IEEE
VEHICULAR TECHNOLOGY SOCIETY NEWSLETTER

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A Terminal Unit Mounted on a Small Garden Tractor

See story on page 14.

President's Message

Robert Fenton
President
IEEE Vehicular Technology Society

During the past year, the leadership of the Industrial Applications Society/Land Transportation Committee (IAS/LTC) has explored the transfer of this committee from the IAS to the Vehicular Technology Society (VTS). Both Societies and IEEE Headquarters have approved this move, and I am pleased to inform you that LTC is now a formal part of VTS.

We welcome all members of LTC and are pleased that you have joined our dynamic society with professional interests in transportation compatible with your own.

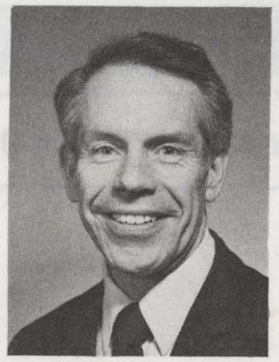
We plan to have LTC comprise the Transportation Systems section of VTS and, toward that end, I have appointed Tony Eastham, the Chairman of LTC, as chairman of that section. Tony has indicated that all LTC officers have joined VTS and will continue serving in their present capacities. In addition Dick Uher, the past LTC Chairman, has agreed to serve as Associate Editor (Transportation Systems) for the VTS Transactions and Bob McKnight (a long-time member of both LTS and VTS) has agreed to assume the corresponding Editorship of this Newsletter. Welcome aboard!

The experience of these LTC people will be invaluable in our support of traditional LTC activities such as the Joint Railroad Conference held annually with the Railroad Division of the American Society of Mechanical Engineers.

One of our primary goals in the coming year will be to increase our membership. Sam McConoughey and several board members have prepared a brochure, which outlines the advantages of VTS membership. This should be available at future Chapter meetings, and we believe it provides convincing reasons for many nonmembers to join. Why not pick up several and distribute them to your nonmember colleagues!

This goal and others will be discussed at the next Board of Directors Meeting in early December when we will discuss goals and priorities for the next few years. You, the membership, are invited to submit your comments and suggestions to any of the Board members. In addition, if you are interested in serving on a committee, please let us know. We would welcome hearing from you.

Editor's Notes



A. Kent Johnson
Newsletter Editor

Newsletter Advertising Available

Are you interested in running an ad or an institutional listing in the VTS Newsletter? If you are interested, we would like to make that service available and accordingly we announce the following rate structure:

For ads:		
	Full Page	$300/Issue
	Half Page	$210/Issue
	Quarter Page	$120/Issue
	Eighth Page	$ 80/Issue

Discounts of 5, 10 or 15 percent will be given for ads that are listed in 4, 8, or 12 consecutive issues, respectively.

Also, the following rates for institutional listings (approximately 1.0 x 3.25 inches in size) are available:

4 Consecutive Listings:	$300
8 Consecutive Listings:	$500
12 Consecutive Listings:	$720

All ads and institutional listings must be camera ready and accompanied by checks made payable to IEEE/VTS. For further details contact the Newsletter Editor.

Newsletter Deadlines

Month of Issue	Final Copy to be Rec'd By VTS Editor	Target Mailing Date
February	12-30-85	01-27-86
May	3-10-86	04-14-86
August	6-09-86	7-13-86
November	9-13-86	10-15-86

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Board of Directors Report

Samuel A. Leslie
VTS Secretary

TO: IEEE VTS Board of Directors
VTS Chapter Chairmen

An executive committee meeting was held September 12, 1985 at the IEEE Office in Washington, D.C. The following were in attendance:

Bob Fenton
Roger Madden
Art Goldsmith
Stuart Meyer
Sam McConoughey
Eric Schimmel
Bill Lee
Bob McKnight
Leo Himmel
Bob Eckert
Sam Leslie

The following agenda items were covered at this meeting.

CONFERENCE REPORT

A written report from Evan Richards indicated the following:

The '84 SAE/IEEE-VTS Convergence Conference was the most successful ever, with a nominal $60K surplus being projected. The official financial report will be forthcoming shortly.

The '85 Boulder Conference was also a financial success, with a surplus on the order of $6000 being reported.

The '86 Dallas Conference Committee reports that they have already received abstracts for around a dozen papers so far.

The '87 Tampa Conference Committee reports a conflict with local University exam schedules for the originally selected date. They suggested the first week in June, but this conflicts with AFCEA (the same week) and with COMSOC (the following week). An earlier week was suggested; the Conference Committee is to resolve this conflict by the next Board meeting.

FINANCIAL REPORT

Art Goldsmith reported that the half-year financials indicate that we are ahead of budget. He reported that a check for the $3K seed money plus $4K surplus was received from the Boulder Conference Committee.

Also, Bob Fenton presented Art Goldsmith two checks from the Convergence Conference, with one being a refund of the $10K seed money and the other for $60K surplus for VTS's portion of the proceeds.

This presentation brought an immediate response from members of the Board that something along the lines of a Graduate Fellowship for students specializing in Vehicular Electronics be instigated. Roger Madden is to look into the feasibility of something along this line and is to bring a recommendation before the Board at the next full meeting.

EIA LAND MOBILE SHOWCASE

Sam McConoughey reported that, as of September 11, three panelists have been obtained for the IEEE VTS seminar at the EIA Show. They are:

Dr. John Davis, Director
Cellular Telecommunications Laboratories
AT&T Bell Laboratories

Mr. Richard Sell, Program Manager
Data Communication Systems
Motorola, Inc.

Mr. Boyd Fair, Assistant Director
SRI International

An IEEE booth will be present at this show, and will be staffed by Roger Madden and others. Membership kits will be available, and Sam indicated that IEEE HQ will now accept credit card numbers for payment of membership application fees. Furthermore, he noted that IEEE is continuing to reimburse the various Societies for new member solicitation.

NOMINATIONS COMMITTEE REPORT

Stu Meyer reported that the following Board member's terms expire at the end of this year:

Bob Fenton
Chuck Lynk
George McClure
Stu Meyer
Eric Schimmel

Fenton, Meyer, and Schimmel have all agreed to run for election again, and Stu is in the process of contacting McClure and Lynk to see if they are also willing to stand for re-election. In addition, Stu has obtained agreement from Vino Vinodrai and Leo Himmel to run for election.

Stu also mentioned that George McClure is running for Division III Director.

PUBLICITY REPORT

Bob McKnight distributed three publicity release papers with the following titles:

"Papers Sought For ASME/IEEE Joint Railroad Conference"

"Papers Sought For May 1986 Vehicular Technology Conference"

"New Officers Elected To IEEE Vehicular Technology Conference"

It was noted that elected board members Meyer, Schimmel, McClure, and Lynk were inadvertantly obmitted from the publicity announcement.

MILESTONES PROGRAM

Sam McConoughey reported that IEEE now has a milestones program to erect monuments (plaques) commemorating historic events. An example would be a plaque at a police building where FM mobile radio was first

used. Sam will report further on this subject at the next Board meeting, and welcomes suggestions for candidate locations.

IAS TRANSFER

Bob Fenton reported that he has received a letter from Dr. Engleson indicating that the transfer of the Land Transportation portion of IEEE-IAS to VTS has been officially completed. However, the IAS-LTC members have not been transferred; it will be up to VTS to invite those members of the Land Transportation Committee to join VTS.

Bob Fenton is to mail a letter to the 400-plus members of the IAS-LTC to ask them to join VTS.

In a late input, Bob also stated that he is appointing Dr. Tony Eastham as Chairman of the VTS Transportation Systems Committee. Tony held a similiar position in IAS-LTC, the Board welcomes him in his new position. Tony's mailing address is:

Dr. Tony Eastham
Department of Electrical Engineering
Queens University
Kingston, Ontario K7L3N6

Office Phone: (613) 547-6935

MEMBERSHIP BROCHURE

Sam McConoughey submitted a draft membership brochure for review by the Executive Committee. After a few minor suggestions and corrections, Bob Fenton asked Sam to proceed with getting the membership brochure published.

PROPAGATION COMMITTEE REPORT

Bob Eckert (Secretary of the IEEE-VTS Propagation Committee) reported on the progress of his committee. He stated that they are on target for a special issue either in the VTS Transactions or possibly a joint special issue with IEEE-AAP (Antennas and Propagation).

Sam McConoughey noted that the members of this committee (Chaired by Neal Shepherd) have assimilated much useful data and have put in long hours in coming up with what will be a very useful document.

POTENTIALS

Bob Fenton noted that VTS had run two advertisements in the May and August issues of the IEEE Potentials magazine for students. The magazine is requesting that VTS run the advertisements again; Bob Fenton is to work on a camera-ready copy for publication in next February's magazine.

PLANNING OBJECTIVES FOR 1986

Bob Fenton submitted a list of objectives for the VTS Board during next year. These objectives are:

1. Integration of LTC members into VTS,
2. Upgrading the Vehicular Electronics area of VTS,
3. Increasing VTS membership,
4. Finalizing and implementing our awards program,
5. Completion of Constitution and Bylaws revision,
6. Completion of Radio Propagation report and publication in the Transactions, and
7. Strengthing of Chapter ties.

Bob made special note of item 2 above, in that the publication of papers relating to vehicular electronics in the VTS Transactions has dropped sharply over the past few years. This appears due in large part to SAE putting increasingly higher priority on vehicular electronics in their activities. The consensus of the Executive Committee is that the Board should be more involved in this area, perhaps in working more closely with SAE and the Convergence committees to determine if there are papers that would not be suitable for one organization that would be acceptable to the other. Bob Fenton and Roger Madden are to start this process.

In regard to Item 3, Bob noted that Carl Stevenson is looking for guidance from the Board on how to increase membership. The upcoming membership brochure was mentioned. In addition, Stu Meyer is going to contact some of the trade publications (such as Mobile Radio Technology) to see if some publicity can be generated for associate and possibly full membership candidates.

Bob stated that the Board ties to the VTS Chapters have always been difficult, with only a few Chapters bothering to report activity. Bob suggested that a telephone campaign by the Chapter Activities Chairman would be most useful in prodding many Chapters into action, and that the Board should help the Chapters more with programs and organization help. He noted the the Board will reimburse expenses incurred with the telephone campaign activity.

On a separate note, Stu Meyer noted that a few Chapter Chairmen are not full IEEE members, which is in variance with the current IEEE VTS Bylaws.

NEXT BOARD MEETING

The next VTS Board meeting will be held in Washington, D.C. at the Embassy Suites Hotel on December 11, 1985. The meeting will start at 9:00 AM, and will end at 4:00PM. In addition, there will be a dinner get-together the night before at Blackie's Restaurant (near the Embassy Suites Hotel) at 7:00PM for those who can make it. As before, our meeting room will be available at a reduced rate if enough members register at the Hotel. I will mail a query approximately four weeks before the meeting to determine who will be attending and who will be staying at the hotel. Be sure to mention that you are a part of the IEEE VTS party when you make reservations. The telephone number of the Embassy Suites Hotel is (202) 659-9000.

Respectfully submitted,

Sam Leslie

Samuel A. Leslie
IEEE VTS Secretary

Chapter News

Gaspar Messina
Chapter News Editor

Meetings

New Jersey Coast (EMC/VT/AP)

The Feasibility of Measuring Ocean Surface Currents from Satellite Platforms
by Prof. Robert E. McIntosh, Electrical and Computer Engineering Department, University of Massachusetts, Amherst, Massachusetts
Held May 21, 1985, with 15 attending.

Cellular Radio: Relationships for Three-Dimensional Modeling for Co-channel Re-use
by Mr. Philip T. Porter, Bell Communications Research, Holmdel, New Jersey
Held June 18, 1985, with 13 attending.

List of Officers for September 1985 to September 1986, New Jersey Coast

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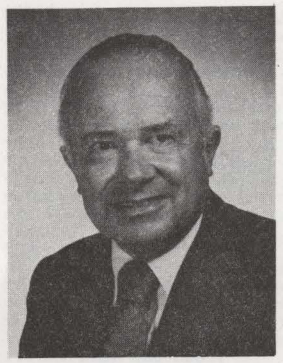


Professional Activities

Frank E. Lord
Professional Activities Editor

PROFESSIONAL AWARENESS

It is a common fault never to be satisfied with our fortune nor dissatisfied with our understanding.

de la Rochefoucauld

One of the many activities of the United States Activities Board (USAB) and the Professional Activity Committees for Engineers (PACE) is to sponsor and organize Student Professional Awareness Conferences (S-PAC). Through these conferences students become aware, often for the first time, of the many facets of an engineering career in addition to those that are purely technical. To date, nearly 200 such conferences have taken place with very successful results. Some of the material in the PACE Source Sheet on S-PAC can also serve as a reminder to practicing engineers of the many nontechnical aspects of an engineering career. Therefore, I am presenting an extract from that material here.

"WHAT IS PROFESSIONAL AWARENESS?
Engineers must be technically proficient, professionally astute, and aware of their responsibility to society. Professional awareness includes those subjects that affect engineers' careers, regardless of how well prepared they may be technically. It includes such subjects as:

. "SELF ASSESSMENT. Unless people know themselves, they cannot determine their positive and negative attributes. They cannot improve or sell themselves from a strong position, nor can they set realistic goals and objectives.
"Engineers must assess themselves in the following areas: (1) personal values, (2) personal assets and liabilities, (3) special capabilities, (4) educational needs--M.S., Ph.D., M.B.A., LL.D., continuing education, (5) level of challenge desired, (6) performance standards, (7) loyalities to family, employer, profession, and others, (8) value attached to volunteer service (extracurricular activities), (9) self-motivation, with or without incentives, and (10) goals and objectives - setting them early and pursuing them.

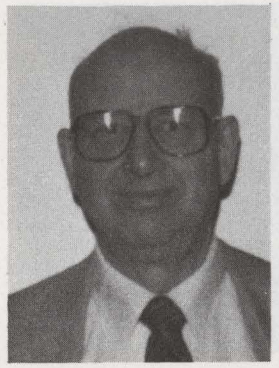
. "USEFUL SKILL DEVELOPMENT. Personal skills are not normally emphasized in an engineering curriculum but are part of the normal working environment. Therefore, it is important to discuss such skills at S-PACs: (1) oral and written communication, (2) listening, (3) observing, (4) interviewing, (5) negotiating, (6) human relations, (7) political skills, (8) delegating, (9) decision-making, (10) responsibility, authority, and accountability, and (11) initiative.

. "ECONOMIC CONSIDERATIONS. Earning a living and maintaining a reasonable standard of living are fundamental concerns of everyone. For engineers there are some additional considerations: (1) initial salary vs. job interest, challenge, growth, security, risk, and other factors; (2) location vs. cost of living, potential for continuing education, and active participation in a professional society; (3) compression of salaries over a career span in engineering vs. career changes; (4) stability of business or an enterprise within an industry; (5) opportunity to save for future family and career needs; (6) prevalency of career obsolescence in the industry and the particular enterprise; (7) personal responsibilities that are acquired, and how they affect career mobility and flexibility.

. "PROFESSIONAL FACTORS. Engineering is more than a job or succession of jobs. It is a profession encompassing an integrated continuum of several important professional activities, including: (1) continuous active association with an engineering society, (2) civic and social responsibilities, (3) learning and growth through volunteer services, (4) licensure and registration, (5) continuing education, and (6) publications, talks, and other services to the profession."

These aspects of engineering careers, as well as others, are addressed by the many committees and task forces of USAB. These entities are organized into four Councils and the Council Chairmen are members of USAB. Reports are made periodically which serve to keep us up to date. You can keep informed through your Section PACE Chairman, your Society PACE Chairman, or from the Washington Office. You are also encouraged to make inputs through these paths. These inputs may be your own thoughts and desires. In some areas there is also need for case history type information to support our efforts in specific areas, such as age discrimination, intellectual properties and pensions. One time efforts are greatly appreciated by those who are working steadily for our professional betterment.

Transportation Systems



Bob McKnight

Transportation Systems Editor

Papers sought for ASME/IEEE Joint railroad conference

The 1986 Joint Railroad Conference sponsored by the American Society of Mechanical Engineers and the Institute of Electrical & Electronics Engineers will be held April 7-8, 1986 at the Omni Hotel in Norfolk, Virginia.

Technical papers are sought for this conference, which will feature the following subjects:

-- Railroad communications and control systems.

-- Railroad and/or commuter electrification projects.

-- Rapid transit and/or light rail passenger systems.

-- Design, application, development and operations pertaining to the above mentioned railroad and transit systems.

-- Safety aspects of railroad and transit systems.

Papers may cover design of systems and equipment, methodology of control, installation and maintenance.

Authors should send six copies of a 500-word summary or abstract to Anthony Daniels, Meetings Chairman LTC/VTS, Morrison-Knudsen Engineers, Inc., 180 Howard Street, San Francisco, CA 94105. Phone: 415-442-7474. Deadline for summaries is December 1, 1985. Papers will be published for distribution at the Joint Railroad Conference.

Microprocessor technology & computers are key elements in railroads' ATCS

Computers, microprocessors and "Star Wars" controls are coming to the railroad industry. The impetus for this forecast is the Advanced Train Control Systems project being undertaken by the Railway Association of Canada and the Association of American Railroads.

Major railroads in the ATCS project include the Algoma Central, British Columbia, Burlington Northern, ConRail, CN Rail, CP Rail, Norfolk Southern, Santa Fe, Southern Pacific and Union Pacific.

The overall concept of ATCS is to design a modular system with sufficient flexibility to allow the user railroad to apply the degree of simplicity or sophistication best suited to its scale of operations.

An Economic Objective is increased productivity through application of microprocessor technology which should be less labor intensive and less costly. Thus ATCS is suitable for lower density lines. On higher density lines, ATCS is one way to increase exsiting fixed plant capacity.

More precise control over train operations will lead to higher productivity through better utilization of the railroads major resources: labor, fuel and rolling stock.

An Operational Objective is enhanced control of train operation to improve fuel efficiency and enhance day-to-day decision making by providing more comprehensive and timely information to train dispatchers and centralized control centers.

An operational goal is to accommodate plant modifications with minimum hardware replacement and taffic disruption during changeover.

Greater system reliability is a priority.

Safety Objectives include even more stringent controls than currently exist are required to prevent unauthorized train and engine movement, to prevent overspeed train operation and to ensure positive enforced protection of field forces.

To achieve these objectives, ATCS will have six main subsystems, each made up of from two to 14 modules.

THE PRESENCE DETECTION, TRAIN IDENTIFICATION AND LOCATION subsystem will detect the presence of trains, locomotives and cars; detect the presence of track equipment; make positive identification of locomotives and monitor the movement of trains. This is the basic subsystem required for ATCS beyond conventional train order or the most basic form of manual block.

THE TRACK AND ROUTE INTEGRITY subsystem will continuously monitor track and route conditions and identify many types of track or route abnormality. This information would be available to the train control subsystem and/or the locomotive cab.

THE ANCILLARY SYSTEMS INTERFACE subsystem would have two optional modules:

1- Systems alert module would interface the train control subsystem with automatic grade crossing warning devices and defective equipment detectors.

2- Other module would interface the train control subsystem with onboard locomotive sensing devices for both diagnostic and historical data purposes.

THE SWITCH CONTROL subsystem has four modules to monitor and/or control switches.

THE TRAIN CONTROL subsystem with its 14 modules will provide the route and interlocking logic; an ability to put all forms of clearance and operating instructions into the locomotive cab and display them; speed regulation; and automatic enforcement of instructions. It will also provide the interface with the track forces to ensure their optimum productivity without detriment to train operation.

THE MANAGEMENT OF TRAIN OPERATIONS subsystem will tie together train control and other related management information systems.

The 39 modules making up the six subsystems can be configured to provide the user railroad with the degree of control it desires. Each additional module will be upwardly compatible with the existing system. Therefore, a user railroad can enhance its present form of train control without discarding its present system.

MOVES TOWARD A SYSTEM ENGINEER

The ATCS project was approved by the Operating Committee of the Railway Association of Canada (RAC) in March 1984, and in May 1984 by the Operating-Transportation General Committee of the Association of American Railroads (AAR). ATCS is an industry-wide project co-sponsored by both RAC and AAR.

At a public meeting held in Toronto, Ontario in June 1984, 450 people heard about ATCS. The meeting was to inform suppliers concerning the operating requirements of the system and the part they might play in the project.

Of the 85 companies that want to be a part of the project, 70 have offered to provide components, 17 have offered to provide entire systems or major parts of systems. Another 15 companies have offered services of various kinds.

On February 4, 1985, a contract was signed with a consortium led by Arinc Research Corp. for $1,050,000 to be equally shared by AAR and RAC.

The work is to be conducted through the first quarter of 1986. Two subcontractors are Transportation & Distribution Associates, who have extensive experience in railroad technology, and Philip A. Lapp, Ltd., specializing in communications engineering.

The Arinc team has begun cataloging technologies available for each of the more urgently needed functions in terms of effectiveness, availability, reliability, safety and cost. This information is needed for cost/benefit analysis. Arinc will apply the system engineering process in achieving the ATCS objectives.

The process provides the logic and traceability needed to ensure that the system design is ultimately responsive to user functional requirements. The process will also provide options available in terms of trade-offs among quality, reliability and cost.

FORM -FIT- FUNCTION specification is the key to the Arinc process. F3 prescribes the size of each physical module in the architecture, where it is to fit in the architecture, what functions it must perform and how it is to interface with other physical modules, but it leaves the internal design up to the supplier.

The form-fit-function approach for electronics has been successfully used in the air transport industry for over 20 years. It has proved to provide all the advantages of competitive supply and demand market place, while offering the purchaser the assurance that each component will do what it's supposed to do. The procedure encourages suppliers to use their most effective technoloy and to provide highest quality at lowest cost.

Railroads desire to take advantage of similar benefits by fostering a more competitive market place, a greater diversity of suppliers and the achievement of technology transparency.

Arinc expects to complete technology assessment by the middle of the third quarter of this year (1985). System architecture will be defined early in the fourth quarter of 1985. Also, the research plan will be available in fourth quarter 1985.

Arinc will begin writing draft specifications in the fourth quarter 1985 and initiate industry and supplier review in early 1986.

Input from railroads will be sought on the priority of need for certain functions and/or development of modules found to be most cost effective.

It is hoped that construction of prototype modules could be underway in the first half of 1986.

Several task forces have been set up, including the following:

-- Systems engineering
-- Economic assessment
-- Communications engineering
-- Computer systems
-- Locomotive
-- Operations
-- Public relations
-- Regulatory liaison (separate groups for United States and Canada
-- Research
-- Signal engineering
-- Track and roadway engineering

Each task force will provide the system engineers with the best available advice regarding technologies and practices that are or are not acceptable to the industry.

The economic assessment task force is working on three tasks:

1- Develop a common methodology by which benefits of installing advanced train control systems can be estimated by any railroad.

2- Prepare a general estimate of the savings to be realized by the industry as a whole.

3- Will identify modules which are likely to provide the earliest returns as a guide to prioritizing the sequence of development.

VTS group makes good progress on radio propagation modeling

The growth of users in land-mobile services in the 800 MHz and 900 MHz portions of the spectrum have fostered a need for better understanding of radio propagation in this area. However, there are no generally accepted procedures for providing accurate and reliable 800 MHz propagation information.

However, IEEE identified the 806-947 MHz frequency range as one requiring immediate attention. In early 1983, the Vehicular Technology Society organized an Ad Hoc Committee on Radio Propagation Models for land-mobile applications in that band. The Committee was supported by a broad group of technical experts from government and industry.

The Ad Hoc Committee's task is to develop radio propagation models for land-mobile radio services operating in the 806-947 MHz range which will provide statistical methods of predicting reliable service areas and co-channel interference. The radio services to be covered by the models include conventional and trunked private land mobile, common carrier, cellular land-mobile, and private and common carrier radio paging systems.

Work is well along and the final report is planned to be available next year.

Committee objectives are to (1) identify current capabilities to establish propagation, (2) define propagation modeling requirements, and (3) recommend propagation modeling approaches.

These objectives will be explored in depth in this report through a comprehensive evaluation of today's needs and capabilities in 800 MHz propagation loss determination. More specifically, the report will:

-- Identify the technical factors that affect 800 MHz propagation.

-- Summarize current knowledge in making 800 MHz propagation estimates.

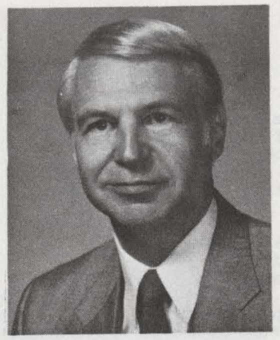
-- Explore the relationship between the propagation path, the environment and the equipment involved.

-- Address such issues as prediction accuracy, automated versus manual calculations, the relationship of reliability criteria to system compliance testing and others.

-- Indicate current deficiencies in prediction methods and the collection of propagation data and outline a program that addresses these limitations.

-- Recommend modeling approaches that are most appropriate to employ when evaluating particular land-mobile systems.

Those participating in this work include: Nadia Adawi, LCC Inc.; H. W. Arnold, Bellcore; Virgil R. Arens, Applied Electromagnetics; Henry L. Bertoni, Polytechnic Institute of New York; Robert Bultitude, DOC, Communications Research Centre; Joseph Child, Telesciences; William A. Daniel, FCC; Ramsay P. Decker, Spectra Associates; John Dettra, Dettra Communications; George M. Dewire, Continental Paging Communications; Robert P. Eckert, FCC; Dr. Robert E. Fenton, Ohio State University; Robert Forrest, Communications Technology Associates; Earl Flath, Jr., ECA; Willaim Frazier, NTIA; Vic Graziano, Motorola; Eldon Haakinson, Department of Commerce NTIA/ITS; George H. Hagn, SRI International; David M. Hodgin, Spectra Associates; Dave Land, Compucon; Sam Leslie, General Electric; Dr. R. Singh Lunayach, LCC Inc.; S. R. McConoughey, FCC; James J. Mikulski, Motorola; Joseph Moffitt, Bell Atlantic Mobile Systems; John Murray, J. Murray Associates; Ed Quinn, Bell Atlantic Mobile Systems; Dr. Phil Rice; Philip L. Rice Associates; Walt Roehr, Telecommunication Networks; Herb Sachs, Sachs/Freeman Associates; F. J. Schaefer, AT&T Bell Labs; George L. Schrank, Comp Comm.; Neal H. Shepherd (Chairman) Lynchburg, VA; Ed Weingart, Bell Atlantic Mobile Systems; Dan Yost, Compucon; William Wickline, Kathrein.



News From Washington

Eric Schimmel
Washington News Editor

MORE TV SPECTRUM SHARING?

Would you believe that it has been fifteen years since the FCC adopted the historic propoasal which permitted land mobile radio systems to utilize UHF-TV spectrum? Now a decade and a half later the Commission has initiated another proceeding to determine how much additional TV spectrum sharing may be technically possible. To assist it in this evaluation the FCC has established a technical industry advisory committee composed of representatives from both the mobile radio and broadcast industries. Readers who wish to make an intellectual contribution to this effort are urged to participate in the committee. The mobile radio community is particularly interested in hearing from persons within the industry who also have experience evaluating TVI parameters.

Reproduced below are pertinent excerpts from the Notice of Proposed Rulemaking. As this issue goes to press the first meeting of the advisory committee has been held. Watch for additional meeting information will be published in various trade publications.

Before the
FEDERAL COMMUNICATIONS COMMISSION FCC 85-289
Washington, D. C 20554 35820

In the Matter of	)	
	)	General Docket No. 85-172
Further sharing of the UHF	)	
Television Band by Private	)	RM-3975
Land Mobile Radio services	)	RM-4829

NOTICE OF PROPOSED RULEMAKING

Adopted: May 31, 1985 Released: June 10, 1985

By the Commission: Commissioners Quello and Rivera issuing separate statements.

INTRODUCTION

1. In recognition of the Commission's responsibility to promote the most efficient use possible of the limited spectrum resource, and in order to accommodate some of the identified communications needs of the private land mobile radio services through the 1990's, we are commencing a proceeding with this Notice of Proposed Rulemaking to provide for further sharing between the private land mobile services and the UHF television broadcast service. This proposal would make additional spectrum available to land mobile services where most required, with minimal impact on TV broadcast service.

BACKGROUND

2. The private land mobile radio services represent the largest group of licensed radio users regulated by the Commission. These services provide for the communications needs of a broad community of users, from police departments to small businesses. The expanding use of mobile communications since the 1960's has led to increased demands for, and congestion in, the private land mobile frequency bands, particularly in the nation's largest metropolitan centers.

3. On January 13, 1982, the Commission adopted a Notice of Inquiry in PR Docket No. 82-10 to examine the future trends and requirements of the Private Land Mobile Radio Services (PLMRS) and the land mobile user community. A staff report entitled Future Private Land Mobile Telecommunications Requirements (hereinafter the Future Requirements Report) was included in that docket in August 1983 and concluded that private land mobile radio services will experience substantial growth through the remainder of the century, resulting in a need for significant additional communications capacity. 1/ Additionally, in October 1983, the Commission's Office of Science and Technology released a report entitled Analysis of Technical Possibilities for Further Sharing of the UHF Television Band by the Land Mobile Services in the Top Ten Land Mobile Markets (hereinafter Further Sharing Report). 2/ This report showed that sharing opportunities vary from market to market, depending on the selection and size of the land mobile operating area in each market, the existing TV broadcast stations, and the protection criteria for sharing land mobile with broadcast services.

4. The Future Requirements Report suggested a combination of more efficient technologies and additional spectrum allocations as the best means available for providing the relief needed in these services. The report concluded that considering some implementation of new narrowband technologies, and assuming an additional spectrum release from the land mobile reserve in the 900 MHz band, 3/ the private land mobile radio services would suffer serious shortfalls of communications capacity by the year 1990 in a number of major urban areas. For example, assuming that 17 megahertz of the reserve spectrum was released for private land mobile use and that narrowband technologies were developed on interstitial channels in the existing 150-170 MHz band, the report projected shortfalls from 3 to 109 megahertz in the top markets by the year 1990. 4/ A petition filed by the Land Mobile Communications Council (LMCC) provided information that agreed with the Future Requirements Report findings concerning projected spectrum shortfalls. 5/ Another petition filed by LMCC proposed further sharing of UHF TV channels 14-69 as a solution to the projected shortfall. 6/ Likewise, a petition filed earlier by the Los Angeles County Sheriff's Department proposed that further sharing of TV Channels 14-20 be allowed in major metropolitan areas. 7/

5. The Further Sharing Report examined land mobile sharing of UHF TV broadcast channels in Boston, Chicago, Dallas-Ft. Worth, Detroit, Houston, Los Angeles, New York, Philadelphia, San Francisco and Washington, D.C. The report indicated that with no changes to the interservice sharing criteria currently governing land mobile sharing of the UHF TV band, possible additional sharing would not significantly contribute to satisfying the projected land mobile requirements. 8/ However, with some changes to these rules, at least one TV channel in all the major cities except Detroit was considered available for land mobile sharing.

6. While we are considering in this proceeding additional sharing of spectrum currently allocated for TV broadcasting service, the improved utilization of existing land mobile spectrum through the implementation of improved technology is also being vigorously pursued. In this regard, the Commission recently adopted a Report and Order which permitted narrowband technologies in the 150-170 MHz private land mobile band. 9/ We have also adopted a Notice of Proposed Rule Making proposing to release twelve megahertz of the 900 MHz land mobile reserve spectrum for private land mobile use. And, with the increasing demand of private land mobile services in mind, the Commission proposed that more efficient use be made of this spectrum by employing narrowband technologies. 10/ The Commission believes that new technologies will play an essential part in satisfying the projected growth of private land mobile services. 11/ Cost and implementation considerations, however, argue against relying totally on new technologies to provide capacity through the end of the century. Even assuming the eventual adoption of the proposal for new 900 MHz spectrum and the implementation of other developing technologies, such as digital techniques, narrowband techniques, and adaptive antennas, it appears that the capacity of the spectrum allocated to private land mobile services will in some areas fall short of the demands projected through the end of this century. Since part of these demands involve essential public services such as police and fire protection, medical assistance, transportation, and energy generation and distribution, as well as many other services needed by the public, it is desirable to find solutions to these projected shortages.

7. Since 1970, spectrum sharing between land mobile and UHF television has helped to accommodate a significant portion of the demands of private land mobile service in major metropolitan areas. Under the rules adopted in Docket No. 18261, 12/ specific television channels were reallocated for land mobile use within a limited area surrounding each of thirteen major urban centers. 13/ Such a geographical sharing arrangement still appears to offer the best near-term possibility for addressing land mobile needs in the larger urbanized areas. However, it has been over fourteen years since the Commission established standards for land mobile services to share UHF television spectrum on a geographical basis. Since that time, modifications have been made in the table of TV assignments and a number of new UHF television stations have been authorized. Additionally, in 1982 the Commission adopted rules implementing provisions for Low Power Television (LPTV) stations. 14/ Approximately 40,000 applications, many for LPTV stations near major markets, have been filed. To date over 700 LPTV stations have been authorized. As noted above, the Further Sharing Report shows that, assuming the current interference protection criteria and land mobile operating parameters are unchanged, few, if any, channels could be made available for land mobile sharing in some of the larger metropolitan areas without having a significant impact on TV service. We believe that reexamination of our protection criteria and other rules may lead to the availability of spectrum to private land mobile services where most required, while minimizing the impact on TV broadcast services.

8. Accordingly, the objective of this proceeding is to propose additional spectrum to provide additional communication capacity for land mobile services. We propose to permit further land mobile use of the UHF TV spectrum for several reasons. First, interservice use of TV channels 14 to 20 in major metropolitan areas, as provided for in Docket 18261, has proven practicable. Second, we have evaluated possibilities for further use of the UHF-TV band by land mobile and consider our proposal to be technically

feasible. Third, preliminary review of other spectrum, such as the 216-225 MHz band or bands above 1 GHz, indicates that no choice offers such promising possibilities for land mobile use as does the UHF-TV band. Furthermore, we propose to allow land mobile use of UHF-TV channels on a shared basis because the impact on broadcast users would be less than if we reallocated the spectrum for land mobile use only, which would require repacking of existing broadcast stations. Repacking would involve the relocation of existing UHF-TV stations into the remaining portion of the UHF-TV spectrum - an action that would be costly and would cause major disruption of existing TV service.

TECHNICAL CONSIDERATIONS FOR SHARING

12. The amount of sharing between the television and land mobile services possible in a given geographical area depends on the values assumed for various technical parameters, the degree of protection intended for TV service, the permissible locations of land mobile base stations, and the permitted operating range of mobile stations. The sharing arrangement adopted in Docket 18261 provided protection for co-channel and adjacent channel full service TV stations and pending full service TV applications. 17/ Co-channel protection was based on a 50 dB desired-to-undesired (D/U) field strength ratio at a hypothetical 55-mile Grade B contour, except in New York, Cleveland and Detroit, where a 40 dB ratio was used for some stations. 18/ 19/ Adjacent channel TV protection was based on a 0 dB D/U ratio. 20/ Land mobile fixed stations were not permitted within one mile of a TV station operating on a channel 2, 3, 4, 5, 7, or 8 channels removed from the land mobile channel. 21/ 22/ The sharing criteria used in Docket 18261 were based on limited measurement data and estimated values of pertinent parameters. Because of the uncertainties concerning many of these parameters, the criteria used were deliberately conservative. Based on the following considerations, we are proposing in the instant proceeding to modify some of these criteria.

Receiver Susceptibility

13. For purposes of this proceeding, receiver susceptibility will be defined by the TV-to-LM signal ratio at the TV receiver antenna terminals which will produce a given degree of degradation to the TV reception, which is usually expressed as either perceptible or objectionable interference. The measured ratio varies from TV receiver model to model, and for a given receiver depends on the frequency of the interfering signal with respect to the TV visual carrier. It may be also influenced by the desired signal levels, picture content and viewing conditions, such as ambient lighting and distance of the viewer from the screen.

14. In support of the Commission proceeding in Docket 18261, the FCC Laboratory conducted a number of tests to determine typical co-channel and adjacent channel receiver susceptibility ratios. 23/ Ten different models of TV sets were tested at VHF and the ratios were determined based on the same degree of objectionable interference for the co-channel and adjacent channel cases. 24/ The co-channel susceptibility ratio ranged from 42 dB to 48 dB with a median value of 43 dB. The adjacent channel susceptibility ratio ranged from 20 dB to -40 dB, depending on the frequency separation between the undesired LM signal and the TV channel edges, on the power of the TV desired signal and on whether the upper or lower adjacent channel was being considered. For example, the ratio was as much as 40 dB lower when the undesired signal was at the far edge of the adjacent TV channel; and it was as much as 20 dB lower when the power of the desired signal was a lower value equal to grade B service than when the power of the desired signal was equal to city grade service. The adjacent channel susceptibility ratio was higher when the interfering signal was on the lower adjacent channel than when on the upper adjacent channel. Similar tests were conducted in 1976 by the Canadian Department of Communications (DOC). 25/ The DOC tests involved sampling 52 different TV models at UHF. The co-channel receiver susceptibility ratios for 50% and 90% of the receivers tested did not exceed 40 dB and 45 dB, respectively. The adjacent channel ratios varied in a similar fashion as in the FCC tests.

Antenna Characteristics

15. The directional characteristics and polarization of UHF-TV receiving antennas discriminate against land mobile interference. While receiving antennas in the TV services used near Grade B contours are generally horizontally polarized and receive efficiently in one specific direction, antennas used in the land mobile services are generally vertically polarized and radiate in all directions. Most, if not all, outdoor antennas used to receive TV signals at or near the grade B service contour are highly directional with an average gain on the order of 8 dB and a front-to-back ratio of 10 to 20 dB. 26/ While an antenna's front-to-back ratio is a fairly good indicator of the level of discrimination achievable against land mobile interference, the net discrimination effect varies significantly, depending upon the configuration, installation and age of the entire TV receiving antenna system.

16. With regard to the polarization discrimination between land mobile transmitting and TV receiving antennas, a number of studies have indicated that under certain conditions, a polarization discrimination factor of 20 to 30 dB is achievable. However, an average polarization discrimination factor on the order of 10 dB is commonly cited. 27/ In general, polarization discrimination is higher in open areas and lower in thickly wooded areas and other areas where the reception is poor.

Propagation

17. The relative field strength of TV and LM signals at an antenna is influenced by atmospheric conditions, terrain and obstacles along the propagation path, and by reflection from objects such as buildings and trees. In Docket 18261, the R-6602 propagation curves 28/ were used to predict service areas of TV broadcast and land mobile operations and to determine minimum separation distances needed between land mobile and television stations. In making these calculations, no allowances were made for the variability in field strength from location to location -- known as location variability — or for special situations such as attenuation from major obstacles or enhanced propagation due to superefraction and ducting. At UHF, location variability varies from area to area, and usually ranges between 10 and 18 dB. 29/ An average value of 12 dB is commonly used. 30/

Sharing Criteria

18. In this proceeding, we propose to make several modifications to the sharing criteria used in Docket 18261. These modifications include changes in the co-channel D/U ratio, the computation of the TV protected service contour, and the land mobile operating parameters.

19. We propose to reduce the field strength D/U ratio for co-channel operation from 50 to 40 dB. 31/ It was recognized during the Docket 18261 proceedings that the 50 dB ratio was conservative. Based on the information discussed above, we believe the 40 dB ratio is more appropriate and would result in minimal impact on co-channel TV service. For example, if we assume a median receiver susceptibility ratio of 40dB, 32/ an average TV receiving antenna discrimination of 10 dB (due to the antenna pattern and cross-polarization), and a location variability of 12 dB for both the TV and LM signals, a 50 dB D/U ratio would provide protection for 95 percent of the potential TV viewers at the Grade B contour. For the same assumptions, a 40 dB ratio would provide protection for 88 percent of the potential viewers. 33/ However, we are aware that significant uncertainties still exist concerning many of the factors that go into determining the appropriate ratio, including the receiver susceptibility as affected by noise and other interference, antenna characteristics (cross polarization discrimination and front-to-back ratio) as affected by installation and local environment and propagation variabilities. We, therefore, solicit comments concerning the appropriate value of the field strength ratio as well as on these factors. We also request comments on the acceptable degree on TV reception degradation for appropriate percentages of time and location and on the relationship between this and the above factors.

20. Also, while we are not proposing any changes with regard to the adjacent channel protection ratio at this time, we solicit comments on the appropriateness of maintaining the Docket 18261 criterion of 0 dB D/U ratio for adjacent channel operation, on whether land mobile should be allowed to operate in the same area on portions of the adjacent channel, and on whether mobile units should be allowed to operate inside the predicted Grade B contour on an adjacent TV channel. 34/ In addition, we solicit comments on whether the one mile separation requirement for certain channel separations (2, 3, 4, 5, 6, 7, and 8) should be imposed and on whether protection criteria should be introduced for TV stations 14 and 15 channels below proposed land mobile operations. 35/

21. In determining the necessary separation distances between LM operations and existing TV stations, we propose to base the protected Grade B contours on the licensed power and antenna height above average terrain of the TV stations rather than use the 55-mile hypothetical contour used in Docket 18261. The service contours are determined in accordance with Section 73.684 of the FCC rules. We are aware, however, that adoption of these proposals might have an impact on future modification of existing licensed TV facilities. An affected TV station could increase its power and/or antenna height at a later date, but the resulting service area might be less than expected in the direction of land mobile operations provided for in this proceeding. 36/

22. For the land mobile base station operating parameters, we assumed a reference base station effective radiated power of one kilowatt and a reference antenna height of 500 feet HAAT (height above average terrain elevation from 2 to 10 miles in the pertinent direction). For mobile units, an effective radiated power of 100 watts and an antenna height of 100 feet above average terrain were assumed. These reference values were used to identify approximate areas of operation in each city. In addition, we are proposing to restrict the location of base stations to within 30 miles and mobile operation to within 50 miles of the center of a city. 37/ In addition, base station locations must be chosen to provide protection to television facilities, as directed in the previous paragraphs. The actual areas of operation will also depend on specified power and antenna height limitations, which will be the subject of a subsequent rulemaking proceeding. However, we now solicit comments on whether these assumptions concerning operating parameters and these restrictions on operations are appropriate for typical land mobile operations. 38/ We assume that, in general, the separation distances required to protect existing TV stations from land mobile interference will result in adequate protection of land mobile service from TV interference. We realize that channelization plans for specific areas will have to avoid frequencies near the visual, aural and color carriers of nearby co-channel TV stations. Since in some situations the possibility may exist for interference to land mobile from TV intermodulation products, local oscillator radiation or adjacent channel spillover, we solicit comments on whether these land mobile protection criteria are appropriate. 39/

FLEXIBLE SPECTRUM USE PROPOSAL

39. The preceding proposal reflects our effort to meet the expected future demands for land mobile communications capacity in the largest cities while minimizing the impact on TV broadcast service. However, as discussed in paragraphs 31 and 32, this sharing proposal does not address land mobile requirements outside of the major areas and may not satisfy the total land mobile capacity needs in the two largest areas. Furthermore, the proposal does not address the potential demands of existing and new services other than land mobile that could practically and economically operate within this part of the spectrum.

40. Consequently, we are including herein a supplemental proposal to permit additional use of a portion of the UHF-TV band by expanding the scope of services that may be provided by television licensees. By broadening the communications permitted and establishing well defined interference rules, we propose to allow full service and low power television broadcast licensees on certain channels to decide on their own initiative the types of communications offered on their assignments. Licensees could choose, for example, to distribute video entertainment, provide point-to-point communications (e.g., STL's), land mobile communications, or a combination of these.

41. Authorizing flexible spectrum usage on these channels would, in effect, shift a portion of spectrum usage decisions to individual licensees. It is our tentative belief that such flexible usage would provide an efficient mechanism for adjusting our general allocation plans to locally varying reouirements, because local operators will be in an excellent position to

evaluate local demand for communications services and have an incentive to act quickly to meet those demands. We, therefore, believe that allowing licensees more flexibility in chosing services will serve the public interest.

42. Communications services provided under this flexible allocation structure would be classified as either broadcasting, common carrier or "general" and would be subject to the same non-technical, service-related regulations normally applied to those categories of service. 47/ Licensees would also be required to submit technical data and other information necessary to verify compliance with applicable rules.

43. Our experience to date with flexible spectrum usage in the broadcast services has been limited to secondary and ancillary services where the primary services provided by licensees remain unchanged. This would not be the case under the instant proposal. Therefore, we have kept its scope modest to allow us to fully assess its value as a spectrum allocation tool. We are proposing to grant flexiblity only to existing and future full service and low power television broadcast licensees authorized on channels 50 to 59 (686-746 MHz). 48/ We have selected these particular channels to avoid any potential conflict with our land mobile sharing proposal. These channels are the only contiguous group of ten that are neither already allocated nor proposed for land mobile sharing. A ten channel block is a sufficiently large allocation to provide some flexible communications capacity in all markets, but small enough to be manageable in the event of unforeseen technical or other problems.

44. The protection afforded broadcast licensees would not be altered by this flexibility rule. Thus, for example, LPTV authorizations would still be secondary to full service TV stations regardless of the services offered. Also, to the extent licensees continued to provide some broadcast services, they would be required to abide by the applicable Part 73 rules, except to the extent such rules conflict with the exercise of technical and service flexibility.

45. To realize the benefits of flexibility it is important that licensees be free to select services without being unduly restricted or influenced by the Commission. In particular, our licensing policies should be neutral to the type of service proposed or provided. Thus, we propose not to consider service type as an issue in any comparative evaluation of assignments on these channels, both in renewals and in issuing new licenses.

46. Licensees who operate under the flexibility option would, at license renewal time, be judged based on overall performance with no preference given to any particular service. Also, the standards used to evaluate performance would be applied independently to each service category as are relevant to the type of service. Thus, a standard that is relevant only to broadcast performance would not be used to judge a licensee's performance in providing other services, such as land mobile.

Interference Rules For Flexible Operations

47. Our proposed rules would include a number of technical and geographic restrictions on flexible operations designed to prevent interference conflicts. Because of the flexibility to be afforded licensees under this proposal, the interference rules would be somewhat different from those proposed for land mobile sharing. First, we would require that all transmitters operated by a licensee under the flexibility option be confined within a defined geographical area which we would refer to as the licensee's flexible service area. The flexible service area for full service licensees would consist of all of the area within a licensee's calculated maximum facility 64 dBu contour 49/ excluding any area within the distances specified in Table IV of Section 73.698 from other full service stations on adjacent or taboo channels. 50/ We have chosen to use maximum rather than actual facilities to make flexible service areas as large as possible within the confines of our current channel allotment policies. This will enable licensees to reach communities that would otherwise not be served. In the case of low power stations, the flexible service area would be bounded by the station's actual 74 dBu contour and exclude areas within the 74 dBu contours of adjacent and taboo channel 51/ low power stations. Low power licensees would not be required to exclude areas overlapped by full service stations' protected contours since all low power operations are secondary to those of full service licensees in the event of interference.

48. Full service licensees wishing to operate under flexibility would be required to exclude only those overlap areas of other full service stations licensed prior to the initiation of flexible operation. The same rule would apply among low power licensees. In both cases (i.e., full and low power), extension of the flexible service area to include protected overlap areas of other stations would be permitted if the affected licensees agree in writing.

49. Licensing of new full service and low power stations on these channels would be carried out in accordance with existing rules. Thus, full service stations would be authorized only on those channels and at locations specified in Section 73.606(b). Also, the protected contours of full service stations referenced in our low power licensing rules in Section 74.705 would be based on the full service station's actual rather than maximum facilities. Low power stations located within the maximum facility contours of protected full service stations would be affected only in the event of interference. This is consistent with the secondary status of low power stations and is the policy that now applies if a full service station increases its facilties and causes interference to, or receives interference from, a previously licensed low power station.

50. In addition to the geographical restrictions on flexible operations, we would require that the calculated aggregate field strength of all fixed transmitters operated within the flexible service area of a licensee be maintained below the following levels at the indicated contours: 52/

For full service licensees:

At licensee's own maximum facility 64 dBu contour	64 dBu
At the maximum facility 64 dBu contours of adjacent channel full service stations	64 dBu
At the maximum facility 64 dBu contour of co-channel full service stations	19 dBu

For low power licensees:

At licensee's own actual 74 dBu contour	74 dBu
At the maximum facility 64 dBu contours of co-channel full service stations	19 dBu
At the 74 dBu contours of co-channel low power stations	29 dBu

51. The co-channel protection proposed here is 5 dB greater than proposed above for land mobile sharing. While a 40dB protection ratio has been found to be adequate for land mobile sharing, we believe the more conservative ratio is warranted here because of the wider range of services and system designs to be permitted. However, greater field strengths would be allowed at the contours of protected co-channel stations if the licensees of affected stations agree in writing.

52. Field strength calculations would utilize the propagation curves in Section 73.699. 53/ For multiple fixed transmitters, we would define the aggregate field strength as the square root of the sum of the squares of the field strengths of the individual transmitters. 54/ The power used in these calculations would be each transmitter's peak radiated power in the relevant direction, increased by a power adjustment factor to account for the emission's location within the channel. This adjustment factor "A" (in dB) is calculated using the following equations, where f is the frequency separation (in MHz) from the lower edge of the channel to the center of the emission:

$$A = -48f + 60 \quad \text{for} \quad 0 \leq f < 1.25$$

$$A = 0 \quad \text{for} \quad 1.25 \leq f < 5.75$$

$$A = 240f - 1380 \quad \text{for} \quad 5.75 \leq f < 6.00$$

53. The effect of the power adjustment factor is to reduce the permissible power in emissions near the channel edge to approximate the power roll-off that occurs within a standard television emission at frequencies below the visual carrier and above the aural carrier.

54. The field strength rule and its associated power adjustment factor would apply to fixed transmitters only. We are not proposing them for mobiles because of the difficulty in estimating the field strength of moving transmitters which could be used in large numbers. Also, as a practical matter, mobiles normally operate with less power than fixed transmitters and their operating range is practically limited by the facilities of their associated base station. Therefore, if we specify a suitably low output power limit for mobiles, restrict their operation to within a licensee's flexible service area, and maintain the facilities of fixed stations as described above, the interference potential of mobiles, even in large numbers, should be reduced to an acceptable level without the need for field strength calculations. Consequently, we are proposing to limit mobile transmitters to a maximum of 100 watts peak output power in lieu of the more detailed power and field strength limits discussed above for fixed transmitters.

55. The proposed power limits apply only to in-band emissions. To prevent excessive out-of-channel emissions by flexible operations, we propose to require that no more than 0.5% of the power in any emission fall either above or below the channel. To comply with this rule, licensees would have to take into account not only the frequency spread of the emission but also the frequency tolerance of the transmitter. 55/ This rule would apply both to mobile and fixed transmitters. Transmitters which are type accepted for standard television service and which are positioned normally within the channel would be considered automatically to comply with this out-of-band emission limit.

56. Subject to these proposed technical rules, there would be no limit on the number, location or elevation 56/ of fixed transmitters or the number of mobiles that could be operated within a flexible service area. However, operation of any transmitters outside the flexible service area would not be permitted.

1/ "Future Private Land Mobile Telecommunications Requirements": Final Report, Planning Staff, Private Radio Bureau, FCC, Washington, D. C., August 1983. This study examined the future spectrum needs of the following major urban areas: Atlanta, Baltimore/Washington, Boston, Chicago, Cleveland/Detroit, Dallas, Denver, Houston, Kansas City, Los Angeles/San Diego, Miami, Minneapolis/St. Paul, New Orleans, New York, Philadelphia, Phoenix, Pittsburgh, St. Louis, San Francisco, Seattle, and Tampa/St. Petersburg.

2/ "Analysis of Technical Possibilities for Further Sharing of the UHF Television Band by the Land Mobile Services in the Top Ten Land Mobile areas." FCC/OST R83-3, October 1983.

3/ For simplicity we will refer to the spectrum between 806-947 MHz as the 900 MHz band.

4/ These figures assumed an annual private land mobile growth rate of 6.2%.

5/ Petition for Rule Making filed by the Land Mobile Communications Council, RM-4829, received June 18, 1984.

6/ Petition for Rulemaking filed on October 29, 1984, to allow expanded sharing of the 470-806 MHz Television band by Land Mobile stations in the twenty-one largest metropolitan areas. In view of the petition's relevance to the issues considered herein, it will be included as comments in the Docket file in this proceeding.

7/ A Petition for Rulemaking was filed on September 1, 1981, requesting the use of Channel 15 and 16 in Los Angeles, California. A Supplement To Petition For Rule Making was filed on November 4, 1983, requesting the immediate assignment of TV Channel 19 in the Los Angeles area as well as expanded sharing of the UHF TV band in metropolitan areas. A Notice of Proposed Rule Making in Docket 84-902, 49 Fed. Reg. 45875, November 21, 1984, addressed the immediate request for Los Angeles County. The remainder of that petition, because of its relevance to the issue considered herein, will be included in the docket file in this proceeding.

8/ First Report and Order, Docket No. 18261, 23 FCC2d 325 (1970). The action enacted a 50 dB co-channel and 0 dB adjacent channel protection ratio for UHF TV stations at a 55 mile grade B service contour. A 40 dB co-channel ratio was adopted for some New York, Cleveland and Detroit channels.

9/ Report and Order Docket No. 84-279, adopted on March 1, 1985, 50 Fed. Reg. 13596, April 5, 1985.

10/ Notice of Proposed Rulemaking in Gen. Docket 84-1233 adopted on November 21, 1984. 50 Fed. Reg. 1582, January 11, 1985. The Notice proposes a narrowband channelization plan for the frequencies 896-902 and 935-941 kHz using 12.5 kHz channels. Also, comments were requested regarding the use of 5, 6.25, 7.5, 10 and 15 kHz channels.

11/ Dale N. Hatfield Associates has developed projections claiming that all capacity requirements could be satisfied in existing spectrum if we could take advantage of the multiplicative effects of frequency reuse, channel splitting and increased loading afforded by new technologies. The information is contained in a report entitled "The Role of New Technologies and Spectrum Management in Meeting the Demand for Private Land Mobile Radio Telecommunications Capacity", D. Hatfield, G. Ax and A. Miller, Dale N. Hatfield Associates, Boulder, Co., November 1982.

12/ Reference Docket 18261. First Report and Order. See footnote 8 supra. The action identified 10 urban areas; three other areas were added later in the proceeding.

13/ The designated urban centers were Boston, Chicago, Cleveland, Dallas/Fort Worth, Detroit, Houston, Los Angeles, Miami, New York/N.E. New Jersey, Philadelphia, Pittsburgh, San Francisco/Oakland, and Washington, D.C./Maryland/Virginia.

14/ Report and Order, Docket No. 78-253, 47 Fed. Reg. 21468, May 18, 1982.

17/ Land mobile stations operating within the six megahertz occupied by a TV channel were considered to be co-channel. A land mobile station operating within the 6 megahertz band directly above or below a TV channel was considered to be adjacent channel.

18/ A 50 dB protection ratio means that the amplitude of the desired signal is more than 300 times greater than the amplitude of the undesired signal at the grade B service contour. A 40 dB protection ratio means the desired signal is 100 times greater. From this, it follows that the undesired signal can be 3 times as great with a 40 dB protection ratio than with a 50 dB protection ratio. The 55-mile grade B service contour was based on a hypothetical TV station with an effective radiated power of one megawatt and a transmitting antenna height above average terrain of 2000 feet.

19/ The selection of a 40 dB as a criterion for land mobile use of Channel 15 in New York and Cleveland and Channel 16 in Detroit was based on particular circumstances. For channels 15 in both New York and Cleveland, terrain features in the direction of the co-channel protected TV stations provided additional protection to TV co-channel viewers from land mobile operation. For Detroit, the predicted grade B of the co-channel facility to be protected extended only to 44 miles - 11 miles less than the 55 mile criterion established in Docket 18261.

20/ A 0 dB D/U ratio means that the undesired signal can be as great as, but no stronger than the desired signal at the grade B service contour.

21/ The term "fixed" refers to a base, control or mobile relay station.

22/ These prohibitions are referred to as the "IM & IF Taboos" in UHF Television allocations. These "Taboos" are set forth in Section 73.610 of the Commission's Rules.

23/ FCC Report entitled "Interference to TV by Other Services." Project No. 2229-45, Part I, II, III [1968, 1969].

24/ The staff's investigations tend to confirm that results are the same at UHF.

25/ DOC Report entitled "Task Force on UHF-TV Taboos." Project 6, Assessment of Potential Land Mobile Interference to/from UHF Television. [1976]

26/ Report entitled "Program to Improve UHF TV Reception." Project No. A-2475 Georgia Institute of Technology. [1980]. The gain of an antenna is a rating expressing how much better one transmitting or receiving antenna is with respect to a reference antenna. The front-to-back ratio is the ratio of the maximum power received in the main lobe and the power received in the back 180° of the antenna pattern.

27/ See the following Reports:

FCC report entitled "Polarization Discrimination in Television Broadcasting". FCC Report T. R. R. 4.3. 10 [1958]

FCC Technical Memorandum entitled "Options for Relief of Interference to TV Channel 6 from Educational FM Broadcast Stations." OST TM 82-3 [1982]

BBC Report entitled "Aerial Discrimination against Orthogonally-Polarized Transmissions at UHF." [1964]

CCIR Volume V(1982), Report 239-5 Section 4.5, Report 567-2 Section 4, and Report 722-1.

NBS Report No. 6099, entitled "Performance of VHF Receiving Antennas Propagation".

28/ FCC report entitled "Development of VHF & UHF Propagation Curves for TV and FM Broadcasting." FCC Report No. R-6602 [1966]

29/ CCIR Volume V(1982), Report 239-5 Section 4.3 & Report 567-2 Section 6.

30/ FCC Report T.R.R. 2.4.16 "UHF Propagation Within Line of Sight" [1951]

31/ On April 26, 1985, the Association of Maximum Service Telecasters and the National Association of Broadcasters requested, by letter to the Chairman, that the Commission establish a joint industry-government advisory committee to investigate and advise the Commission as to the protection criteria necessary to prevent interference to UHF television stations from land mobile stations operating in the UHF spectrum. We believe that advice from such a committee would be useful in developing final rules. Formation of an advisory committee and its terms of reference will be the subject of an Order to be released in the near future.

32/ Based on the DOC study, a 40 dB co-channel receiver susceptibility ratio applies to 50% of the TV sets.

33/ The term "potential TV viewers" refers to the percentage of locations at the grade B contour where viewers receive a signal level of 64 dBu or greater for at least 50% of the time. This is defined in the broadcast rules as 50% of the locations.

34/ Testing has been performed to determine the feasibility of utilizing UHF-TV Channel 19, or a portion of that channel, to provide near term relief for public safety operations in the Los Angeles area. See Notice of Proposed Rulemaking in Docket 84-902, 49 Fed. Reg. 45875, November 21, 1984.

35/ Channels 14 and 15 are referred to as the sound image and picture image taboos. These taboos are set forth in Section 73.610 of the Commission's Rules.

36/ In Docket 18261, no provisions were made to protect existing full service facilities from LM interference beyond the 55 miles grade B contour.

37/ Docket 18261 assumed the use of 200 watt and 100 feet as reference values. In this proceeding, since the mobile operating area is reduced from 30 miles to 20 miles around the base station, we have selected a 100 watt limit.

38/ In urban areas such as Los Angeles and San Francisco, this 30 mile restriction may preclude utilization of some commonly used private land mobile antenna sites. We request comments on whether a larger radius should be used in these cases, and if so, what the radius should be and what impact on TV service would result from its use.

39/ OST Report entitled "Analysis of Technical Possibilities for Further Sharing of the UHF Television Band by the Land Mobile Services in the Top Ten Land Mobile Markets." FCC/OST R83-3. Pages 10 & 11 contain a discussion of the possibilities for interference from TV to land mobile.

47/ Used here the term "general" refers to any service which is not classified specifically as broadcasting or common carrier. Any communications service in support of lawful activities and any system design would be permitted, excluding airborne or satellite-borne transmitters, that meet the proposed technical limits.

48/ A footnote would be added to the allocation table in § 2.106 indicating the broader range of permissible uses on these channels and any limitation applicable near the borders due to international agreements.

49/ Service contours are established by using the F(50,50) propagation curves. The service contour for flexible operations by a full service station would be its 64 dBu contour calculated using the maximum power and antenna height permitted in Part 73; for a low power station, the service contour would be its 74 dBu contour calculated using actual power and antenna height.

50/ The protected taboo channels for full service station are +2, +3, +4, +5, +7, -14, -15 channels removed from the license's channel.

51/ The protected taboo channels in the low power case are +7, -14, and -15 channels removed from the licensee's channel.

52/ To verify compliance, a licensee proposing to operate one or more fixed transmitters would be required to submit to us a map showing the calculated aggregate field strength produced by those transmitters at specified intervals along the indicated contour. This information would be required each time a new fixed transmitter is added or removed or when changes are made in system design that affect field strength.

53/ Calculations of field strength at the contours of co-channel stations would use the F(50,10) curves. All other calculations would use the F(50,50) curves.

54/ Aggregate field strength is used here to avoid imposing a maximum power limit on fixed stations and thereby reducing licensee technical flexibility. In the land mobile sharing proposal, because of the narrower range of system designs contemplated, a power limit is reasonable and obviates the need for more complex aggregate field strength calculations.

55/ For example, at 700 MHz a frequency tolerance of .0005% would add 3.5 kHz to the required frequency separation between the transmitter's emission and the channel edges.

56/ It may be necessary to place a maximum limit on antenna height because of the difficulty of predicting propagation effects at very high elevation.

THE CANADIAN REPORT

VTS NEWS FROM REGION 7

William J. Misskey
Canadian Report Editor

This issue of the IEEE Vehicular Technology Society Newsletter inaugurates a new column - "The Canadian Report", which will present news from Region 7, the Canadian region, of interest to IEEE VTS members.

If you have any item which you would like to have appear in "The Canadian Report", please feel free to send it to me at the following address:

William J. Misskey
Electronic Information Systems Engineering
University of Regina
REGINA, Saskatchewan
S4S 0A2
Canada

or phone me at (306) 584-4096. Please note the deadline dates for receipt of final copy listed on page 3 of every newsletter.

This issue we have news from the IEEE VTS Toronto Chapter and two items on interesting mobile applications in agriculture.

News From IEEE VTS Toronto

The Toronto Section VTS Chapter is preparing for the 1985/86 season. This year the focus will be on mobile digital communications. Several major advances in Canadian industry have made valuable strides in this field. More radio users than ever before are aquiring and implementing digital communications.

The VTS meetings for this year are scheduled for the fourth Monday of every month except for September and December. The meeting dates are: Oct. 28/85, Nov. 25/85, Jan. 27/86, Feb. 24/86, Mar. 24/86, Apr. 28/86 and May 26/86.

The October meeting will feature a discussion on the plane earth equation as applied to 800 MHZ cellular systems.

Other planned programs are: digital telemetry, transit communications, digital encryption systems, mobile data terminals and amateur radio packet radio systems. Some on site tours of major communications systems are also currently planned.

We invite members and guests to attend any of our planned meetings. Out of town visiting members are particularly welcome.

If we have somehow missed the opportunity, the VTS can use more support from members in this area. Toronto is one of the evolving hi-tech centres in Canada and we need more representation from local members. If you can help, contact the chapter chairman.

For more up-to-date information regarding meetings and tours please contact the chairman:

Eric Meth
Chairman IEEE-VTS
3125 Steeles Ave. E.
North York, Ontario
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Precise Navigation for Farm Operations

Operating large machinery in farm fields without overlapping is difficult, especially in circumstances of obscured vision. R. Palmer, an associate professor at the University of Regina, has developed a system that will automatically guide or drive the tractor on a pre-computed course.

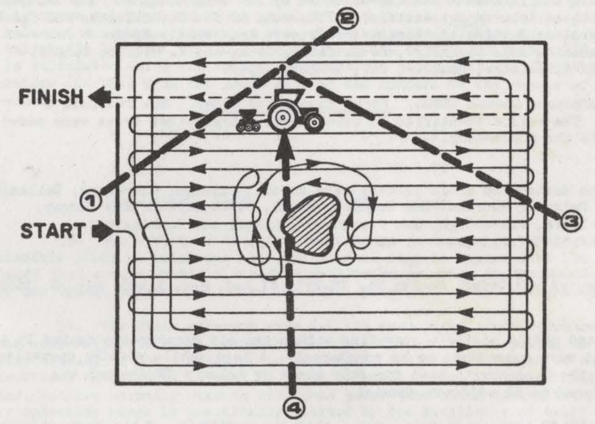
The system is based on the concept of obtaining precise cartesian coordinates by computing the distance to fixed beacons located at the edge of the field. The distance in turn is determined by measuring the phase shift of an electromagnetic signal travelling from the tractor to the beacon and back again. The phase shift of the returned signal as compared to the original signal, represents the distance the signal has travelled. Using a signal of 27 MHz. the distance can be resolved to within centimeters, which is more than adequate for field operations.

The phase shift read can be ambiguous information, since the distance could be 'n' integer wavelengths plus the distance represented by the phase shift. In order to resolve this ambiguity a second frequency is occasionally transmitted.

The beacons in effect bounce the signal back to the mobile unit; they do this by locking the incoming signal from the mobile unit in a PLL and then unlocking the PLL and transmitting from the free running VCXO. The mobile unit upon receiving the beacon's signal compares this to its VCXO's signal and subsequently determines the phase differences.

Microprocessors are used throughout the system for the communication protocol, to maintain constant signal levels and to continuously calibrate phase shift. A lab model has been built and has demonstrated that a farm tractor can be driven automatically to follow a precomputed course.

The system has the potential to decrease field operating costs by up to 25%, which amounts to hundreds of millions of dollars in the Canadian mid-west alone.



Videotex Service for Farm Tractors

SaskTel has developed and is field testing a tractor-borne integrated unit providing telephone service, videotex access and display, and an intercom to the rural residence.

The computerized system accesses SaskTel's agricultural videotex information service, called AGRITEX, and includes the capability of displaying local weather radar and farm market information. Full telephone service to the tractor and intercom access to the farm residence are additional features of this unique mobile radio application.

TERMINAL UNIT MOUNTED ON A SMALL GARDEN TRACTOR

VTS readers who wish additional information on this novel concept are invited to contact:

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Regina, Saskatchewan
CANADA S4P 3Y2
Tel. (306) 347-3903

Communications

J. R. Cruz
Communications Editor

In this issue we are publishing an article on the future communication needs of the U.S. Army. Although most of our readers are interested in civilian applications, we felt that it might be of interest to learn about current military communications planning and research from someone who is deeply involved in this area. Dr. William A. Sander from the U.S. Army Research Office, kindly agreed to give us a brief summary of their communications requirements and needs, and current research efforts.

We have been getting some feedback from the readership about our contributions. We appreciate your comments and will endeavor to make the newsletter as responsive to your needs as we possibly can. Please address all correspondence to:

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ABSTRACTS

"Four-Dimensional Modulation With an Eight-State Trellis Code," A.R. Calderbank and N.J.A. Sloane, AT&T Technical Journal, Vol. 64, No. 5, May-June 1985.

A trellis code is a "sliding window" method for encoding a binary data stream $\{a^i\}$, $a^i = 0,1$, as a sequence of signal points drawn from R^n. The rule for assigning signal points depends on the state of the encoder. In this paper n = 4, and the signal points are 4-tuples of odd integers. We describe an infinite family of eight-state trellis codes. For k = 3, 4, 5, . . . we construct a trellis encoder with a rate of k bits/four-dimensional signal. We propose that the codes with rates k = 8 and 12 be considered for use in modems designed to achieve data rates of 9.6 kb/s and 14.4kb/s, respectively.

"Land Mobile Radio Systems - a Tutorial Exposition," S.C. Gupta, R. Viswanathan and R. Muammar. IEEE Comm. Magazine, Vol. 23, No. 6, June 1985.

An in-depth tutorial on land mobile radio systems.

"Analysis and Simulation of a Digital Mobile Channel Using Orthogonal Frequency Division Multiplexing," L.J. Cimini, Jr., IEEE Trans. Comm., Vol. COM-33, No. 7, July 1985.

This paper discusses the analysis and simulation of a technique for combating the effects of multipath propagation and cochannel interference on a narrow-band digital mobile channel. This system uses the discrete Fourier transform to orthogonally frequency multiplex many narrow subchannels, each signaling at a very low rate, into one high-rate channel. When this technique is used with pilot-based correction, the effects of flat Rayleigh fading can be reduced significantly. An improvement in signal-to-interference ratio of 6 dB can be obtained over the bursty Rayleigh channel. In addition, with each subchannel signaling at a low rate, this technique can provide added protection against delay spread. To enhance the behavior of the technique in a heavily frequency-selective environment, interpolated pilots are used. A frequency offset reference scheme is employed for the pilots to improve protection against cochannel interference.

"Decision Feedback Equalization of Dispersive Radio Channels," A. Leclert and P. Vandamme, IEEE Trans. Comm., Vol. COM-33, No. 7, July 1985.

The performance of adaptive decision feedback equalization applied to high bit rate digital radio systems in the presence of multipath propagation is analytically investigated. Minimum phase (MP) and nonminimum phase (NMP) type fades as well as the transition periods between these two states are considered. Insight is given into the IF recovered timing epoch and its consequences on the decision feedback equalizer (DFE) behavior, especially during transition periods. Required conditions on the DFE structure for ensuring its maximum efficiency are derived and a modified updating algorithm is presented. Finally, dynamic simulation results are reported and compared to theoretical results. They show that the proposed structure is capable of coping with most propagation conditions.

"Differential Detection of Narrow-Band Binary FM," K.J.P. Fonseka and N. Ekanayake, IEEE Trans. Comm., Vol. COM-33, No. 7, July 1985.

In this paper we consider differential detection of narrow-band binary FM, using a detector which utilizes a delay line whose delay period is dependent on the value of the modulation index. The error-rate performance is computed for this receiver and compared with that of the limiter-discriminator receiver. In contrast to the previously published results for one-bit delay differential detection, it is shown that variable delay differential detection yields performance comparable to limiter-discriminator detection.

"Linear Predictive Coding of Speech: Review and Current Directions," Manfred R. Schroeder, IEEE Comm. Magazine, Vol. 23, No. 8, August 1985.

Squeezing the last bit of redundancy out of speech signals and to do it fast, means paying proper attention to human speech production, auditory perception, and — algebra.

"Subjective Effects of Variable Delay and Speech Clipping in Dynamically Managed Voice Systems," J.G. Gruber and L. Strawczynski, IEEE Trans. Comm., Vol. COM-33, No. 8, August 1985.

The purpose of this paper is to examine speech impairments likely to arise in dynamically managed voice (DMV) systems. DMV systems utilize speech activity detection to exploit speech idle time and variable bit rate coding to exploit nonstationary speech statistics. The emphasis here is on systems using speech detection. This processing introduces two impairments not commonly found in traditional communication systems: variable speech burst delay and speech clipping. Simulations of these impairments were implemented, and formal subjective testing was performed to assess subjects' reactions to a range of impairment levels. Emphasis was on formal subjective listening tests and customer opinion of speech quality as defined by a rating scale. The test conditions are applicable to general telephony, where relatively high speech quality is required. Results on variable speech burst delay and front-end and midspeech burst clipping are presented. These results serve as input to the design process and to the establishment of performance guidelines for DMV systems.

"Efficient Discriminator Detection of Partial-Response Continuous Phase Modulation," S. Bellini and G. Tartara, IEEE Trans. Comm., Vol. COM-33, No. 8, August 1985.

The aim of this work is to investigate frequency discriminator detection for continuous phase digital modulation (CPM) in order to avoid the RF carrier recovery problem. An efficient demodulation scheme, based on a discriminator followed by a suitable baseband digital processor of acceptable complexity, is presented. The baseband processor is based on decision feedback and correlation. In the binary case we also derive a simplified scheme with good performance.

RICHARD M. EMBERSON, DIRECTOR EMERITUS OF THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, DIES

Former IEEE Executive Director Pioneered In Radio Electronics

Richard M. Emberson, Director Emeritus and a member of the Board of Directors of the Institute of Electrical and Electronics Engineers, Inc. (IEEE), died on Friday, July 12, in Eugene, Oregon. During his career, he devoted much of his energy and vision to the IEEE, at one time serving as Executive Director and General Manager. He also made innumerable contributions to the fields of optics, radar, and radio astronomy. Dr. Emberson was 71 years old and had been ill for several months.

Speaking for Dr. Emberson's friends and colleagues, IEEE President Charles A. Eldon expressed his sadness, as well as fond remembrance: "Dr. Emberson's 23 years of leadership at the IEEE were marked by an all-consuming interest in people. A wise and caring man, he acquainted himself with every person, every event, every policy and procedure covering the Institute's activities. In many ways, he guided the development of the technical societies within the IEEE. His personal warmth, professional judgment, and industrious spirit helped shape the IEEE toward its present structure."

Dr. Emberson was elected Executive Director and appointed General Manager in 1977, serving throughout 1978. Prior to that, he was Staff Director of Educational, Field, Standards and Technical Services from 1976 to 1977, and Director of Technical Services from 1963 to 1975.

CORRECTION

In the May issue of the Newsletter an equation was inadvertently left out of the article **Radio Channel Traffic and Its Effect on Portable Radio Autonomy**, by William E. Thomson. On page 22, the last line should read:

d) $R \times I_r + T \times I_t + S \times I_s = AH$

COMMUNICATIONS RESEARCH IN THE U.S. ARMY

DR. WILLIAM A. SANDER

ELECTRONICS DIVISION

U.S. ARMY RESEARCH OFFICE

This article begins by describing the general concepts of modern land warfare which determine the requirements for Army communications systems. This is followed by a discussion of communications technology needs which are possible solutions to future Army communications needs. The reader should not assume that these are the only possible approaches. It is hoped that the reader will formulate his original ideas for research which could contribute to solving the Army's needs in communications.

Communications research in the Army is highly predicated on the environment in which the forces must operate. Recent studies by the Army have defined several concepts of modern warfare which emphasize the need for improved communications. These concepts are Airland Battle (ALB) for the current concept, ALB 2000 for the year 2000 timeframe, and Army 21 for the 21st century. These concepts call for larger numbers of smaller forces with greater mobility resulting in large communications networks with greater numbers of users distributed over broader geographical areas. The greater mobility of forces means that the topography, or structure, of Army communications networks is rapidly and continuously changing.

Another characteristic of modern warfare such as ALB 2000 is a high level of electronic warfare employment. Successes in recent conflicts have largely been attributed to superior electronic warfare capability. In any conflict between major powers, both sides are expected to employ sophisticated electronic warfare systems which use the most advanced electronics technology. Thus the outcome of a conflict could be highly dependent on electronic warfare capability and the ability of the force's electronic systems to resist electronic warfare.

Technology in areas other than communications such as sensors, graphics for battle situations and maps, and decision theory for command and control greatly increase the quantity of information required to be transmitted on Army communications networks. So, in addition to developing technology to support rapidly changing networks and electronic warfare, technology is needed to increase the information capacity, or throughput, of the networks.

Continuous availability of effective communication is essential to success in battle; and yet, the existing Army communication systems have not been able to keep pace with and utilize the rapidly expanding electronics technology being developed. The modern concepts of battle create major differences between Army and commercial communications. Also, the nature of battle and communications in the Navy, Air Force, and Army are sufficiently unique that communications technology developed for one service is not likely to meet the needs of the others. The Army communications system consists of large, complex, and highly dynamic networks. A system for an Army corps may consist of thousands of terminals which operate from high frequency to millimeter wave. The network is dynamic because the forces must move frequently and because the enemy is continually trying to prevent the use of our systems either by interdiction or by electronic warfare. In addition, during the heat of battle when the demand and need for reliable communications is the greatest, the extent of movement and interdiction and the levels of electronic warfare will be the greatest.

Commanders must have confidence that under the worst conditions they will be able to communicate the most critical and highest priority messages. This means that the system must guarantee that it will not fail catastrophically. The system must be able to perform with graceful degradation under the worst possible conditions and must be able to process messages with varying priorities from critical to routine. Relocation of terminal sites must be accomplished quickly and easily and commanders must have the capability to communicate with their forces during movement. The physical and electronic signatures of systems must be minimized to avoid detection and interdiction. Communications equipment in and around the command post must be interconnected. Systems which meet these requirements will result in greater system complexity; however increased system complexity must be transparent to the soldier who will use the equipment. Ideally, new systems should be easier for the soldier to use.

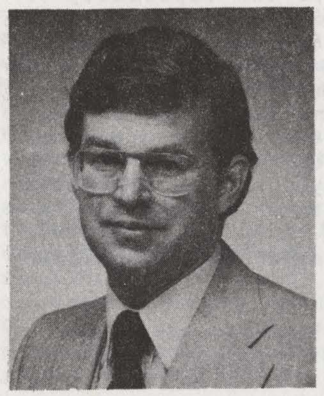
Historically Army systems after World War II were analog. Subsequently digital communications were integrated into Army systems. Now spread spectrum and packet radio technologies are maturing and attempts are being made to integrate these technologies into Army communications systems. Spread spectrum link level technology and methods for varying link level parameters such as capacity, diversity, transmitted power, coding, and jam margin are available but additional research can be performed in these areas. However, technology for integrating these methods into the Army's networks is not well understood. Designers must understand how the incorporation of adapting link level parameters will affect the network as a whole and how the use of adaptivity can be applied to optimize the performance of the network. For example, if a terminal changes its signal to respond to channel conditions, how are all terminals in the network informed of the change so that they can make the necessary changes to continue to be able to receive that terminal's transmissions. The incorporation of spread spectrum into packet radio networks also requires new protocols and architectures to manage the additional capabilities of spread spectrum such as multiple access. Techniques for fast acquisition and synchronization of spreading codes throughout the network are needed in order to minimize the time required for this function and to increase the throughput of the network. It is also important to provide commanders with a mobile communications capability which permits them to access the network while moving.

The command posts in the Army are required to be widely dispersed to minimize the effects of detection and enemy fire. This need only makes the task of moving the communications terminals which support such posts more difficult since many cables must be removed and reconnected. Millimeter wave links because of their high atmospheric absorption and their consequent low probability of interception and fiber optic cables because of their light weight and wide bandwidth are possible solutions to this problem.

The propagation of narrowband radio waves is well understood and models are available for accurate simulation of these systems. However, the propagation of wideband signals such as spread spectrum is not well understood and there are no models which can be said to accurately simulate wideband propagation. There is a need for models which can accurately predict reliable communication range for spread spectrum systems and models of wideband propagation need to be developed especially for UHF and microwave frequencies. Models for propagation in built-up areas and through foliage are also needed.

Another component of the Army communication system which must be made compatible with these concepts is the antenna. Research is needed in adaptive null-steering and beam-steering antennas. Wideband adaptive antennas are also needed for use in spread spectrum systems. Research in electrically small or low profile antennas is also encouraged in order to reduce their visibility. The Army also needs antennas which are easily erected, lowered, and stored to facilitate rapid movement. Another potential area of research is in mobile antennas with improved performance.

Army communications networks in the future will be distributed and adaptive yet there is no theory which can be used to design such networks. A number of theories and models have been developed for pieces of the problem under highly restricted conditions. These theories and models need which can be integrated into larger simulations in a coordinated and controlled manner. Simulation and theory of the large, complex adaptive and distributed networks needed to design and develop reliable Army communications networks with maximum connectivity and effectiveness in the modern battlefield environment are needed.



Automotive Electronics

Dateline: Detroit

Bill Fleming
Automotive Electronics Editor

COLLISION AVOIDANCE USING LASER RADAR

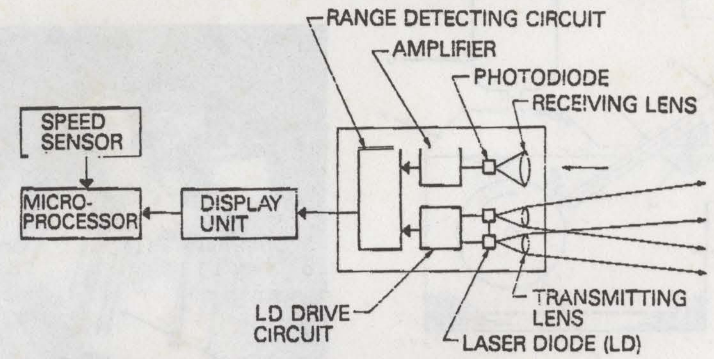
A laser-radar safety system designed to avoid automobile collisions has been developed jointly by Nissan Motor Company and Meisei Company [1]. The system consists of two laser diodes, a PIN photodiode and a range detector circuit. It is capable of detecting objects at a distance of up to 120 meters. Width of the beam is about 4.5 meters, approximately the width of a roadway.

According to Nissan, when installed in the grille, the radar helps prevent the vehicle from running into another vehicle ahead by keeping it a certain distance from that vehicle. In addition, the laser-radar can be produced at a cost less that one-tenth of a cost of a microwave radar.

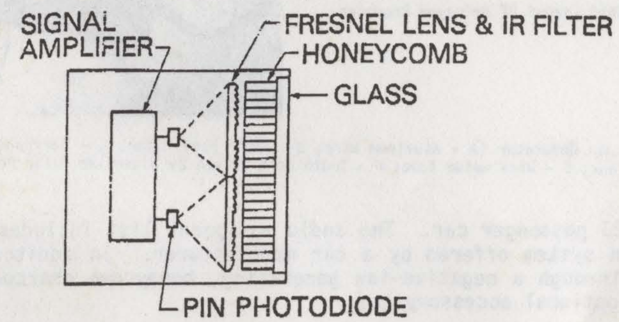
The laser transmitter consists of two laser diodes mounted side by side to provide a wide beam width, high strength output beam. Each laser diode provides 12 watts peak output power. The laser receiver includes a Fresnel lens, infrared filtering, and a honeycomb which is used to block out spurious scattered light. In rain, detection range is reduced by approximately a factor of two, from its clear-air value. Moreover, water splashed by other vehicles can reduce the detection range sometimes by as much as a factor of three. Fog can reduce the detection range by a factor of 2. In cases when the sun is within ten degrees of the axis of the laser beam the laser-radar is totally blinded. On the other hand, the laser-radar has excellent resolution and a well defined beam for good target discrimination.

The authors of the paper conclude that the laser-radar's performance is comparable to that of a microwave radar, and its advantages of target discrimination and lower cost make it more practical than microwave radar.

Another vehicle, the Nissan Research Vehicle, NRV-II, utilizes a 24 GHz radar automatic cruise control system that displays a separation distance from that vehicle to the one in front of it [2]. According to Nissan, the system also give a verbal warning to the driver if the vehicle gets too close to another car, and will even interrupt the cruise control. Nissan concludes, however, that the microwave radar station-keeping system is still too expensive and too complex for production vehicles, and besides, "drivers may not want this type of control."



Schematic Diagram Of Laser-Radar



Structure Of Laser-Radar Receiver

ON-DEMAND HYDROGEN FUEL GAS GENERATOR

A new and remarkable process by which hydrogen can be generated on-board a vehicle, according to demand, has been announced [3]. When the engine is idling, very little hydrogen is generated; when power demand is high, a lot is generated. The vehicles "fuel" tank is filled with plain water, which is consumed along with a special aluminum alloy wire during the hydrogen generation process.

The hydrogen gas is produced by a combination of electrolytic and physical processes at a rate determined by instantaneous demand, using a generator unit small enough to fit in a car engine compartment. In this system, a length of aluminum alloy wire, serving as a catalyst is fed against a rotating drum submerged in a small plastic tank of plain water. Voltage applied between the advancing wire electrode (cathode) and the conductive drum (anode) causes a discharge at the interface with a mechanical action comparable to that applied in Mig welding. The resultant reaction forms aluminum oxide, which sinks to the bottom of the tank as a slurry, and liberates hydrogen gas from the water. The gas bubbles to the surface for collection, and immediate induction by the engine. One reel of 500 meters of one-millimeter wire (one kilogram) can last for 5.5 to 8.3 hours of driving. Reels are reported to cost about $2, which is the only outlay for fuel ignoring an insignificant figure for water consumption. Electrical requirements are 32 volts ac with current varying between 18 and 60 A. A specially designed, engine-driven alternator supplies the required electrical power for the discharge circuit.

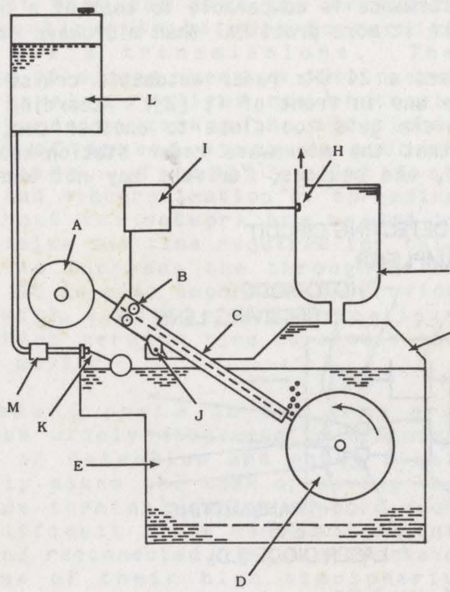
Water consumption, by fluid volume is estimated at about 80% of the equivalent rate for gasoline, and a standard fuel tank could serve for on-board storage.

A vehicle has been built and driven on British highways using hydrogen fuel generated on board. This development is funded by the International Energy Comission, a European-based group of scientists and engineers with registered offices in Guernsey, Monaco and the Cayman Islands [3].

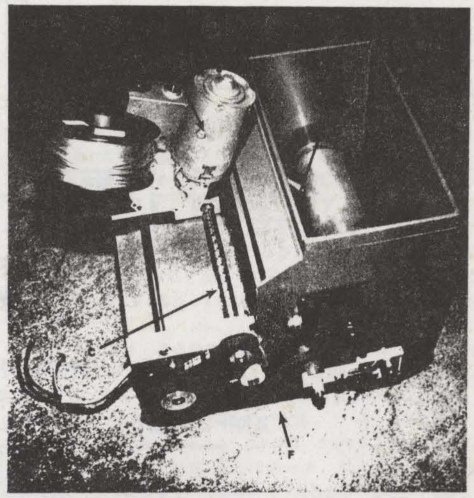
VEHICULAR ELECTRONICS YOU MAY OR MAY NOT WANT

The Buick Questor concept vehicle features heads-up instrumentation like those used in aircraft [4]. The heads-up display may soon be popping up in the steering columns of your vehicle. The experimental instruments, used in Buick's Questor, display a number of operating parameters, such as coolant level and battery voltage.

Another innovation, offered by Mercedes-Benz, is a power-adjustable steering wheel [5]. A small electric motor is followed by a complex gear train with a final worm-gear-engaging teeth machined in the tublar steering column. Controlled by a finger tip rocker switch, this gives a total of 60 millimeter telescopic movement to vary reach.

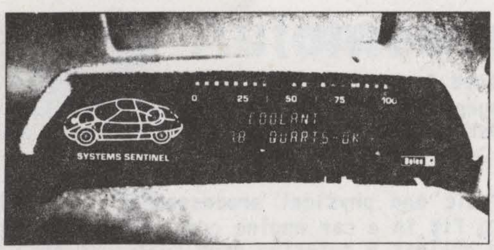


Patent Drawing Showing Basic Layout Of Hydrogen Producer

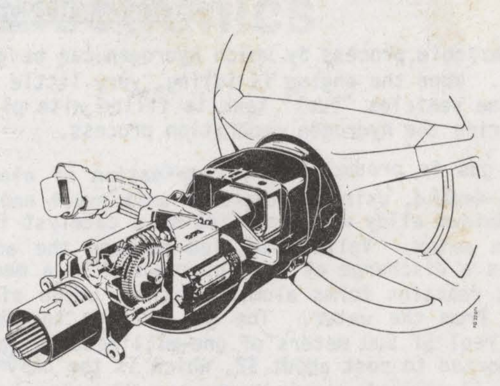


Prototype On-Board Hydrogen Generator (A - Aluminum Wire; B - Wire Feed Motor, C - Carriage Traverse Screw; D - Rotating Drum In Water Tank; E - Wire Guide Tube; F - Tooth Belt Driven By Underside Motor Driving Screw And Drum)

Mazda has introduced a model 323 passenger car. The audio equipment list includes a Pioneer-built digital audio disc player, Japan's first such system offered by a car manufacturer. In additon, an air-purifier system that force-filters stale cabin air through a negative-ion generating, honeycomb charcoal filter and sterilizing lamp light chamber is offered as an optional accessory [6].



Buick Questor Heads-Up Steering-Column-Mounted Display



Electrically Adjustable Steering Column

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