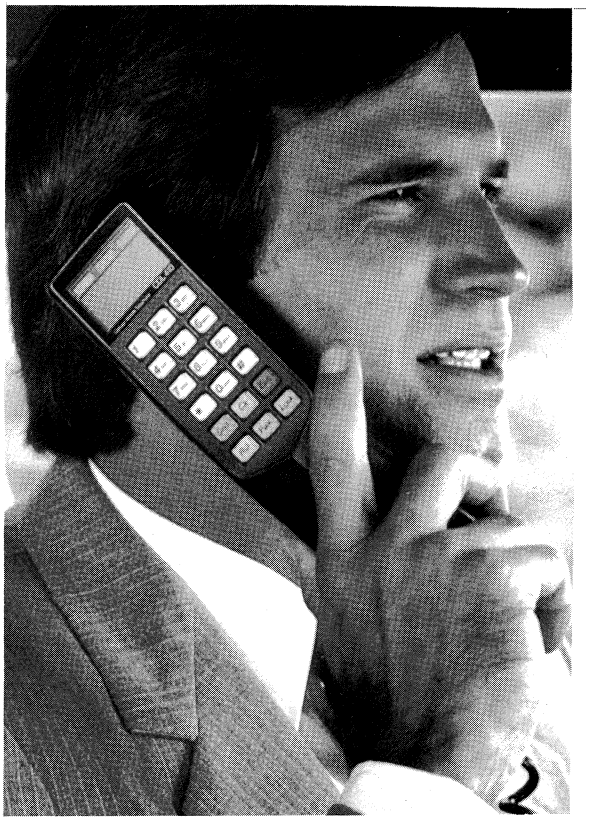

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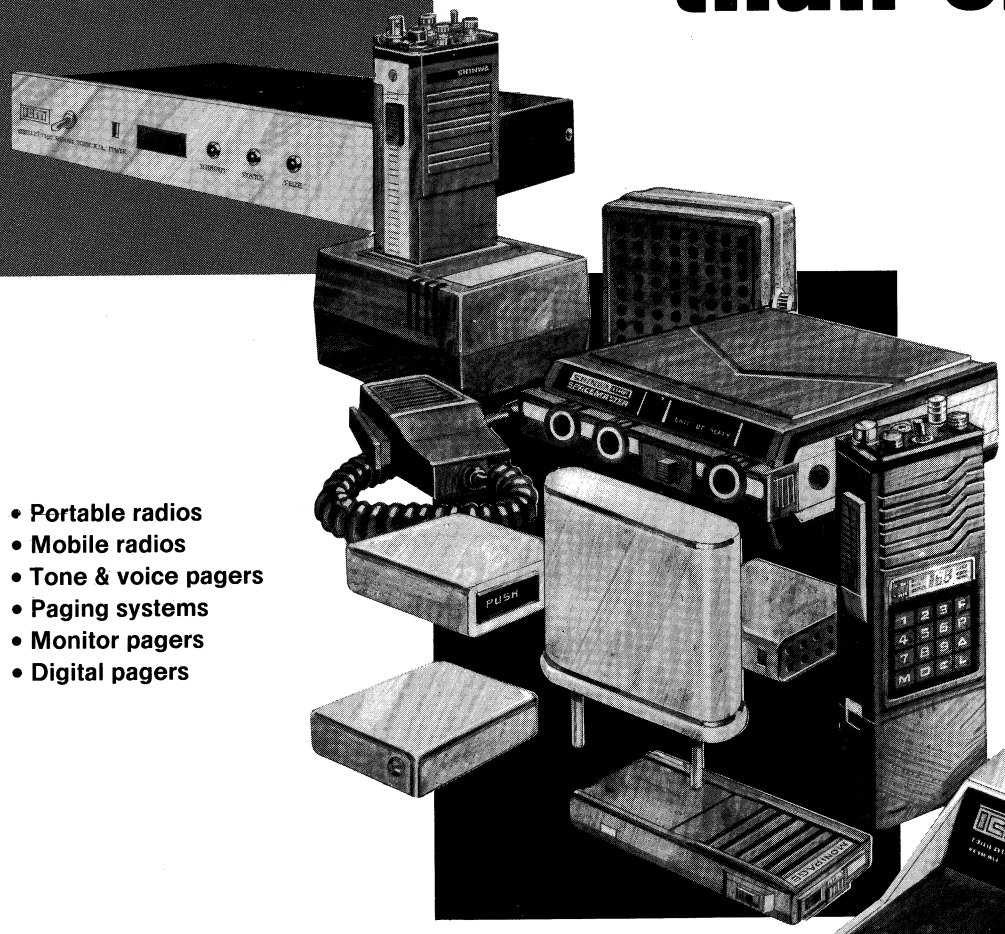

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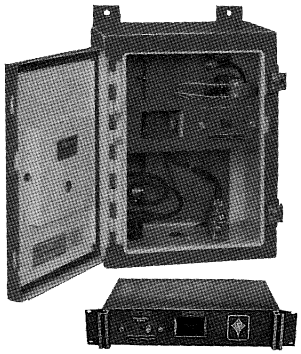
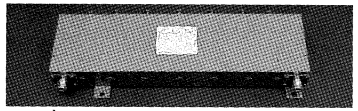
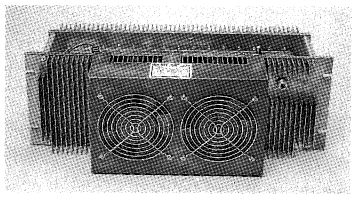


DB8900 Tower Top Preamplifiers use System A or B custom preselector filters such as the DB4257Z14-C (pictured below).



DB8500 Rx Multicouplers, with System A or B preselector filter, expand to 32 channels.



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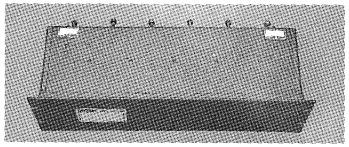
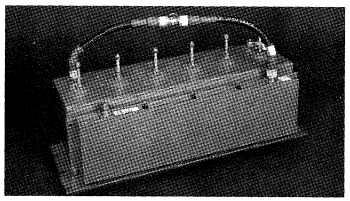
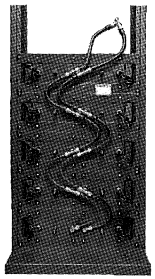


DB4200 aperture-coupled Tx Bandpass Filters handle regular and new System A and B.



DB4187 uses Tx (to 600 watts) and Rx filters for 825-890 MHz duplexing.



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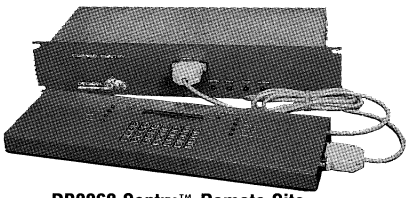
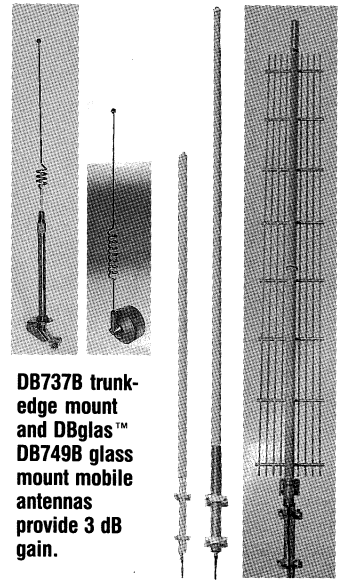


DB8860 Sentry™ Remote Site Monitor reports and controls up to 64 Tx/Antennas.



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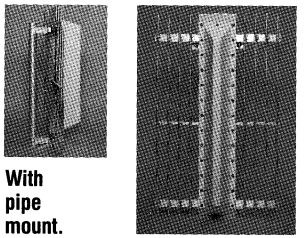
(Right) DB561/4 Sector Antennas provide 11 to 14 dB gain and 120° to 170° patterns, optional mechanical downtilt.



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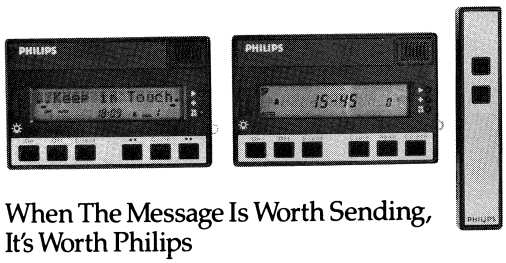

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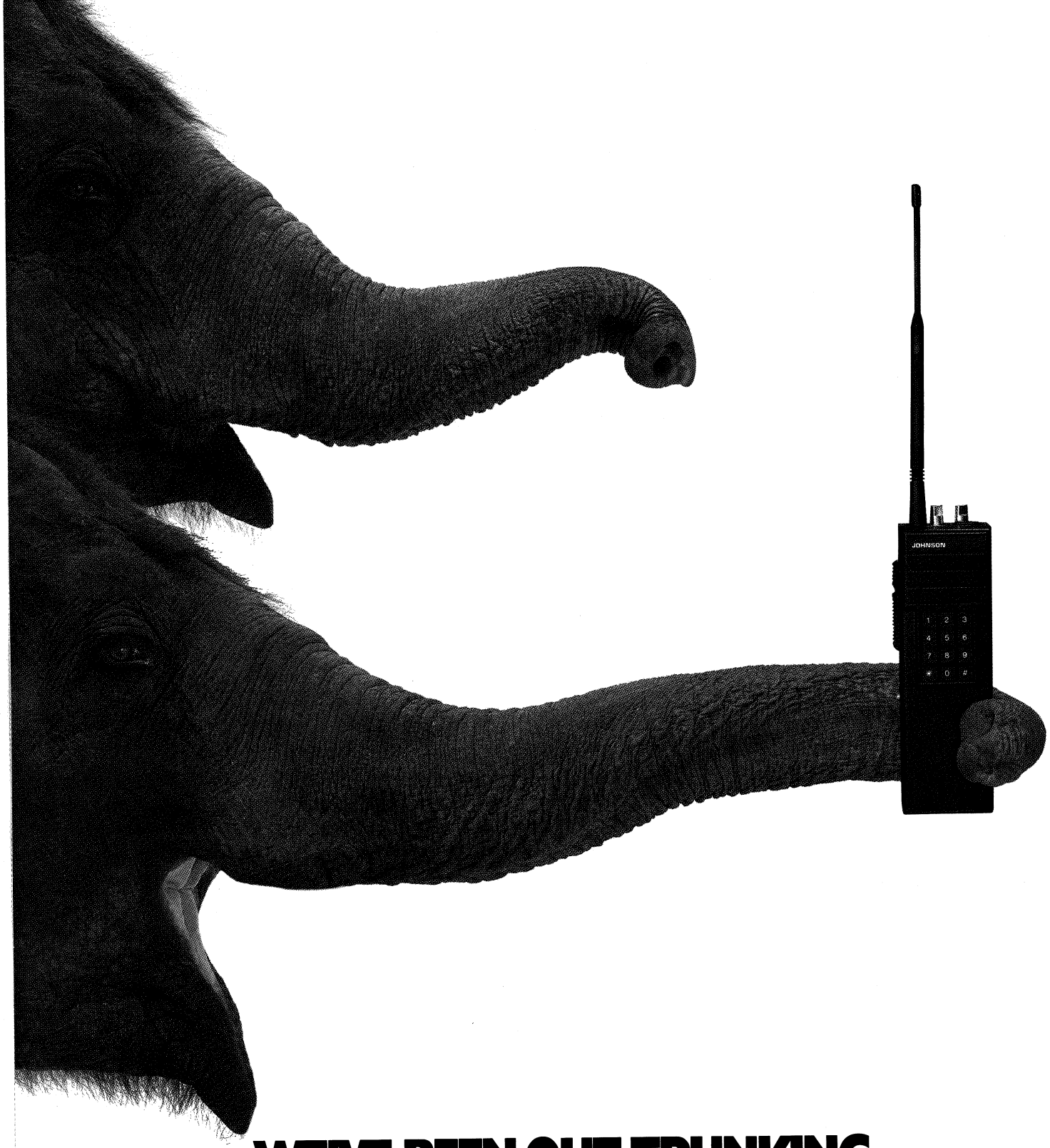

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