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NEWSLETTER

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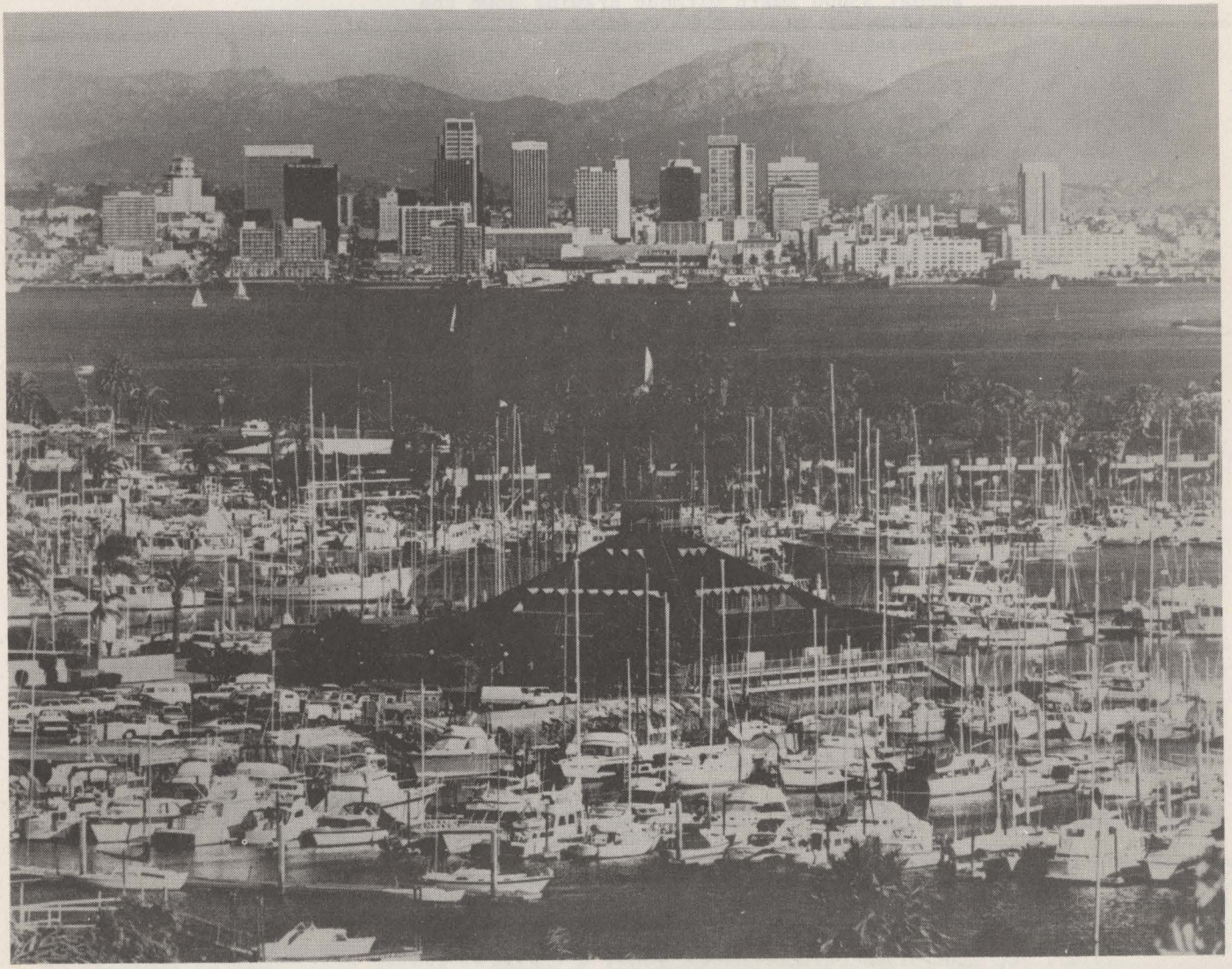
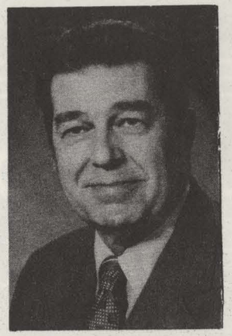
32nd Vehicular Technology Conference

May 23-26, 1982 **San Diego, California**



President's Message



Stuart F. Meyer
President
IEEE Vehicular Technology Society

At the risk of sounding redundant I am mentioning our expanded awards program again. Jack Neubauer has been hard at work wrapping up all of the details in time for the February Board meeting (in Washington, D.C.).

The Dan Noble Memorial Scholarship became an accomplished fact when both Motorola and the Vehicular Technology Society each put up $25,000 in late December. This combined $50,000 fund will be self perpetuating, thus providing an annual $5000 award without drawing down the principal. You will be reading more about all of our awards in the VTS NEWSLETTER.

Eddie Simon and his committee have been hard at work on the 1982 Annual Conference in San Diego (May 23-26) and additional information appears elsewhere in this issue. During a recent trip to California, I met with his group at the conference site. The facilities are first rate at moderate prices and the Conference program looks like a winner as the response to the call for papers has been excellent.

As this issue of our newsletter goes to press, the Conference Record problems of the 1981 Washington, D.C. meeting have been cleaned up, and at long last all of the manuscripts are scheduled to go to the printer in January. Prior to early February you should receive a confirmation of your mailing label information with a firm shipping date. This same mailing will confirm the exact price for this conference record (for those who did not attend the conference or would like extra copies). If you attended the 1981 conference and/or have written in asking for this information but have not yet received a copy of this confirmation please contact me at the address and phone number below.

We are still looking for suggestions on how to expand and improve our Vehicular Technology Society. Let me have your ideas and suggestions and my office will distribute copies to all board members for discussion and action at future meetings.

Sincerely,

Stuart Meyer
President, VTS

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Month of Issue	Final Copy To be Rec'd By IEEE Editor*	Target Mailing Date
May	3-09-82	4-13-82
August	6-09-82	7-13-82
November	9-15-82	10-20-82
February	12~~1~~4-82	1-18-83

*Inputs for newsletter staff editors should be received by newsletter editor at least one week before these dates.

Editor's Notes

A. Kent Johnson
Newsletter Editor

We would like to call your attention to several special features in this edition of the Newsletter.

1. The election results of the recent election have just been received and are contained herein.

2. The annual conference is to be held May 23 to May 26 at the Town and Country Hotel in San Diego. More information concerning the conference is contained in this newsletter.

3. The Society is participating in a scholarship program--The Dan Noble Memorial Scholarship--and Al Goldstein of of Motorola has been invited to provide details.

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Election Results

The results of the recent election for members of the board of directors have just been received. The newly elected members of the board (listed in alphabetical order) are:

Al Goldstein
A. Kent Johnson
Sam Leslie
Fred Link (Re-elected)
Sam McConoughey (Re-elected)

The term of office for these five board members will be two years rather than the customary three years due to the lateness of this election.

Society Officers and Board of Directors

SOCIETY OFFICERS

Society President	Society Vice President	Society Secretary	Society Treasurer
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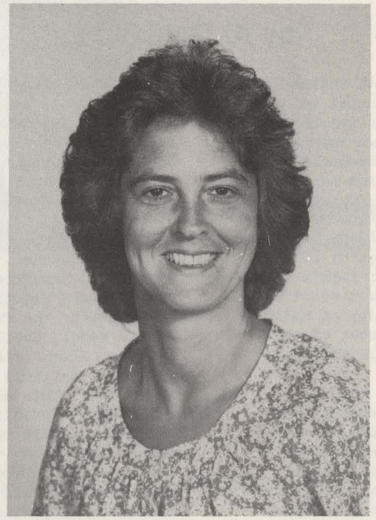
BOARD OF DIRECTORS

NAME	RESPONSIBILITY	TERM
William H. Chriss	Past Treasurer	Jan79-Dec81
Robert E. Fenton	Treasurer	Jan80-Dec82
Al Goldstein	Conference Coordinator	Jan82-Dec83
A. Kent Johnson	Newsletter Editor	Jan82-Dec83
Samuel A. Leslie	Society Secretary	Jan82-Dec83
Fred M. Link	Chairman, National Meetings Committee	Jan82-Dec83
Charles Lynk	Chairman, Paper of Year Comm.	Jan80-Dec82
Roger Madden	Junior Past President	Jan79-Dec81
George F. McClure	Chairman of Publications Comm. and Transactions Editor	Jan80-Dec82
Samuel R. McConoughey	Chairman, Chapter Activities	Jan82-Dec83
Stuart Meyer	President	Jan80-Dec82
James J. Mikulski	VTS Rep. IEEE Comm. on Social Implications of Technology	Jan80-Dec82
George J. Mitchell	Vice President	Jan79-Dec81
Ronald G. Rule	Education Committee	Jan79-Dec81
Robert A. Mazzola	Chairman, Membership Committee	Jan79-Dec81

1982 VTS Conference



Adriana Gianturco, keynote speaker of the 32nd VTS Conference

ADRIANA GIANTURCO TO KEYNOTE 32nd VTS CONFERENCE

Ms. Adriana Gianturco, Director of Transportation for the State of California, will explore the conference theme "Vehicular Technology - Meeting the Challenge of Limited Resources" when the conference convenes in San Diego, May 23-26, 1982. Ms. Gianturco is uniquely qualified to address the challenges of vehicular technology. Since 1976, she has been Chief of CALTRANS, the state's largest department, with responsibility for 16,000 miles of highways; rail and roadway transit systems; aeronautics; and overall transportation planning. She is a native Californian, a Phi Beta Kappa graduate of Smith College and she holds a Masters Degree in Economics from the University of California. Truly a dynamic leader with a diverse background and an innovative approach.

Other sessions will focus on Communications, Automotive Electronics and Transportation Technology. In addition to the latest in U. S. developments from the Departments of Energy, Transportation and Commerce; there will be presentations from Canada, Italy and Japan; as well as four days to meet and mingle with the leaders in vehicular technology. The large exhibit area will feature product demonstrations and a look into the future of practical sytems.

I.E.E.E. CONFERENCE TO BE "BEST EVER"

Mr. Eddie Simon, Chairman of the 32nd Vehicular Technology Conference to be held May 23-26, 1982 in San Diego, notes that all conference presentations have been scheduled. The conference theme "Vehicular Technology - Meeting the Challenge of Limited Resources" will be explored by international experts in three general topic areas:

COMMUNICATIONS. Including: Mobile telephones in cellular systems; radio guidance technology; mobile propagation; new antenna forms; simulcasting; etc.

AUTOMOTIVE ELECTRONICS. Featuring: Electric and hybrid vehicles; vehicular measurement and control; electronic sampling and analysis; etc.

TRANSPORTATION TECHNOLOGY. Examining: The powered highway; guideways for mass transit; magnetic levitation; linear propulsion; etc.

In addition to a keynote address by Adriana Gianturco, Director of Transportation for the State of California, there will be technical presentations from Italy, Canada and Japan; the latest in U. S. developments from the Departments of Energy, Transportation and Commerce; AND four days of product demonstrations, equipment exhibits and the opportunity to meet and mingle with the leaders in vehicular technology.

For further information, contact:
Eddie Simon, Conference Chairman
9320 Earl Street, #20
La Mesa, CA 92041
(714) 697-6691
464-7030

Daniel E. Noble Fellowship

by Al Goldstein

A Graduate Fellowship, in Electrical Engineering, has been established as a memorial to Daniel E. Noble, in recognition of his valuable contributions to the development of two-way vehicular communications and solid state technology. The stipends are provided by income from an endowment fund, established jointly by the Vehicular Technology Society and Motorola, Inc. Dr. Dan Noble, an executive of Motorola from 1940, was former Vice Chairman and Director Emeritus of Motorola, Inc., and was the electronic firm's Science Advisory Board Chairman at the time of his death. He was Director of the Institute of Radio Engineers from 1957 to 1962, and Director of the Institute of Electrical and Electronics Engineers during 1963 and 1964.

Noble, a former professor of mathematics and electrical engineering at the University of Connecticut, joined Motorola in 1940, after having designed and supervised construction on several pioneer FM broadcast systems, including the first two-way FM radio system for a state police department (Connecticut), for which he received much recognition. At Motorola, Noble supervised the development and design of a complete commercial FM communications system, foundation for a whole new product line. His leadership in design and development at Motorola established the company very quickly as a leading producer of this type of communications equipment for police departments, taxi cab operators and other activities in which efficient two-way communications played an important role. During World War II, Noble directed, at Motorola, the development for the U.S. Signal Corps of the famous SCR300 FM Walkie Talkie two-way radio which was widely used by the allied military forces. In addition to his work with the Signal Corps, Noble also collaborated on projects with both the Radiation Laboratory at Massachusetts Institute of Technology and the Radio Research Lab at Harvard. Following the war, Noble foresaw that the future direction of electronics was with solid state technology. In 1948, he was instrumental in establishing a Motorola research facility in Phoenix. Since then, Motorola has become one of the world's leading producers of semiconductors-the solid state technology Noble foresaw as the "future" of electronics. The Government Electronics Division continues to be an advanced technology operation, serving the needs of national defense and space programs. Noble received many awards for his distinguished career, including the WEMA (Western Electronic Manufacturers Association, now called the American Electronics Association) Medal of Achievement, the Franklin Institute's Stuart Ballantine Medal, the University of Connecticut Engineering Alumni Plaque and the 1978 Edison Medal from the Institute of Electrical and Electronics Engineers. This was given in recognition for Noble's "leadership and innovation in meeting important public needs, especially in developing mobile communications and solid state electronics. Noble served on the Board of the IEEE and the IRE, (Institute of Radio Engineers) and several technical committees, including the chairmanship of Panel 13 (Mobile and Portable Radio Telephone Communications) of the Radio Technical Planning Board. Panel 13 assisted the Federal Communications Commission in the allocation of radio frequency assignments and standards, and through Noble's work, the citizens band frequencies were set aside for later use. He was also a member of the National Television Color Systems Committee, which established the transmission standards for color TV. He was a Life Fellow of the IEEE, Life Fellow of the Franklin Institute, and a member of the National Academy of Engineering.

The selection process has begun, and it is expected that the successful candidate will be announced at the VTS Convention next May in San Diego. It is intended that the process of nomination, selection and award be completed every year by the time of the VTS Spring Convention.

Board of Directors Nominations

Each year nominations are received for candidates for election to the Board of Directors. Each year five members of the Board of Directors are elected for a three year term. Candidates for nominations are selected by the Nominating Committee and by Petition of the General Membership. At this time we are requesting suggestions from the General Membership as to appropriate candidates for nomination.

Please send your suggestions of a candidate to me at the following address:

Roger D. Madden
2025 M Street, N.W.
Room 5322
Washington, D.C. 20554

In addition to identifying the candidate it would be useful to have their address and telephone number for contact purposes.

Chapter News

Sam McConoughey
Chapter News Editor

MEETINGS

Cleveland

"Antenna Pattern Prediction"
by Bill Wickline of Kathrein, Inc.
Held on June 9, 1981 with 18 attending including 8 guests.

"A History of FM Two-Way Radio"
by Stuart Meyer, President of VTS
Held on September 23, 1981 with 26 attending, including 10 guests.

"New Steerable High-Power Shortwave Broadcast Stations"
by Donald Hastings, Chief Engineer
HCJB, Quito, Ecuador
Held jointly with Audio & Broadcasting, SBE, & NAB on October 7, 1981 with 63 attending including 17 VTS members and 24 guests and 22 from SBE.

Denver - VTS/COMSOC

"Tour of Johns-Manville Communication Center"
by David N. corbin, P.E., Vice-President & Manager
Satellite Communications Transponder Corporation of Denver, Inc.
Held on October 15, 1980 with 51 attending including 24 guests.

"Satellite Communications - A Technical Up-date"
by Russ Johnson, Vice President of Engineering, Western Tele-Communications, Inc.
Held on November 12, 1980 with 46 attending including 20 guests.

"Telecommunications as viewed by Cable Television"
by John Clark, Marketing Manager, United Cable Television of Colorado
Held on January 14, 1981 with 25 attending, including 5 guests.

"Electro-Magnetic-Pulse (EMP) - Its causes, effect and mitigation"
by Lloyd Watts, P.E., Federal Emergency Management Agency
Held on February 11, 1981 with 11 attending, including 2 guests.

"SlowScan Television Transmission"
by Glen Southworth, President Colorado Video Inc.
Held on March 11, 1981 with 28 attending.

"The Lectric Leopard" (Electric Powered Vehicle)
by Glenn Roberts, Sales Manager, U.S. Electricar Corp., Althos, MA
Held on April 15, 1981 with 30 attending, including 10 guests.

"Tour of Satellite Business System Tracking, Telemetry & Command Station"
by John E. Hewitt, Station Manager, SBS
Held on May 26, 1981 with 19 attending, including 9 guests.

"International Conference on Communications (ICC-'81)"
in which VTS was a joint-sponsor - June 16 - 18
Attendance at conference - 209.

"Paint Your Wagon"
A night at the theatre
Held on December 17, 1980 with 32 attending, including 18 guests.

New Jersey Coast - EMC/VT Chapter

Announced plans to hold a meeting November 24, 1981
"The Army Tactical Frequency Engineering System (ATFES) Pilot System, A User/Developer Interactive Program"
by Samuel M. Segner, Chief C^3 Survivability & Spectrum Management Div. CENSEI, Ft. Monmouth, NJ.

Washington, D.C.

Announced plans for a September 17, 1981 meeting
"Secure Land Mobile Communications"
by Thomas E. Tremain, Sr. Speech Scientist & Technical Director, Speech Research at National Security Agency.

ELECTION RESULTS

Chapter Secretaries, send us the information!

Cleveland

Mr. Warren Benditz, Chairman '81 - '82
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Mr. Karl Beckman, Secretary
Motorola Communications
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Tel. (216) 267-2210 x247

Mr. Frank "Fritz" Hemrich Vice Chairman '81 - '82
Communications Department
585 East 222nd Street
Euclid, OH 44123
Tel. (216) 289-2759

CHAPTER-OF-THE-YEAR

Selection of the Chapter-of-the-Year for the 1980 - 1981 Season in now underway. As noted in this Newsletter previously, the Chapter having the best season attendance, as reported to the Editor and carried on these pages determines the winner. It includes only regular Chapter meetings. (Credit for conference participation is handled separately.) The Season runs from September 1 through August 31. Reports must be in by December 1.

We have reminded Chapters to report and how to report meetings in five of the last six issues. Again have your Chapter Secretary send us a copy of the IEEE Form L-31 following each meeting. Then make sure it appears on these pages, if it doesn't, send a duplicate!

Advance notices of meetings, without attendance, do not give credit, where credit may be due. We publish them, but because of the Newsletter lead time, the meeting is history. Send the L-31 following each meeting!

TIDBITS

Chicago's VTS members, thanks to Al Goldstein and Dick Crouse, will shortly hear of efforts to get this Chapter moving again.

Denver, who we last heard from in the November 1980 issue, has submitted a whole year's report all at one time. (See above.) We'd much rather have the L-31's following each meeting, but welcome back to these pages!

New Jersey Coast puts out a mimeo local newsletter that not only carries meeting news but items about its members; it also carries advertising! Nice job NJC. (Now if we could only get them to send us the L-31's!)

A. B. "Buck" Buchanan, a founder of this Society sent his thanks for the AVANT GARDE award. He advises he is now blind and physically handicapped. Well wishers may write to him at 226 Hecla Street, Lake Linden, MI 49945.

SPEAKERS BUREAU

We welcome Jack Neubauer (see President's Message, November '81 issue of this Newsletter) to our roster of speakers for whom your Society sponsors travel costs to your Chapter Meetings.

Jack needs no introduction to long-time VTS members. A founder, and AVANT GARDE, Jack has been serving as Chairman of the Awards Committee. He will be available to visit Chapters in an effort to spread revival of our numerous activities.

Contact Jack at P. O. Box 125, Collingswood, NJ 08108 or telephone him at (609) 858-2788.

For our other speakers, see the November 1981 issue for a complete run down.

by Sam McConoughey, Editor & Shiela Parker
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1982 IEEE Vehicular Technology Society

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TOKYO, JAPAN	Dr. Marlo Akiyama Kogakuin University 1-24-2 Nishi-Shinjuku Tokyo, 191, Japan
TORONTO	Dale Moreland Canadian General Electric Company Mobile Radio Dept. 100 Wingold Avenue Toronto, Ontario, Canada M6B, 1R2
VANCOUVER	Alen R. Howatson 902 Fourth Street New Westminister, BC Canada V3L 2W6

Communications

Tom Rubinstein
Communications Editor

BIBLIOGRAPHY

RADIOWAVE PROPAGATION

In researching a paper, we discovered that there appears to be no comprehensive bibliography of Radiowave Propagation prediction and measurement articles in existence. As this discipline remains a big area of concern in the Land Mobile Radio field, we spent a few days gathering citations on the subject. The result is the bibliography reproduced below. While we have attempted to include all articles on the subject which are relevant to Land Mobile Radio, some may have escaped our notice. We would appreciate any additions or corrections that anybody elects to bring to our attention.

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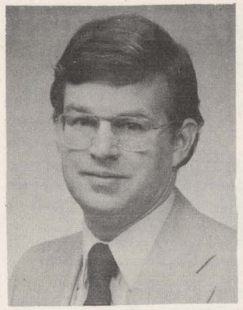
International Conference

Road Traffic Signalling
London, March 30-April 1, 1982

This conference organized by the Institution of Electrical Engineers covers the whole field of road traffic signalling. Adaptive urban traffic control systems will feature strongly with up-to-date descriptions from the UK (SCOOT), Australia (SCATS), USA (UTCS), France and Germany. The Japanese contributions are featured in the session on design of individual intersections of all classes of road user. Similar inputs have been received for sessions on Motorway and Tunnel control, the design of roadside equipment, and the management of signal data and the systems now becoming possible with the application of microprocessors.

Those wishing to receive further programme details and registration forms should write to the IEE Conference Department, Savoy Place, London WC2R OBL, England; telephone 01-836 2441; telex 261176.



Automotive Electronics

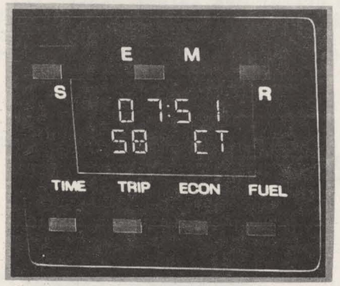
Dateline: Detroit

Bill Fleming
Automotive Electronics Editor

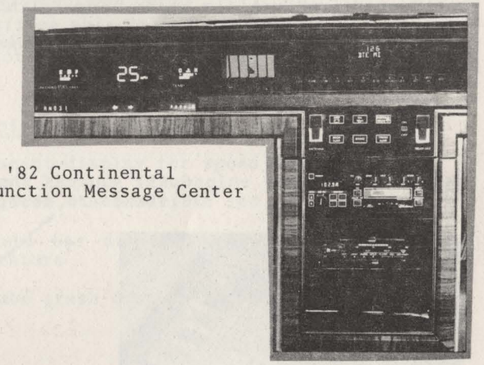
FORD MOTOR DIGITAL MESSAGE CENTER

For 1982, Ford is offering two versions of electronic instrumentation: a less-expensive, 7-function "tripmaster"; and a second-generation, 12-function message center.[1] A typical function provided by the instrumentation, for example, gives the estimated driving range available before the fuel tank runs dry.

The '82 Continental message center uses vacuum-fluorescent displays supplied by Futaba Corp. of America and Nippon Electronic Co. Ltd., two Japan-based companies. Microcomputers for the message centers are supplied by National Semiconductor Corp. and Intel Corp., both USA-based companies. Other suppliers include: Intel and RCA for integrated circuits, United Technologies Corp. for keyboard assemblies, and Motorola Inc. for microprocessor controls.



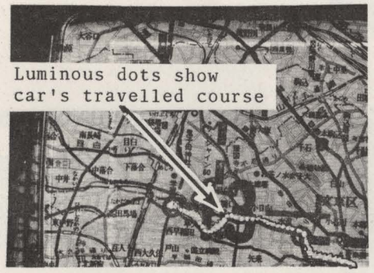
'82 Ford LTD
7-Function Tripmaster



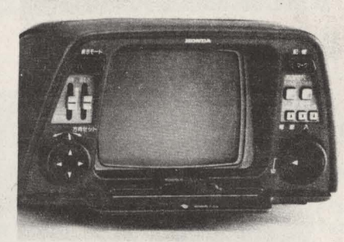
'82 Continental
12-Function Message Center

HONDA ONBOARD INERTIAL NAVIGATION SYSTEM

In Japan there is a market for driver navigation aids because of confusing, narrow, unnamed streets, and alleys which exist in many parts of that country, especially in the far eastern isles.[2] Honda Research and Development Company has announced a "Gyrocater" inertial navigation system similar, in principle, to that in a 747 jet-liner.



A Honda-Prepared Map Is
Inserted Over the Display Screen



Electro-Gyrocater
Display Center

Gas-Rate
Gyroscope

The gas-rate gyroscope measures changes in inertia of helium gas flow due to changes in vehicle direction -- this is done using a hot-wire thermal detector. Vehicle travel distance is picked up from an odometer pulse sensor. Next, a high-speed 16-bit microcomputer, built by Texas Instruments, is used to compute the path of vehicle's past travel. This path is then shown as a series of luminous dots on a six-inch CRT display. Honda-prepared maps are inserted over the CRT display, and any landmarks or turn-offs can be marked on the CRT with brighter and larger dots by touch of a memory dot control button.[2]

It is stated that the Gyrocater will cost between $870 and $1300, while providing accuracy close to that of a $44,000 aircraft system.[2] The navigation aid should prove a boon in the maze-like traffic of Tokyo, but just how much worth it will have in more organized and properly named American and European streets remains to be seen.

NISSAN (DATSUN) ONBOARD "DRIVE-GUIDE" SYSTEM AND ADJUSTABLE RIDE CONTROL

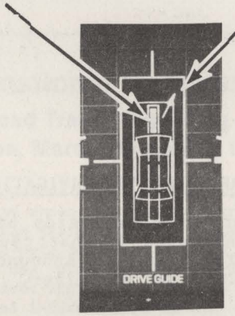
Not to be outdone , Nissan announced the "Drive-Guide" onboard navigation system that gives direction and distance-to-destination information.[3] Direction information is obtained by use of a terrestial magnetism sensor which consists of an electrically extended stubby pole mounted on the trunk. Travel distance is computed based on keyboard-input reference location data. The driver is informed of the correct direction and residual distance by means of the dash-mounted "Drive-Guide" Display.

The Drive-Guide system is available on the new Nissan GT-ES Skyline sports car. This car is also unique in that it offers adjustable ride control.[3,4] The vehicle shock absorbers are remotely controlled by solenoid-actuated orifice adjustments, which permit driver selection of either "soft" or "firm" vehicle ride. The "firm" ride setting is some 70% higher on "jounce" and 30% higher on "bump" than the "soft" ride setting. The idea is that the driver can select "soft" for rough unmade roads and for low-speed running, while "hard" is available for maximum cornering performance or for fast-speed running.[4]

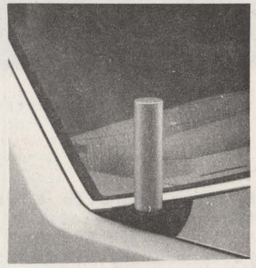
Input Control Panel

Small squares show distance to destination

Arrow shows direction of vehicle travel



Drive Guide Display


Terrestial Magnetism Sensor

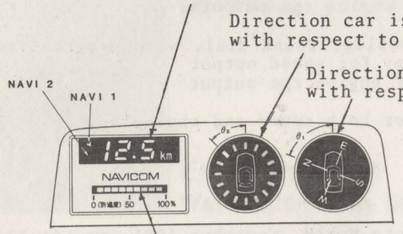
TOYOTA ONBOARD "NAVICOM" SYSTEM

Toyota led the parade of Japanese navigation aids with its announcement of the onboard NAVICOM system,[5] two months prior to the announcements of the Honda and Nissan systems described above. The driver enters his destination's azimuth direction, and the X-axis and Y-axis coordinates of the destination. The NAVICOM system then keeps the driver informed with updated estimates of remaining distance to destination, direction of car with respect to the destination, direction of car with respect to compass reference, and ETA (estimated time of arrival). In addition to the NAVICOM system, Toyota also announced a newly designed digital LED instrumentation panel (shown above) which will be included on Celica models.[5]

Computed distance to destination

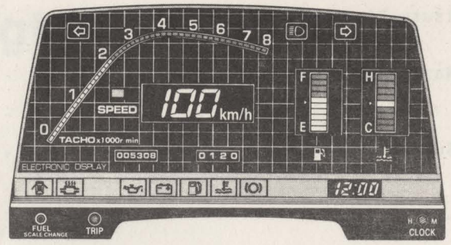
Direction car is heading with respect to destination, θ_2

Direction car is heading with respect to compass, θ_1

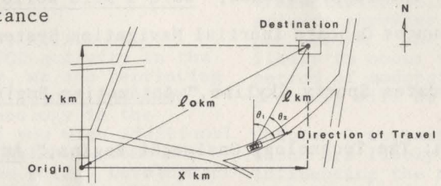


Percentage of distance travelled

NAVICOM Display



Digital Instrumentation Panel

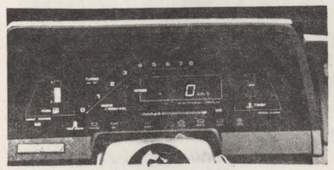


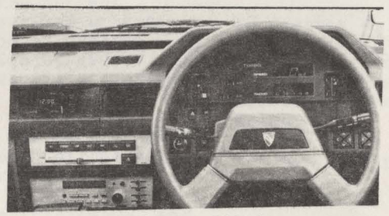
X-Y Coordinates Used to Locate Vehicle

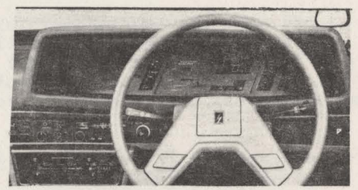
DIGITAL ELECTRONIC INSTRUMENTATION FLOODS JAPAN

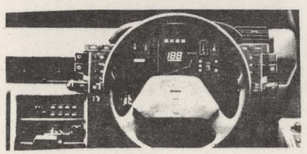
Now that the Japanese Ministry of Transportation has approved as of early 1981 the use of electronic instrumentation on the Toyota Soarer, several other manufacturers have followed suit.[6] Here's a run-down on what is happening in Japan:

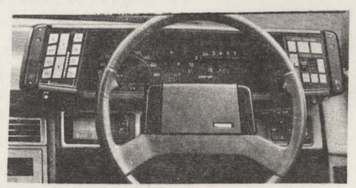
Car Model	Type of Electronic Display Used
Toyota Soarer	- Vacuum fluorescent display for speed output - LED, 44-segment display for engine rpm output (color changes from green, to amber, to red, as speed increases) - Fluorescent-tube bar display for fuel level and for coolant temperature
Nissan Silvia (Datsun 200 SX), and Nissan Leopard	- Fluorescent tube graph display for engine rpm output

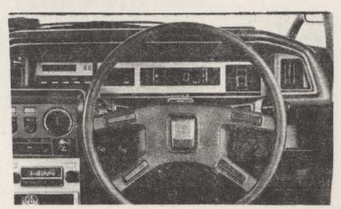

Toyota Soarer


Nissan Silvia (Datsun 200 SX)


Nissan Leopard


Isuzu Piazza


Mazda Cosmo


Subaru

Isuzu Piazza	- Duplicate analog-bar-graph and digital-LED displays for both speed and engine rpm outputs.
Mazda Cosmo	- Fluorescent tube analog, round-dial, with progressive color change display for speed output - LED bar display for engine rpm output
Subaru	- Digital readouts for both speed and engine rpm outputs

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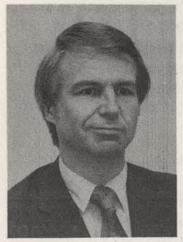

News from Washington

Eric Schimmel
Washington News Editor

Digital Communications

In keeping with our recent practice of publishing information on FCC activity in the area of spectrum technology, we are reprinting some excerpts from a recent report entitled "The Future of Digital Technology in the Private Radio Services. If you wish additional information on the report, which is some 60 pages in length, contact the Policy Development Division, Private Radio Bureau, Federal Communications Commission, Room 5322, 2025 M Street, N.W., Washington, D.C. 20554, (202) 254-3301.

This report presents the results of a staff study conducted by the Policy Development Division of the Private Radio Bureau (PRB). The study was conducted to provide information and analysis on issues and concepts of significance to the Bureau. This report is intended to stimulate discussion within and outside the FCC. The analyses and conclusions presented in the report are those of the Private Radio Bureau staff and do not necessarily reflect the views of the other Commission staff or the Commission itself. Discussions of rulemakings which have not been adopted by the Commission represent PRB staff opinions and do not necessarily reflect the view of other Commission staff or the Commission itself.

EXECUTIVE SUMMARY

The following report provides an overview of developments in digital technology, an assessment of the effect of the current regulatory structure in the various private radio services on the adoption of digital technologies, and an exposition of several regulatory areas which may require attention in the near future.

Chapter 1 is a discussion of the current state of digital communication in each of the five major private radio service categories:

Aviation, Land Mobile, Marine, Microwave, and Personal. Federal Communications Commission rules have been changed in the past in response to petitions requesting that specific types of digital systems be authorized in the various services. However, the rules are not always sufficiently flexible to allow the use of new digital technologies or expanded use of current technologies. Several current rulemaking initiatives will provide additional flexibility to accommodate near-term requirements.

Chapter 2 is a discussion of the digital technological developments expected over the next twenty years, along with some resulting regulatory issues. It is expected that digital transmission will predominate throughout the private services early in the next century, if not before. The digital "explosion" is not likely to occur in the near-term. Instead, a period of moderate growth and development probably will be experienced.

Chapter 3 contains a discussion of the factors which are likely to be most inportant in influencing the rate of adoption of digital technologies in the various private radio services. The most important factors influencing the rates of adoption of digital technology in the near term are:

1. Need for data communications (person to computer and computer to computer);
2. Need for secure communications (digitized voice or specially coded data);
3. Regulatory constraints (including international agreements);
4. Market structure (new entering market with lower cost digital communication products);
5. Need for improved system performance (shorter wait times, improved efficiency and convenience of operation);
6. The rate of development of competing common carrier (and other) systems and analog technologies.

In Chapter 4, recommendations are made about what actions, if any, should be taken in the near future to facilitate the adoption of digital technology in the private radio services. These recommendations are summarized below:

A. General - Review all permissible communications and eligibility rules in the private radio services to determine applicability and enforceability in a digital radio environment.

B. Aviation-No immediate action appears necessary.

C. Land Mobile

1. Review policy establishing voice as predominant operating mode.
2. Study the compatibility

of analog and digital transmissions to determine if digital-only channels should be allocated; if so, consider whether to allocate these channles from the 900 MHz reserve or from some other band.

3. Review station identification requirements and the Commission's ability to monitor transmissions for enforcement purposes in a digital environment.

4. Review subpart J, including 90.233(b) which is the "two-second" rule, in light of increased demand for non-voice operations and the difficulty in distinguishing between digitized voice and data.

D. Marine - No immediate actions appears necessary other than continuing work to expand use of narrow-band-direct-printing.

E. Microwave - Develop criteria for channel assignment which reflect the bandwidth requirements for systems using both voice and data.

F. Personal

1. Continue work on Docket 20777 (deregulation of Part 97 regarding emissions authorized in the Amateur Radio Service), RM-3788 (use of additional digital modes in the Amateur Radio Service) and the NPRM for a new 900 MHz personal service.

2. Review radio control rules to determine feasibility of relaxing restrictions on permissible emissions.

3. Review CB and GMRS rules to determine feasibility of relaxing restrictions on permissible emissions.

Summary

The preceding discussion has indicated that digital transmission will become the standard in the PSTN as well as in other ICNs in the not-too-distant future. It also is clear that the computer market, and especially the personal computer market, will be expanding rapidly during the next decade. The expanded use of computers and ICNs in turn is creating a new information industry to provide data bank and electronic mail service. The above developments will be providing a very strong impetus for the eventual conversion of the private services to digital, by stimulating digital hardware cost reductions, and by stimulating interest in accessing computers and interconnecting with larger communication systems.

Summary

It appears there will be tremendous improvements in digital voice encoding technology during the next decade, with a variety of low-cost, highly efficient systems being developed that can provide good quality (voice) communications. However, this development will force the Commission to address a number of regulatory questions concerning permissible communications and service distinctions. The rate of adoption of the new technology will depend not only on the resolution of the above issues, but also on the regulatory incentives that are provided, and a host of market related conditions. In conclusion, it seems that increased use of digital voice systems is fairly inevitable in most of the private services, although there is uncertainty about its rate of adoption.

Summary. Status reporting systems can only transmit a relatively limited number of messages, but can be more spectrally efficient than two-way data systems and cost less. The operating characteristics of status reporting systems complement those of a two-way data system and can help offset some of the dissadvantages of non-voice systems. In the future, we can expect to see further development of more sophisticated status reporting systems, such as the Gandalf system, with perhaps some significant cost reductions.

Summary. Digital paging will offer improvements not only in spectrum efficiency, but also in receiver operating convenience and flexibility. Although a price premium initially will be associated with the new digital pagers, it should disappear as the market develops and becomes more competitive. However, the enforcemet problems still may be significant enough to encourage a reevaluation of the role of service distinctions and permissible communications in the future digital communications environment.

Summary

Non-voice digital systems can offer a substantial improvement in spectrum efficiency and several operational advantages for some types of services. Future systems can be expected to be more spectrally efficient and less expensive, especially if the market expands. Modest increased use of these systems is expected in most services during the next five years, with usage expanding at a greater rate after that period. In order to not impede this development, the Commission will have to resolve the same regulatory issues associated with digital voice communications (i.e., permissible communications and service distinctions) as well as some additional issues (e.g., wideband channels and

additional exclusive channels for non-voice digital communications).

Conclusion

General

Digital transmission (voice and data) will predominate throught the private services early in the next century, if not before. The transformation from analog to digital will result from the rapid development of personal computers and large digital integrated communication networks; the need to use the spectrum efficiently in order to accommodate more users; and the desire for enhanced flexibility of operation that can be provided by digital technology.

The digital "explosion" is not likely to occur in the near-term (next five years), since personal computers are just beginning to make significant penetration into U.S. households and businesses, and digital ICNs are beginning a period of rapid development. It will be at least five years before a significant number of private service licensees become comfortable with computers, and subsequently non-voice communication systems.

Increased use of digital technology will force the Commission to consider a number of issues relating to permissible communications, service distinctions, regulatory structure, and technical standards (interference considerations). The Commission may have to modify its approach to regulating the private services in order to not impede adoption of the more efficient digital technologies.

Digital Voice

Digitized voice systems may eventually outperform analog systems at a comparable price, however, this will require a significant breakthrough in voice encoding technology. Analog techniques for voice communication will dominate for at least the next 10-15 years.

There will be modest growth in land mobile digital voice systems in the near-term as the importance of secure communications continues to grow.

Increased use of digital voice also can be expected in the mocrowave and aviation services, but will be adopted more slowly in the personal and marine services.

Non-Voice Systems

Two-way data, status reporting, and digital paging systems offer a comparatively high level of spectral efficiency which could be further improved.

The cost of non-voice systems is relatively high, but should decrease significantly in the future.

Two-way data and status reporting systems can substitute for voice systems in some types of operations.

Digital paging can provide improvements in spectrum efficiency and receiver-operating convenience, but at higher cost in the near-term.

Digital (alphanumeric readout) pagers may substitute for voice pagers, but this probably will not occur to a great extent in the private services.

Non-voice communications will increase in all private services at a modest rate during the next five years.

Advanced Systems

Advanced systems (packet radio, spread spectrum, integrated radio systems) can facilitate development of digital communications and can offer enhanced flexibility for the system designer and user.

Advanced systems will be used to a limited extent in the private services in the near-term.

The Commission will have to resolve a number of significant issues before advanced systems can be widely employed in the private services.

Chapter 3 - FACTORS INFLUENCING THE ADOPTION OF DIGITAL TECHNOLOGIES

The factors which are likely to affect the rate of adoption of digital technologies can be grouped into three major categories: (1) factors related to the availability of spectrum in general and for specific technologies; (2) factors related to specific communication needs and applications; and (3) economic factors.

The first category includes such factors as: the amount of available spectrum; the availability of substitute communication services which do not utilize "private" spectrum' the overall demand for communication services which fall under the purview of PRB; the regulatory environment vis-a-vis digital emissions; and international obligations. The second category includes such factors as: the demand for secure communications other than that using analog scrambling; the demand for data communications in a mobile environment; the demand for high bit rate data communication; the demand for more reliable mobile communication in congested urban areas; as well as the demand for other communication applications which cannot be accomplished

using analog transmissions. The third category includes such factors as: the cost of digital equipment (which will probably be affected to some extent by the rate of adoption of digital technologies in the telephone system); the costs of comparable analog equipment; and the cost of obtaining needed communication services.

In the following sections, the factors which are likely to be most important in influencing the adoption of digital technology in each of the private radio services, within the next five years, will be discussed. An attempt will be made, where possible, to rank the factors by relative importance within a service category. In addition, any important interrelationships of the factors will be examined and discussed.

Land Mobile

In the land mobile radio services, it would appear that the primary factor which will influence the rate of adoption of digital technologies is the demand for data transmission capabilities in a mobile environment. The reason for this is that this is a communications capability which requires digital transmissions. While the need for secure communications can be met with either analog or digital, this is not the case with data. Furthermore, it is possible that cellular mobile telephone systems may provide a secure voice communication service for many land mobile users. Therefore, although the demand for secure communications will have some influence on the rate of adoption of digital technologies in the land mobile services, the availability of substitutes in the form of analog scrambling and/or common carrier services such as cellular, make this factor less important than the demand for data transmission capability.

The cost of specialized digital equipment will also affect the rate of adoption of digital technology in the land mobile services. However, it is expected that the cost will decline from current levels as the demand increases and additional equipment manufacturers are attracted into the marker for digital equipment. Less expensive equipment may also result from digital developments in the telephone network, as well as other digital transmission systems which may have applicability in the land mobile radio services.

Finally, spectrum availability will have an impact on the rate of adoption of digital technology in land mobile. The specific effects of the amount of spectrum which is available are somewhat ambiguous. On one level, an increased supply of available spectrum may slow adoption of digital which is being used to make more intensive use of a given amount of spectrum. Therefore, in terms of adopting digital to increase efficient spectrum use, an increased supply of spectrum could serve to slow the rate of adoption of digital. However, for those uses which require digital emissions (data transmission and digitized voice) an increased supply of spectrum should help to accelerate the adoption of digital technology in land mobile because of the opportunity to establish digital systems in new spectrum without the problem of possible interference complaints from established analog users. While there are conflicting opinions about the ability of analog and digital to coexist on common frequencies, it is clear that the likelihood of implementation of digital in land mobile would be incresed if new spectrum from the 45 MHz of reserve spectrum from the 900 MHz band were allocated for digital use on a primary basis, or for digital or analog on an equal basis. In this case, an increae in the availability of spectrum should result in an increase in the rate of adoption of digital technologies in the land mobile services.

CHAPTER 4 - TIME FRAME FOR REGULATORY ACTION

Traditionally, as new service needs and/or technologies develop, the Commission receives a petition for rulemaking to modify existing rules to permit the new service and/or technology. This approach is viable in cases in which sufficient lead time exists between the time the petition is submitted to the Commission, and the time the petitioner desires to use the new service and/or foresight on the part of the petitioner, as well as a reasonably expeditious rulemaking process by the Commission. The increasing rate of technological change in communications is making it more difficult for the Commission to changes rules, in a timely manner, in response to petitions. Consequently, unless the Commission anticipates new technologies to some extent, we will be likely to impede some of the new technologies.

It is clearly impossible to accurately predict which new technologies will be used in various service areas, or exactly when they will be used. Therefore, in order to provide for these technologies, the Commission must develop more flexible rules. However, this flexibility must be constructed in such a way that existing systems are not jeopardized. Essentially, the Commission must balance a desire to maintain the quality of existing services with a desire to build additional flexibility into the regulatory structure in order to more easily authorize new technolgies. The inevitable movement of the private radio services toward greater use of digital technologies necessitates a change in the current regulatory structure.

Given this general framework, each private radio service area is discussed to indicate what actions, if any, are needed to facilitate the use of digital technologies within the next few years.

General

An area which affects all services is a review of permissible communications and eligibility rules for applicability and enforceability in a digital radio environment. As the use of digital emissions becomes more prevalent, a continuation of existing permissible communications and eligibility rules will require either more sophisticated monitoring equipment or a relaxation of some of these rules, or some combination. This could be a problem both for services within a major service area, as well as among the major service areas.

Land Mobile

The existing regulatory structure for the private land mobile services assumes voice as the predominant mode of operation. Digital transmissions, when permitted, are authorized on a secondary basis to voice. The reasoning behind the secondary basis, as well as the "two-second" rule regarding digital transmissions, is to assure that in case of conflict, voice will prevail. This may be an appropriate time for the Bureau to reevaluate its existing policy about the nature of private land mobile communication, and initiate an inquiry into authorizing digital on an equal basis with voice. Unless this basic policy is changed it is likely that the adoption of digital technologies in the private land mobile service will be impeded. However, prior to changing this policy, it is necessary to determine what, if any, technical problems may arise in an environment shared by both analog and digital transmissions. The Bureau should also investigate the desirability of allocating channels for digital use only, or digital use on a primary basis. Special digital channels may be advisable because some digital systems may require bandwidth which is wider than a standard voice channel in order to operate efficiently. Such channels also could serve to speed the adoption of digital in the land mobile service. Since the spectrum which is most likely to be readily available for such channels in the near-term is in the 900 MHz reserve, and since this reserve is being gradually allocated, it would seem incumbent upon PRB to ascertain as expeditiously as possible whether or not there is a need for an allocation from this reserve for digital technologies.

Another aspect of the private land mobile radio services which will be affected by the increased use of digital technology is the whole area of permissible comunications rules and existing service distinctions. Since much of the private land mobile regulatory structure contains various eligibility requirements and rules regarding what type(s) of communication can be conducted on certain frequencies, and given the fact that digital transmissions are inherently more difficult to monitor for purposes of enforcing permissible communication and/or eligibility rules, PRB will have to reexamine some of these rules. There are two related issues to be addressed here. First, if monitoring digital transmissions are not restricted, since much of the regulatory structure becomes, de facto, unenforceable, should the regulatory structure be modified to reflect this situation? Related to this second point is the question of station identification requirements. Current rules require identification either in voice or international Morse code. If it is decided to deviate from the current regulatory structure which favors voice over digital, it will be necessary to consider modifying identification requirements as well. Any modification would, of course, have to be done in conjuction with FOB.

Finally, although several pending rulemakings serve to relax some of the restrictions on digital emissions identified in Chapter 1, there still appear to be restrictions on the use of digital in the 800 MHz band. Specifically, licensees are precluded from using digitized voice, except in the Police, Fire, and Power Radio Services, by 90.385(c). While a proposal is being developed to authorize digitized voice to other land mobile licensees, the authorization would be on a secondary basis to voice. In terms of digital data, although a proposal is being developed to relax the restrictions contained in 90.385(c), licensees on shared frequencies would still be restricted by the "two second" rule on transmissions. Since digital data transmissions are more efficient in terms of spectrum use, it would seem that the current "two-second" limitation should be reexamined to determine if it is deterring the adoption of digital systems. Also, since it may be impossible to easily distinguish between digitized voice and digital data, the two-second limitation on non-voice transmissions may be unenforceable.

Related to this point is our entire approach to non-voice operations. The Bureau currently has very detailed rules limiting the use of land mobile frequencies for various signaling, telemetry or alarm operations. With the likely increase in the demand for such remote operating capabilities, as labor and transportation costs increase and communication costs remain stable and/or decrease, a reevaluation for the restrictions contained in Subpart J would seem to be appropriate.

Briefly, the following four items for further action in the land mobile area are recommended:

1. Review policy establishing voice as predominant operating mode.
2. Study the compatibility of analog and digital transmissions to determine if digital-only channels should be allocated; if so, consider whether to allocate these channels from the 900 MHz reserve, or from some other band.
3. Review station identification requirements.
4. Review Subpart J, including 90.233(b) which is the "two-second" rule, in light of increased demand for non-voice operations and the impossibility of distinquising between digitized voice and data.

Conclusions

The use of digital technologies for voice and data transmission has been growing at a modest rate within the private radio services in recent years. However, as the demand for secure communications increases, as the demand for high speed data transmission capability increases, as personal computers and large digital integrated communication networks develop, and as expected that the transformation from analog to digital will accelerate. All of the private radio services are likely to witness a gradual increase in the use of digital technologies over the next five years, with even more rapid changes expected beyond a five year time frame.

Since the rate of technological innovation in communications is increasing, it is imperative that the Commission take the necessary actions to insure that the adoption of new technologies is neither hindered nor blocked by an inflexible regulatory structure. Existing rules must be continually monitored to identify areas in which new technology may be stifled. Proposed rules must be written in such a way that licensees are afforded as much technical flexibility as is possible, consistent with acceptable interference levels. In such a regulatory environment, digital technologies will flourish not because of regulatory fiat, but rather because of existing and projected communications needs.

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