IEEE
VEHICULAR TECHNOLOGY SOCIETY
NEWSLETTER

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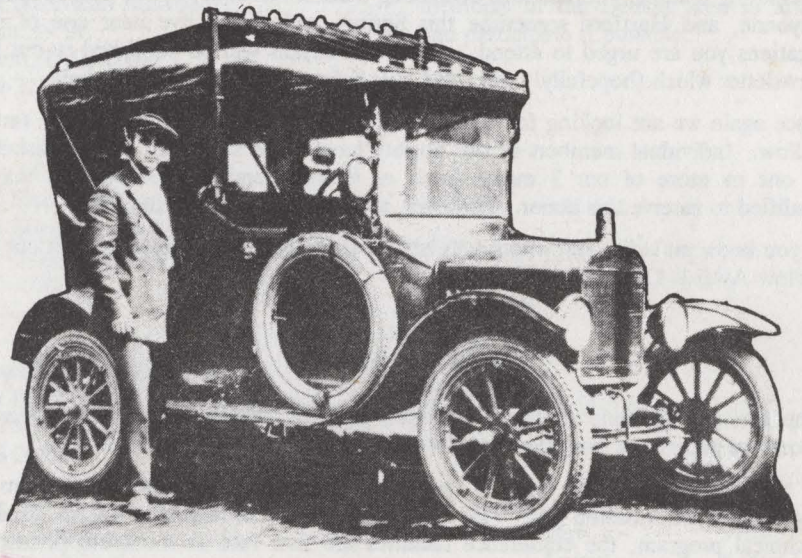
The First Detroit Police Radio Car in 1921



See story on back cover.

President's Message

Robert Fenton
President
IEEE Vehicular Technology Society

Three pioneering achievements in land-mobile radio:

(i) the commencement of regular one-way police radio communication (Detroit, 1928),
(ii) the initiation of two-way regular police radio communications (Bayonne, N.J., 1933), and
(iii) the operation of a two-way FM system for such communications (Hartford, Ct., 1940),

have been approved as National Electrical Engineering Milestones by the IEEE. I'm sure you'll find the corresponding article elsewhere in this Newsletter to be fascinating reading. Ceremonies dedicating these milestones will be held in Detroit, Bayonne, and Hartford sometime this Spring, and if you live near one of these locations you are urged to attend. Additional details will be published in our May Newsletter which (hopefully!) will reach you before the ceremonies are held.

Once again we are looking for qualified VTS members to nominate for the rank of Fellow. Individual members of our Society have made significant accomplishments in one or more of our 3 major fields of interest, and such individuals may be qualified to receive this honor. However, they must first be nominated.

If you know an individual whom you believe to be qualified, please contact our BTS Fellow Awards Chairman

R.A. Isberg
1215 Henry St.
Berkeley, Ca. 94709
(415) 526-1446

who can provide help in the nomination process. You must act quickly as the necessary paperwork must be completed and mailed in by early May.

In the very near future, you will receive the preliminary conference program and registration information for VTC '87 in Tampa. In addition to an excellent technical program, the conference facilities are first rate at moderate prices, and Alan Gondeck and his committee are working hard to insure that VTC '87 will be a memorable event. You won't want to miss this one, so send in your reservations early.

Your Board of Directors will meet in Washington, D.C. shortly after you receive this issue. If you have any ideas or thoughts you would like presented or discussed, please contact either me or another board member.

Best wishes for a successful 1987.

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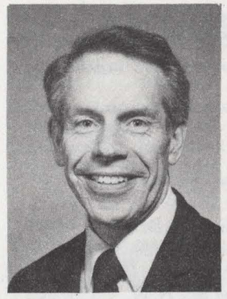

A. Kent Johnson
Newsletter Editor

Elsewhere in this newsletter you will find a copy of an article which appeared in "IEEE CENTER FOR THE HISTORY OF ELECTRICAL ENGINEERING" on Three Mobile-Radio Milestones. We think you will find this to be of great interest. We have learned that ceremonies will be held in Detroit on May 8, 1987 to commemorate events there. A bronze plaque describing the Engineering Milestone will be presented during a 7 pm ceremony at the original Belle Isle Radio Station. Mayor Coleman Young, Detroit Police Officials and national, regional and section officers of the IEEE will be invited to participate. We would strongly encourage all VTS members in the Detroit area to attend these ceremonies and participate if possible.

Month of Issue	Final Copy to be Rec'd By VTS Editor	Target Mailing Date
May	3-10-87	4-14-87
August	6-09-87	7-13-87
November	9-13-87	10-15-87
February	12-30-87	1-27-88

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Board of Directors Report

Samuel A. Leslie
VTS Secretary

MINUTES OF THE IEEE VTS BOARD OF GOVERNORS MEETING

The IEEE VTS Board of Governors met on October 21, 1986 at the Convergence '86 Conference in Dearborn, Michigan. The meeting was called to order at 1:05PM.

ROLL CALL

The following were in attendance:

# Robert E. Fenton	President
# Roger Madden	Vice President
# Art Goldsmith	Treasurer
# Sam Leslie	Secretary
# Evan Richards	National Conf. Coord.
# Sam McConoughey	Junior Past President
# Stu Meyer	Senior Past President
# Fred Link	Conference Site Sel.
# Kent Johnson	Newsletter Editor
Tony Eastham	Trans. Sys. Chairman
Yoshio Nakamura	Tokyo Chapter Rep.
Tony Van Den Huevel	Noble Scholarship
Paul Anderson	
Jim Evans	
Ted Rykala	

Nine of the thirteen present were elected Board members. A minimum of eight elected is necessary for voting on matters that come before the Board. Thus, a quorum was present.

The President added several items to the draft agenda which was previously mailed to the Board. Stu Meyer moved, Evan Richards seconded that the agenda as changed be approved for the meeting. The vote was unanimous in favor.

Fred Link moved, Evan Richards seconded that the minutes of the May 19, 1986 Board meeting be approved as published. The vote was unanimous in favor.

TREASURER'S REPORT

Art Goldsmith submitted his treasurer's report dated October 15, 1986, and noted that the Society is almost $35K ahead of budget.

Evan Richards moved, Roger Madden seconded that the treasurer's report be accepted as presented. The vote was unanimous in favor.

Art also noted that IEEE headquarters has changed the VTS student dues to $7.00 per year to conform with a "round up" rule (one-half of $13.00 annual dues of $6.50 automatically becomes $7.00). Also, Art Goldsmith made a motion to increase the nonmember dues from $64.00 a year to $72.00 a year. Stu Meyer seconded the motion, and the vote was unanimous in favor. This increase was to bring non-member dues more in line with current IEEE guidelines.

CONFERENCES AND MEETINGS

1986 Dallas VTC

The Dallas Conference Committee reported a surplus of nominally $5100.

MagLev & Linear Drives Conference

Tony Eastham reported that the 1986 MAGLEV and LINEAR DRIVES International Conference that was held in Vancouver on May 14-16 was a success, with a surplus of $4652.51 (Canadian) being reported.

Tony Eastham moved, Evan Richards seconded that the Society be the technical sponsor for the 1987 Conference. The Board vote was unanimous in favor.

The 1987 Maglev & Linear Drives Conference is scheduled to be held in Las Vegas on May 19-21 at Bally's hotel. No financial sponsorship (and obligation) is required for this conference, although IEEE will still have copyright rights for the published articles. Evan Richards is to look into how the Society can sponsor a conference without some form of financial obligation on the Society's part.

Convergence Conferences

Evan Richards reported that the number of exhibits for the 86 conference is up, but that the number of registrations is down slightly.

VTS is tentatively scheduled to sponsor the the 1988 Convergence Conference. The sense of the Board is that the Society wishes to maintain close ties to the Convergence Conference Committee.

1987 IEEE Annual Conference

After discussion, Sam McConoughey moved, Art Goldsmith seconded that the Society decline participation in the 1987 IEEE Annual Conference due to the lack of qualified resources to support this conference. The vote was unanimous in favor.

The president is to write a letter notifying the IEEE Annual Conference committee that the Society is unable to provide support.

1987 ASME/IEEE Joint Railroad Conference

This conference is scheduled for April 21, 22, and 23 in Toronto.

1987 Tampa VTC Conference (June 1-3)

Evan Richards reported that the 1987 Tampa conference committee has issued a call for papers with abstracts to be submitted by December 15. Also, he noted that he has agreed to arrange speakers for the awards luncheon and for the banquet.

The generation of software programs for conference registration and record keeping was discussed, with some noting that programs are "re-invented" each year for VTS as well as other IEEE Conferences. The conference committee is to look into whether programs written for previous conferences would be applicable for future VTS conferences.

Evan Richards moved, Stu Meyer seconded that an additional $1000 seed money with a revised cash flow statement be provided to the Tampa Conference Committee. The vote was unanimous in favor.

Since the above additional advance may change the ratio between the local sponsoring Chapter and the Society, Roger Madden moved, Kent Johnson seconded a motion that the Tampa Conference should distribute any surplus (or loss) in proportion to the contributions by the Society and the local Chapter. The vote was unanimous in favor.

Mr. Yoshio Nakamura indicated that the Tokyo VTS Chapter wishes to contribute to the Society in a more positive way, and suggests that they might provide members to chair special technical sessions at the upcoming Tampa Conference, perhaps on Digital Mobile Radio or Vehicular Technology in Japan. Evan Richards moved, Stu Meyer seconded that the Society accept the Tokyo Chapter's offer of help with the 87 Conference. The motion carried with eight in favor, one against. Details are to be worked out with the Tampa program committee.

Mr. Nakamura also indicated that the Tokyo Chapter may be willing to provide a Tokyo Chapter report for the newsletter, and that they may be able to provide translated papers that may be appropriate for the VTS Transactions. Bob Fenton is to write the associate editor for communications, Bill Lee, to put him in contact with the Tokyo Chapter.

1987 Motor Veh. Navigation & Info. Systems Conf.

This conference is scheduled for October 6, 7, & 8, 1987 in Toronto. The sponsoring committee of this conference requested that the Society provide sponsorship for 25 percent, with no financial support being required. Sam McConoughey moved, Evan Richards seconded that the Society accept the 25 percent sponsorship of the 1987 Motor Vehicle Navigation and Information Systems Conference. The vote was unanimous in favor.

1988 VTC Philadelphia Conference

The 1988 Conference is scheduled for June 15-17, and will be held at the Holiday Inn - Center City, 1800 Market Street, Philadelphia, Pennsylvania, 19103.

1989 VTC Conference

Fred Link reported that the selection of a site is still under consideration, with previous candidates of Orlando, Chicago, and Phoenix being discussed. Tony Eastham raised the possibility of a joint Railroad/VTC conference in San Francisco for 1989. After discussion, Stu Meyer moved, Tony Eastham seconded that Fred Link take the necessary steps to finalize San Francisco as a joint Railroad/Vehicular Technology conference, to be held in the latter part of April 1989. The vote was unanimous in favor. Orlando, Chicago, and Phoenix are now on the back burner pending the finalization of San Francisco for 1989.

1990 VTC Conference

The Board is still looking to Detroit for the 1990 Conference, principally due to 1990 being the 40th anniversary for the founding of the original VTS chapter in Detroit.

PUBLICATIONS

Transactions Editor's Report

George McClure's written report indicates that the Transactions publication schedule is back on track.

The current injunction against joint special issues will be revisited at the November TAB meeting in New Orleans. Bob Fenton stated that he has written another letter to TAB restating our opposition to the ban against joint issues.

Newsletter Editor's Report

Kent Johnson reported that the November Newsletter has been mailed, and that the deadline for the next newsletter is December 30, 1986.

Student Prize Paper Book

The president discussed a request to support the IEEE Student Prize Paper Book. Roger Madden moved, Evan Richards seconded that the Society contribute $200 to assist in the packaging of the Student Prize Paper Book. The vote was unanimous in favor.

COMMITTEE REPORTS

Transportation Systems

Tony Eastham noted that both IEEE and ASME sponsor the Joint ASME/IEEE Railroad Conference, with each providing seed money in alternating years and with each assuming financial responsibility on a 50-50 basis. ASME sponsored the 1986 conference, and it is the Society's turn to sponsor next year's conference.

Evan Richards moved, Sam McConoughey seconded that up to $2000 seed money be authorized for the '87 IEEE/ASME Joint Railroad Conference. The vote was unanimous in favor.

Vehicular Electronics

Bob Fenton reported that the Industrial Electronics Society has added the VTS as a co-sponsor for their post-convergence conference.

The president indicated that monthly meetings sponsored by the Society on vehicular electronics in the Detroit area might be appropriate as an adjunct to the current SAE activity.

Constitution and Bylaws

Roger Madden recounted that the Society's revised Constitution had been returned from TAB with minor changes, and had been distributed to the Board members for review before this meeting. Roger Madden moved, Evan Richards seconded that the Society adopt the Constitution with the modifications incorporated per TAB's suggested changes. The vote was unanimous in favor.

Nominations

The President congratulated the Nominations Chairman, Sam McConoughey, for getting the election process back on schedule.

Membership

A written report from Mark Sihlanick indicates that steps have been taken to update the membership brochure to reflect the rounding off of yearly dues. An update for student dues will have to be made due to the recent IEEE HQ directive to "round up" to $7.00. The recent ads in IEEE Potentials have produced a few inquiries from interested students.

Publicity

Bob McKnight's written report indicated that he has sent press releases on upcoming VTS functions to some 60 magazines. The sense of the Board is that Bob McKnight's efforts at publicity are producing results, and that his diligence is much appreciated.

Also, he has renewed the VTS ad in IEEE Potentials for the upcoming December and February issues.

CCIP Representative

Roger Madden reported that CCIP had sent a letter to the Chief Engineer of the FCC stating that IEEE was interested in the technical aspects of subjects relating to regulatory matters.

Noble Scholarship

Tony Van Den Huevel stated that $15K from VTS and $15K from Motorola has been transferred to the IEEE Foundation for addition to the Noble Scholarship fund. Future scholarships thus will be for $7500 per previous Board action.

He reported that the remainder of the stipend has been paid to the 1985 awardee, and that the first half of the stipend has been paid to the 1986 recipient.

He further indicated that application forms have been sent to over 300 accredited engineering schools. In response to a question from one of the Board members, Tony reports that a booklet or a mailing list (labeled) may be obtained which contains the accredited list of schools for North America. This information may be obtained from IEEE Headquarters by calling Lois Juniewicz, (201) 981-0060, and asking for the department head listings of all accredited Universities.

Transportation Electronics Scholarship

Roger Madden distributed a draft of the proposed wording for the scholarship for review by the Board. After discussion, the sense of the Board is that the five administrators proposed is unwieldy, and that perhaps a fewer number (of around three) of administrators would be more workable.

Sam McConoughey thus moved, Fred Link seconded that the document as provided and with minor modifications made as suggested be forwarded to the Convergence Conference Committee for review and suggestions. The vote was unanimous in favor.

Standards

Paul Anderson indicated that the IEEE Standard 263 is now obsolete due to the use of measuring equipment that is no longer available, and that the Society should either update the standard or recommend that it be dropped. Bob Fenton reported that this standard is being published in the upcoming VTS Newsletter for review and comment by the membership, and that action at this moment would be premature. The president is to arrange with Chuck Lynk and Jack Neubauer to resolve this issue by the next Board meeting.

Ad Hoc Propagation Committee

Sam McConoughey reported on the progress of the Ad Hoc Committee on 800 MHz propagation, and on the advisability of making this committee a permanent standing committee after the completion of their project. After discussion, Fred Link moved, Roger Madden seconded that such a standing committee be appointed starting in 1987, and that it is to be coordinated with the president of IEEE Society on Antennas and Propagation. The vote was unanimous in favor.

Chapter Activities

A request has been received from IEEE members in Israel to help in the formation of a VTS Chapter. One of the subjects mentioned was in the implementation of a seminar on cellular radio. The Board agreed to recommend a list of names that they may call upon to assist with providing a list of speakers for this seminar.

Milestones Program

Sam McConoughey submitted a written report indicating that the paper work for nominations have been completed and approved, as follows:

IEEE Section	Milestone	Site
SE Michigan	First one-way sys. (1928)	Detroit PD
N. Jersey	First 2-way sys. (1933)	Bayonne PD
Connecticut	First FM system (1940)	State Pol.

The Society President named Walt Williams (Detroit), Frank Gunther (North Jersey), and Fred Link (Connecticut) to represent the Society for the respective recognition ceremonies, which is to take place next spring.

Also, Stu Meyer was charged with the responsibility of providing certificates of recognition to the above for their help with this program, and also to Lt. Russel V. Robinson (Detroit PD) and Dr. Ronald Kline for their help.

Professional Activities

A written report from Frank Lord describing his attendance at the National PACE Conference on Labor Day weekend was distributed for review.

Fellows Program

A written report from Al Isberg indicates that three very well qualified senior members of the VTS are being considered by the IEEE Fellow Committee. Also, Bob Fenton noted that Al has agreed to another term as the Fellows Program Chairman. The Board certainly appreciates Al's efforts in this area.

COMSOC Issue

The President reported that Fred Andrews, President of COMSOC, has indicated that our suggestion of adding "fixed communications" to their proposed scope to resolve the conflict issue between VTS and COMSOC was considered and rejected. Their reason is that they do not want to restrict the use of portable and mobile communications since they see an increasing use of these devices as a means of communicating with personal computing devices.

Bob Fenton also reported that the COMSOC President was sympathetic to the idea of a joint special issue between VTS and COMSOC on Cellular Mobile Radio, but that their publications chairman was strongly against the idea.

To prevent this situation from occurring again, the Society's Publications Chairman and his staff are in the process of mapping out and reserving special issue topics for the next several years.

Accreditation Committee Support

Bob Fenton noted that the IEEE has requested names of senior representatives from both academia and the industry that may be willing to serve on an accreditation committee.

Planning Committee Report

Sam McConoughey circulated a report outlining the priorities for the Society for the upcoming year:

1. Now that the Society's Constitution revision has been finalized, work on revising the Society's By-Laws should be started.
2. Improving the quality of the Society's Transactions and in identifying subjects for special issue publication should be a goal.
3. Improve the Society's newsletter by including more general interest articles.
4. Update the Society's membership brochure to include the latest changes in fee rates and to delete the initiation fee, by April 1987.
5. Provide earlier organization of conference committees, and maintain a five-year lead on site selection.
6. Be more aggressive in the pursuit of IEEE awards for deserving Society Members.
7. Reactivate or eliminate dormant or inactive committees, and create new committees where a need exists.
8. Revitalize our Chapter activities.
9. Revisit the Board of Governors reorganization that was proposed several years ago.

10. Explore ways of how VTS surplus funds can best be used to directly benefit members and the Society.

NEXT MEETING

The next Board meeting is tentatively scheduled for February 5, 1987, from 9:00AM to 4:00PM at the IEEE Headquarters building in Washington, D.C. A dinner meeting the night before (February 4) is planned at the Black Horse Tavern (20th & 'N' Street, near the Embassy Suites hotel).

ADJOURNMENT

Kent Johnson made a motion that the meeting be adjourned. Adjournment was at 5:58PM.

Respectfully submitted,

Samuel A. Leslie
Secretary

Professional Activities

Frank E. Lord
Professional Activities Editor

COMPETING

"I wish that appropriate steps would be taken by government and management to make better application of our human and capital resources to reverse the negative trade balance of the United States electrotechnology industry." HENRY BACHMAN, IEEE President

"The major challenge for the electronics industry in 1987 is to solidify and enhance its worldwide competitive position. My wish is that specific efforts now under way by the AEA and other groups effectively halt the decline of U.S. high technology in the world marketplace and strengthen its position as world technology leader." J. RICHARD IVERSON, President, American Electronics Association

It is difficult to pick up a newspaper or news type magazine these days that does not have an article or at least a mention of the need for the United States to improve its position in world markets i.e. be more competitive. Readers who have been following this news trend will have noted that the government is getting into the act and that politicians are making noises on the subject. We all know what happens when the government gets too eager in trying to improve something. Have you filled out your W4 form under the new simplified tax law?

Industry has not helped itself much either. The MBA mentality of concentrating on the present (and maybe the next) quarter has become so ingrained in United States businesses that industrial leaders who actually think ahead five years are so unusual that articles get written about them. The tendency for business and industry to overly concentrate on the present does not create an environment in which engineers can make their maximum contribution to the nation. Engineers' work provides long term benefits for the most part.

Efforts by individual companies and specific industries to improve efficiency do not always work because of a long recognized principle that what is the best tactic for a single entity is not usually the best for the whole group. The classic example involves individual savings rate and the

collective savings rate of the nation. Or think of a company of soldiers with each man crouching deep in his fox hole maximizing his chance of not being wounded while the whole company is overrun because no one was taking the risk required to shoot back.

So finding the way to enhance industrial competitiveness, which most everyone agrees is essential for a healthy United States economy, is far from easy. Companies and industries acting individually are not likely to do the right thing and government trying to coordinate appropriate activity is likely to do the wrong thing. I do not know the answer to this dilemma, but I do know ;that the enhancement of engineering productivity can enhance industrial competitiveness and I know further that engineering productivity will improve if engineers are more fully utilized. So there is a way that we as a profession could contribute to the improvement of the Uniteds States economy and trade position. Of course, we can not accomplish this by ourselves; industry would have to implement our ideas. Also, leaders would have to inspire, investments would need to be made and salesmen would have to sell.

The specifics of what we could promote as a profession across the board would include the following:

-Use engineers in tasks that utilize their highest skills and even frequently challenge those skills.

-Provide engineers with adequate support personnel such as technicians, wiremen, assemblers, writers, draftsmen, administrative assistants, and secretaries.

-Encourage the establishment of additional educational facilities that train people specifically for engineering support work.

-Establish engineering environments that enhance efficient creative work, are conducive to productive thought and provide the engineering tools necessary for challenging endeavors.

-Use engineers in the guidance and direction of engineering support personnel to assure that their output is of a quality that enhances the engineering effort.

-Use engineers in higher management particularly where major decisions are based to a considerable extent on technological issues.

-Promote the use of participatory management that includes engineers.

-Provide the opportunity and encourage engineers to exchange information within the corporate structure through mechanisms such as talks, papers and workshops.

-Improve engineers opportunity for meaningful participation in management communications.

-Provide a structured opportunity and a high degree of encouragement by employers for engineers to pursue further knowledge through outside courses or degree programs.

-Provide engineers with the opportunity to attend work-related conferences and seminars. Such events encourage information exchange and often provide engineers with peer recognition of their accomplishments.

-Provide engineers the opportunity to share in the profits derived from their efforts through patent rights, stock options, steady employment, professional pay levels and other benefits.

If these and other studied recommendations are widely followed, engineers will be considerably more productive for the duration of an extended career period. Improved engineering leads to better products in terms of function, performance, reliability and cost. Our nation would benefit.

As always, comments from readers are welcome.

Transportation Systems

Bob McKnight
Transportation Systems Editor

Vehicular Technology Society elects five directors for 1987-89 term

New directors for the next three years for the Vehicular Technology Society have been elected by the members of the Society.

They will serve a 3-year term of office from January 1, 1987 through December 31, 1989.

These directors are:

- Leo M. Himmel, Sr., Executive Director, Communication & Signal Division, Association of American Railroads. Mr. Himmel is the Chairman of the VTS Education Committee.
- A. Kent Johnson, Research Engineer on the Technical Staff, AT&T Bell Laboratories. Mr. Johnson is Editor of the VTS Newsletter.
- Samuel A. Leslie, Manager of Research, The Antenna Specialists Co. Mr. Leslie is Secretary of VTS.
- Fred M. Link, Independent Consultant, founder of Link Radio Co. and a radio pioneer. Mr. Link is VTS Chairman of the National Site Selection Committee.
- Samuel R. McConoughey, Electronics Engineer, Federal Communications Commission. Mr. McConoughey is the Immediate Past President of VTS.

Transportation gets feature billing at five conferences in 1987

Transportation may be taken for granted by most people- a means to get from here to there- but 1987 will see five conferences devoted to various aspects of applying advanced technology to transportation ranging from personal automobiles to rapid transit and railroads.

First meeting in the new year is the Joint Railroad Conference sponsored by the IEEE Vehicular Technology Society and the Railroad Division, American Society of Mechanical Engineers.

Topics getting feature treatment include:

- High speed rail operations.
- Monitoring, fault detection and maintenance including diagnostics and/or automated trouble shooting.
- Innovations in control systems including signaling and communications.
- Expansion of microprocessor controls to all phases of rail and transit operations.

This joint conference will be held in Toronto, Ontario, Canada, April 21-23, 1987.

High speed rail will get full treatment May 19-21, 1987 at Las Vegas, Nevada in a conference on Magnetic Levitation and Linear Drives. Another IEEE VTS sponsored meeting will be held in conjunction with a Transportation Research Board and American Society of Civil Engineers meetings on their views of high speed rail.

With several potential corridors already identified in states such as Florida, Ohio, Pennsylvania and the Las Vegas-Los Angeles corridor, these new forms of transportation are worth closer looks by technologists as well as planners and sociologists.

Next is the Vehicular Technology Conference of 1987 to be held in Tampa, Florida, June 1-3. Communications is the major topic at this meeting, especially mobile, satellite and cellular radio systems. A special feature of this year's conference will be digital mobile radio, a hot topic at this time, as more businessmen and corporations are taking advantage of digital technology to transmit data via radio between vehicles and offices.

Automotive electronics will play a big part at the VTS 87 conference with emphasis on microprocessor controls, on-board computers for drivers, and vehicle location systems.

Again, heavy emphasis will be on design and implementation of new technology.

Number four in the hit parade of transportation forums for 1987 is the Fifth International Conference on Automotive Electronics scheduled to be held October 12-15 at the Institution of Electrical Engineers at Savoy Place in London, England.

Major emphasis will be on electronics and microprocessor (or computer) controls for vehicles to ease control for drivers and make them more fuel efficient and safer.

Aside from straight technology, topics include ergonomics, comfort, safety, security and convenience. Also getting much attention is electronic quality, reliability and serviceability.

Also of a new slant on technology will be a discussion on the legislative impact on electronic technology applied to vehicles.

Last but not least in this menu of transportation technology conferences is the annual technical conference of the Communication & Signal Division, Association of American Railroads, to hit Pittsburgh, PA October 12-14.

In a continuing saga of applying computers and electronics to railway signaling and communications, electrical engineers are faced in the rail industry of applying more systems and equipment while management asks for fewer people to manage, install and maintain these high tech systems.

As expected a progress report on the nation's railroads' Advanced Train Control System Project should be interesting as some preliminary testing and prototype systems will be in service this spring and summer.

For those who wish to feast on transportation technology, or mingle with those who know, and to learn what's going on, there are at least five conferences to attend during 1987.

ATCS takes shape as prototypes begin operation and spec writing begins

The Advanced Train Control Systems Project of US and Canadian railroads is moving along. From concept to reality has been reached on some phases of the project and functional specification writing has begun. Five Component Specification Drafting Committees are at work and all have completed at least one draft of a functional-type specification. These CSDCs are greatly aided by three consulting firms employed by the Association of American Railroads and the Railway Association of Canada, sponsors of the ATCS project.

The consultants are Arinc Research; Transportation & Distribution Associates, and Lapp-Hancock & Associates.

At the beginning is Specification 100, the overall ATCS system architecture. It identifies the hardware and software components of ATCS, their functions and the nature of the interfaces between them. There are companion specifications that describe the architecture of the ATCS communications sytems, locomotive equipment, track forces equipment, wayside equipment and the computer-aided dispatch system. There are specifications for each of these subsystems which identify hardware and software and define the integration requirements for each to fit into the total ATCS configuration.

ATCS communications specifications describe the communications flows between any pair of communications nodes-- the dispatch system, locomotives, end of train, track forces and wayside equipment-- and the system architecture to support those flows.

The ATCS Locomotive specification covers a wide variety of items. A few are mentioned to give a flavor of the detail and wealth of data required:

- Data link radio, message processor, display and keyboard.
- Locomotive computer, transponder interrogator, data recorders, sensor control units, throttle actuator, odometer/pulse generator, end-of-train unit, interconnection between locomotives.
- Various system operations including downloading movement authorities into locomotive computer, data bases in locomotive computer, location reporting, enforcement of speed restrictions and movement authorities, data communications to dispatch center and data links to defect detectors, and various data logging functions including "health" of locomotives.

-Locomotive computer specifications include logic modules, data file on board, message formats and handling, interface with other components and computer operations.

- ATCS interrogator specifications include power requirements, locomotive mounting, processing capability, frequency selection and interconnection with the locomotive computer. System operation discusses how the interrogator scans for and powers the transponders, and the receiving and processing of a transponder message.

-ATCS Transponder specifications are for transponder types, message content, message format, error detection and transponder location. The transponder power signal and message transmission frequencies are specified to provide optimum transponder performance. The transponder system is described as a sequence of operations resulting from an interrogator signal.

-Dispatch systems specifications identify the hardware and software components of the system, their functions and the nature of the interfaces between them. Such funtions as requests for train location, wayside equipment status, and issuance of movement authorities to trains are key tasks of the system.

- ATCS Field Systems specifications cover several items such as monitoring switch point position, remote control of switches, data link interface to wayside systems including defect detectors, track and route integrity systems, and various system interfaces.

Situations addressed by field systems include:

- Indication of the position and status of a hand-operated switch in an approaching locomotive via the data link.
- Control of a switch and indication of its positions and status in a locomotive via the data link.
- Indications from defective equipment detectors in a locomotive via the data link.
- Indications from any wayside device at the dispatch center via the data link or land lines (pole line, microwave, leased lines from communications common carriers or fiber optics).
- Indications of the operational status of wayside devices, such as highway-railroad grade crossing warning devices, in a locomotive via the data link.
- Indication of track integrity or track condition in a locomotive via the data link, in the dispatch center via land lines or through a wayside signal.
- Indications of route integrity in a locomotive via the data link, in the dispatch center via land lines or thorugh a wayside signal.

Characteristics common to ATCS components

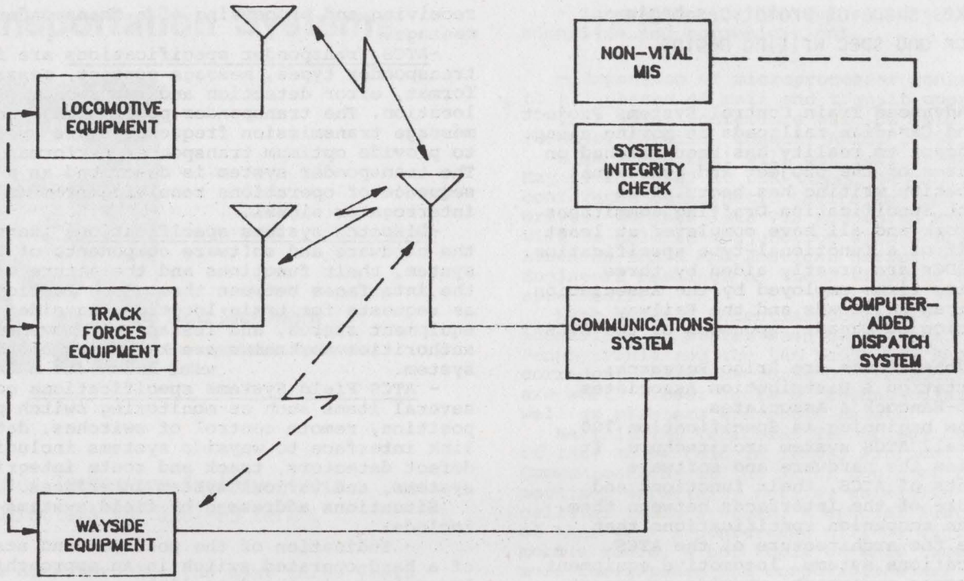
Seven characteristics are common to all the specifications of ATCS components. They are:

- Performance Characteristics
- Physical Characteristics
- Reliability
- Maintainability
- Availability
- Fail-Safety
- Environmental Conditions

PUBLIC MEETING IN APRIL 1987

Work is continuing on specification writing which has involved meetings at which railroad engineers on the Component Specification Drafting Committees and ATCS consultant engineers exchanged views with suppliers and manufacturers representatives.

Tentatively a public meeting is scheduled for April 9, 1987 in Toronto, Ontario, Canada at which time ATCS progress will be reported and a free exchange of ideas will occur between ATCS project members and manufacturers.



MAJOR ATCS SUBSYSTEMS

IEEE VEHICULAR TECHNOLOGY CONFERENCE

June 1-3, 1987

Holiday Inn Hotel & Convention Center
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- **Mobile Radio Systems**
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- **Mobile Digital Communication Systems**
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- **Automotive Systems**
- **Vehicle Onboard Computer Systems**
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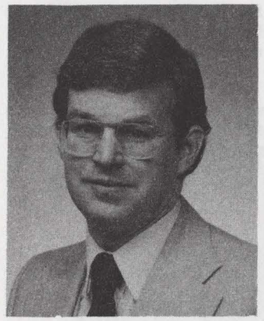
- **Automobile EMI Generation**

Vehicular Electronics

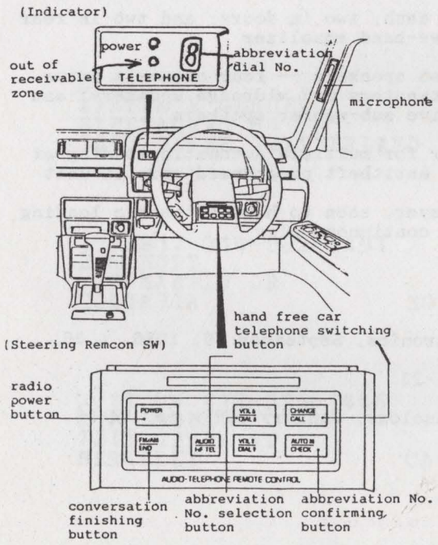


Bill Fleming
Vehicular Electronics Editor

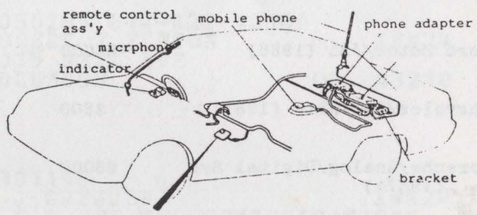
BRAKE LIGHTS MAY GO SOLID STATE

The emergence of red light emitting diodes (LEDs) that produce light 10 times as intense as that emitted by conventional LEDs is making the automotive industry take a second look at the devices. LEDs may replace incandescent bulbs now used in brake lights, taillights, and turn signals [1]. LEDs probably will first be used in center high-mounted brake lights that were required for the U.S. market starting with the 1986 model year. Because federal standards dictate lower minimum outputs for center mounted brake lights than for bumper-level stop lights, the center mounted brake light is the first target application for LEDs.

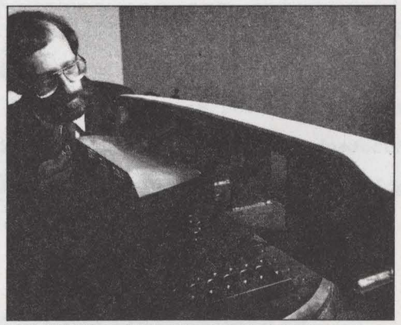
Potential advantages of LED brake lights include: (a) long life, (b) design flexibility due to variable positioning of 50-to-100 small LEDs, and (c) a deep distinctive shade of red produced by monochromatic 660-to-680 nm emitted wavelength. And, of course, the major disadvantage is cost, where LED-based stop lights are 2 1/2 to 3 times more expensive than incandescent assemblies [1].



Steering Wheel-Mounted Control Switches to Initiate Operation of Hands Free Mitsubishi Phone



Schematic Diagram of Hands Free Mitsubishi Car Telephone System



LONG LAMP. General Motors Corp. is testing 27-in.-long contoured brake lights using LEDs as replacements for incandescent lamps.

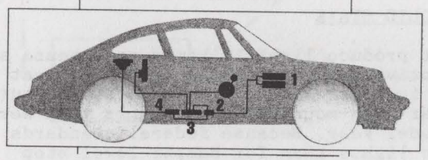
Center High-Mounted LED-Array Brake Light For 1988 Corvette [1]

MITSUBISHI HANDS-FREE CAR TELEPHONE SYSTEM

Mitsubishi Motors, Mitsubishi Electric, and Nippon Telephone & Telegraph have co-developed a hands free car telephone system for the new luxury Debonaire V Mitsubishi sedan [2]. An electric condenser microphone is built into the vehicle door pillar, and it permits the driver and all passengers to make phone calls from their seats. In addition to the hands-free phone; a second, conventional, phone set -- operated piggy back with the hands free phone -- is stored in the rear center arm rest.

Initiation of hands-free operation is done using steering wheel mounted switches that are optically linked to the telephone electronics located in the trunk. Frequently called numbers are recalled by number codes, and a synthesized voice announces the full number about to be dialed, while a synthesized phone ringing indicates that the number is being called [2].

For Porsche's 911, ADS distributes sound signals—from either radio/tape player or compact disc player (1)—with a crossover (2) that separates bass from higher registers. A four-channel amplifier (3) powers tweeters and midrange speakers; a two-channel amplifier (4) drives subwoofers, positioned to take advantage of the inherent bass resonance produced in the space beneath the rear window.



Porsche/Analog/Digital Sound System
Schematic Diagram

AUTOMAKERS TUNE UP THEIR ENTERTAINMENT SYSTEMS

It began with Delco-GM/Bose in 1983 -- now look at what we have [3]:

Entertainment System	Approx. Price	Features Included
Delco-GM/Bose (1983)	$1000	four speakers, each speaker's sound spectra tailored to acoustic properties of car
Ford Motor/JBL (1986)	$1000	35 watts/channel (140 watts total), three speakers per enclosure gives extended frequency response
Chrysler/Infinity (1987)	$600	two speakers in dash, two in doors, and two in rear corners; and five-band equalizer
Porsche/Analog/Digital Sys (1987+)	$8000	six channels, ten speakers -- four channels drive four groups of tweeters and midrange speakers, and two channels drive sub-woofer speakers
Nakamichi (aftermarket) (1986)	$1260	slide-out drawer for multiple automatic loading of cassette tapes, antitheft programmed code in unit
Ford Motor/Sony (1987)	$1000	compact disc player, soon to have automatic loading of 12 disks for continuous play

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2. Japan Autotech Report, Vol. 021, August 27, 1986, pp. 21-23.

3. C. Greenleaf, "Car Audio: Automakers Tune Up," High Technology, January 1987, pp. 54-55.

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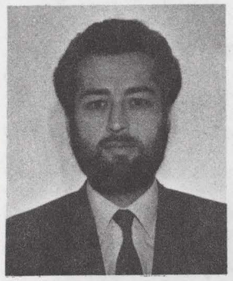

J. R. Cruz
Communications Editor

ABSTRACTS

"Packet Communications on a Mobile Radio Channel," M.R. Karim, AT&T Technical Journal, Vol. 65, No. 3, May/June 1986.

This report has explored the possibility of transmitting packetized data over a Rayleigh fading channel. The random errors due to the FM channel impairments have been ignored, and only burst errors that characterize the fading channel are considered. The protocol simulated is the widely used HDLC protocol which requires a frame to be retransmitted only when the remote end has detected errors in the received frame. Packets are sufficiently short so that most of them fall in the interfade time intervals. This leads to a high transmission efficiency. It is shown that the delay and throughput depend on the fade statistics. Also, for a given vehicle speed, they both improve monotonically as the packet size decreases. However, a smaller packet size increases the overhead fraction of the packet and thus reduces the effective throughput. Furthermore, there is a range of values of the packet size over which the delay is small and the efficiency high.

"Satellite-Borne Active Phased Array Techniques for Mobile Communications," P.G. Sheehan and J.R. Forrest, IEE Proc. Vol. 133, Pt. F, No. 4, July 1986.

The paper investigates the design of active phased arrays for communications satellites. In particular, consideration is given to the problems occurring when active arrays are required to produce multiple beams. There is a real need to keep the complexity of the array electronics to a minimum, but this conflicts with the desire to obtain the greatest possible freedom of control of the radiation pattern produced. The paper demonstrates a method of coping with the problem. Low-gain elements are used to provide design freedom and they are grouped into subarrays to limit the complexity of the rest of the system. With appropriate configurations of subarrays, greatly improved radiation pattern characteristics can be obtained and frequency reuse between multiple beams becomes feasible. A demonstration model of 108 microstrip patches grouped into 32 subarrays, operating at 12 GHz, has been constructed and verifies that the technique is effective.

"Baseband Switches and Transmultiplexers for Use in an On-Board Processing Mobile/Business Satellite System," B.G. Evans, F.P. Coakley, M.H.M. El-Amin, S.C. Lu and C.W. Wong, IEE Proc., Vol. 133, Pt. F, No. 4, July 1986.

The paper reviews the traffic requirements for two specific services which will benefit by the use of on-board processing: (i) business satellites for European coverage and (ii) land mobile satellites for Europe. Although the traffic requirements are very different for the two services, the proposed architectures are similar in comprising a mixture of baseband switches and transmultiplexers. The paper reviews various architectures for both components, and estimates the chip count and power requirements for the various architectures.

"Low-Power Integrable Paging Receiver Architecture," C.B. Marshall, IEE Proc., Vol. 133, Pt. F, No. 5, August 1986.

A receiver architecture is described that is ideally suited to UK paging applications. The receiver is similar to a direct conversion receiver, in that the absence of an 'image' response allows integration, but it only requires a single front-end mixer and so consumes less power. To achieve this the local oscillator frequency is offset slightly from the incoming carrier frequency, allowing the modulation to be recovered by a straightforward discriminator. Extensive measurements show that a bit error rate of 0.01 can be obtained with a 12 dB IF S/N ratio. Noise-generated DC is identified as having a major impact on the receiver performance, and is shown to be determined by the IF noise spectrum. The degradation of sensitivity caused by various tolerances is considered, and the best nominal parameter values selected.

"A Simple Digital CPMFSK Generator," S.K. Ray, IEEE PRoc., Vol 74, No. 10, October 1986.

A digital method of generating a serial M-ary continuous-phase frequency shift keying (CPMFSK) signal has been described. Based on the time-domain frequency modulation (TDFM) concept, the method offers a very simple and elegant implementation using ROM and can accommodate any arbitrary modulation index. The proposed CPMFSK generator has been physically implemented and tested for satisfactory operation.

"Crosscorrelation Between the Envelopes of 900 MHz Signals Received at a Mobile Radio Base Station Site," F. Adachi, M.T. Feeney, A.G. Williamson and J.D. Parsons, IEE Proc., Vol. 133, Pt. F, No. 6, October 1986.

An experimental investigation is reported of the crosscorrelation of 900 MHz signals received by two spatially separated antennas at a base station. The investigation embraced vertical, horizontal and combined horizontal and vertical separation of the antennas, for transmission from test routes 1.3 km from the base station. It was found that a crosscorrelation < 0.7 (i.e. when diversity improvement becomes significant) can best be achieved using vertical separation of the antennas of between 11 λ and 13 λ, for the 1.3 km cell radius. At 900 MHz such an antenna separation is easily obtained and, in addition, the roof space required is small. Moreover, the crosscorrelation using vertically spaced antennas is independent of the incoming arrival angle (unlike horizontally spaced antennas), and hence low correlation can be achieved while maintaining omnidirectional coverage.

"Traffic Performance Characterization of a Personal Radiocommunication System," V.R. Kolavennu, S.S. Rappaport, R.R. Duersch, H.L. Lester and C.M. Puckette, IEE Proc., Vol. 133, Pt. F, No. 6, October 1986.

A recently proposed personal radiocommunication system is described. The system, which is intended to provide a low-cost mobile radiotelephone service, employs a novel radio link architecture that combines features of centralized and distributed control. Consumers would typically purchase two transceivers, one for a vehicle, the other for the home. The latter unit interfaces with the public switched telephone network through an ordinary modular coupling. Two types of payload radio channels are used, local direct and repeater. Users gain access to these channels by successfully completing a specified exchanged of command messages on supervisory channels used in a random access mode. An analytical model was developed to characterize traffic performance and a simulation of the proposed system's traffic characteristics was undertaken. Both are described in the paper. Predicted performance characteristics are presented.

"New Channel Assignments Strategy in Cellular Mobile Radio Communication Systems," B. Arazi, IEE Proc., Vol. 133, Pt. F, No. 6, October 1986.

Currently used channel assignment strategies in cellular mobile radiocommunication systems deal inefficiently with the higher-priority demands for a communication channel posed by a user who enters a new cell while his telephone conversation is in progress. A completely new strategy for allocating communication channels to various users is proposed in the paper. The proposed strategy creates naturally more favorable conditions for users having higher priority, and this without significantly degrading the overall performance of the system. The performance of the proposed scheme is simulated under some basic conditions to give an initial indication of its potential.

"Modulation Techniques for Microwave Digital Radio," T. Noguchi, Y. Daido and J.A. Nossek, IEEE Comm. Mag., Vol. 24, No. 10, October 1986.

This second article in the Special Series on Microwave Digital Radio deals with digital radio modulations, a technology that has experienced remarkable growth in a very short time. The first generation digital radio systems, introduced scarcely over a decade ago, used low-level modulations such as 2- and 4-level phase shift keying (2-PSK and 4-PSK). Shortly after, systems were introduced using 8-PSK [1,2] and 9-level quadrature partial response signaling (9-QPRS) [3]. This was followed by systems using high-level quadrature amplitude modulation (QAM). Specifically 16-QAM [11-22] is becoming commonplace. Moreover, the feasibility of 256-QAM [23-27] and even 1024-QAM as candidate modulations are being actively investigated by various manufacturers.

What are the features of radio systems that use such high-level modulations? Why has multilevel QAM become the most popular type of modulation? What are the important associated technologies for realizing such high-level modulations?

"Receiver Techniques for Microwave Digital Radio," J.K. Chamberlain, F.M. Clayton, H. Sari and P. Vandamme, IEEE Comm. Mag., Vol. 24, No. 11, November 1986.

This article describes the receiver techniques that have been developed to deal with linear signal distortions and interferences arising from anomalous propagation.

"Multipath Fading Channel Models for Microwave Radio,: W.D. Rummler, R.P. Coutts and M. Liniger, IEEE Comm. Mag., Vol. 24, No. 11, November 1986.

This article gives an overview and provides a framework within which the work in multipath fading channel models for microwave digital radio can be put into perspective.

"Effects of Pulse Shaping and Soft Decisions on the Performance of Digital FM with Discriminator Detection," T.T.

Tjhung, K.K. Yeo and P.H. Wittke, IEEE Trans. Comm., Vol. COM-34, No. 11, November 1986.

Band-limited digital FM systems employing discriminator detection are analyzed. The error-rate performance of binary FM with premodulation shaping and duobinary FM with the same occupied bandwidth are compared. At bandwidths above 1.1 time the bit rate, it is found that binary FM gives a lower error rate than duobinary FM. For binary FM to meet lower bandwidth requirements, frequency deviation ratios below 0.4 times the bit rate must be used. At these low deviations, binary FM does not perform as well as duobinary FM with the same bandwidth. In addition, if a more complex receiver is used which makes use of Viterbi decoding after the discriminator, the performance can be made better than binary FM even at the larger occupied bandwidths.

"Performance of Partial Response CPM in the Presence of Adjacent Channel Interference and Gaussian Noise," V.K. Varma and S.C. Gupta, IEEE Trans. Comm., Vo. COM-34, No. 11, November 1986.

Partial response continuous phase modulation (CPM) schemes have found wide acceptance because of their compact spectra and comparable performance with other traditional modulation schemes. Although optimum receivers are complex, simple suboptimum receivers are found to yield very good performance in special cases. Performance of such modulation schemes is of interest in a multiple user environment where adjacent channels are spaced closely to improve the system capacity.

This paper presents the performance of partial response CPM in the presence of adjacent channel interference and Gaussian noise. The mean-square crosstalk in CPM systems employing MSK-type receivers is formulated. Based on this formulation, a number of modulation schemes employing different receiver filters are analyzed for their ACI rejection. Comparison of results proves that receiver filters, in addition to the spectral occupancy of the signal, play an important role in deciding the crosstalk. The error performance of various schemes evaluated using simulation technique is compared, and it is found that in the presence of adjacent channel interference, certain schemes perform better than minimum shift keying (MSK). The results of the simulation further prove the inadequacy of Gaussian assumption for the adjacent channel interference. It is seen that judicious choice of modulation scheme and receiver filter can result in better spectrum utilization.

"Examples of Continuous Phase Modulation Using Discriminator Detection," I. Kalet, S. Shitz, Z. Haddad, A. Trachtman, and Y. Baruch, IEEE Trans. Comm., Vo.. COM-34, No. 11, November 1986.

Continuous phase modulation (CPM) techniques for digital communication have been proposed to achieve narrow bandwidth and good bit error rate (BER) performance in coherent systems. These modulation schemes may also be used with noncoherent discriminator detection. However, in this case, the CPM schemes should be designed for noncoherent detection. Using a receiver proposed by Chung for GTFM and "modified GTFM" signals, we show that it is possible to slightly improve BER performance over that of previous GTFM noncoherent schemes. We also show that a form of GMSK can achieve discriminator detectability performance almost equal to that of classical binary FSK (modulation index = 0.7) but with a much narrower bandwidth.

Chapter News

Gaspar Messina
Chapter News Editor

Meetings

New Jersey Coast (VT/AP/EMC)

Nuclear Electromagnetic Pulse, Aircraft Vulnerability Assessment
by Mr. Anthony G. Zimbalatti, Gruman Aircraft Systems Division,
Beth Page, New York
Held October 21, 1986, with 26 attending, including 7 guests.

Radio Propagation in the Portable Communications Environment
by Dr. H. W. (Pete) Arnold, Bell Communications Research, Inc.
Held November 18, 1986, with 25 attending.

Holiday Party/Membership Drive
Held December 16, 1986, with 20 attending, including students and spouses.

Conference (IEE-VTS, United Kingdom)

Sixth International Conference on Automotive Electronics,
12-15 October 1987.
Write to: Conference Services
IEE
Savoy Place
London WC2R OBL, UK

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List of the IEEE-VTS Tokyo Chapter Activities, July 1985-July 1986

(1) July 29, 1985, Report of the 1985 Vehicular Technology Conference. Speaker: Tosio Suzuki, NTT Electrical Communication Laboratories.

(2) Aug. 26, 1985, The present situation and prospect of the mobile communications in the United States and Europe. Speaker: J.J.Mikulski, Motorola, Inc.

(3) Oct. 1, 1985, ATO by Fuzzy Control. Speaker: Seiji Yasunobu, Hitachi Ltd.

(4) Nov. 5, 1985, Cordless Telephones in CEPT countries. Speaker: Masao Ikoma, NEC Corp.

(5) Feb. 13, 1986, Mobile communications in England. Speaker: Fumiyuki Adachi, NTT Electrical Communication Laboratories.

(6) April 17, 1986, Global Positioning Satellite Receiver. Speaker: Koji Yamada, Japan Radio Company.

(7) June 13, 1986, Report of the 1986 Vehicular Technology Conference. Speaker: Masayuki Sakamoto, NTT Electrical Communication Laboratories.

(8) July 15, 1986, New transportation System for Tokyu Bus. Speaker: Kiyoshi Shinkawa, Mitsubishi Electric Corp.

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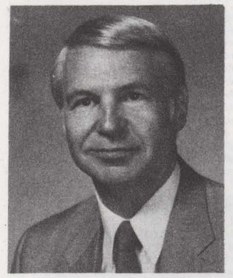
News From Washington



Eric Schimmel
Washington News Editor

THE FINAL DECISION WASN'T FINAL

On September 26, the FCC finally released its Report and Order splitting the remaining 800/900 MHz pie among various mobile radio services. Well maybe not so finally, since at this writing several organizations have just filed Petitions for Reconsideration. Among the controversies still fermenting are the Commission's retention of two megahertz which it proposes to auction for a variety of applications if it can obtain Congressional authority to conduct auctions. Another loose end is the four megahertz retained in reserve as a contingency to satisfy political pressures being applied by the Canadian government for its allocation to a mobile satellite service. It is in fact this contingency which caused the FCC to make an awkward split-band allocation for cellular expansion. This capricious action was taken without consultation with the cellular industry and will incur cost penalties on both equipment manufacturers and system operators, particularly the non-wireline carriers.

Since these issues may remain unresolved for some time, I am reproducing related portions of the Report and Order below. Should the FCC decide to proceed with either of these proposals, additional rulemaking proceedings would be initiated.

In the Matter of	)	
	)	
Amendment of Parts 2 and 22 of the Commission's Rules Relative to Cellular Communications Systems	)	GEN Docket No. 84-1231 RM-4812
Amendment of Parts 2, 15, and 90 of the Commission's Rules and Regulations to Allocate Frequencies in the 900 MHz Reserve Band for Private Land Mobile Use	)	GEN Docket No. 84-1233 RM-4829
Amendment of Parts 2, 22 and 25 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to the Use of Radio Frequencies in a Land Mobile Satellite Service for the Provision of Various Common Carrier Services	)	GEN Docket No. 84-1234 RM-4247

REPORT AND ORDER

Adopted: July 24, 1986 Released: September 26, 1986

By the Commission: Commissioners Quello and Dawson Dissenting in part and issuing separate statements.

TABLE OF CONTENTS

SUMMARY

1. This Report and Order addresses allocation of the remaining 32 megahertz of spectrum from the 900 MHz land mobile reserve bands. It discusses the interrelated issues raised in three Notices of Proposed Rule Making (Gen. Docket No. 84-1231, Gen. Docket No. 84-1233 and Gen. Docket No. 84-1234) that were adopted by the Commission on November 21, 1984.

2. Specifically, this combined Report and Order takes the following actions:

Allocates 10 megahertz of additional spectrum for cellular systems. The 824-825/869-870 MHz and 845-846.5/890-891.5 MHz bands are allocated to the non-wireline frequency block and the 846.5-849/891.5-894 MHz bands are allocated to the wireline frequency block.

Allocates 10 megahertz of spectrum in the 896-901/935-940 MHz bands for private land mobile use other than public safety, and sets forth service rules for operations in this spectrum.

Allocates 6 megahertz of spectrum in the 821-824/866-869 MHz bands for private land mobile use to address specifically the communications requirements of public safety entities. This spectrum will be utilized in the development of a national plan to meet the needs of public safety entities. The national plan will be addressed in a later proceeding.

Allocates 27 megahertz of spectrum in the L-band for a Mobile Satellite Service (MSS). The 1549.5-1558.5 and 1651-1660 MHz bands are allocated on a co-primary basis to aeronautical mobile satellite (R) (AMSS) and MSS, with AMSS having priority access. The 1545-1549.5 and 1646.5-1651 MHz bands are allocated to MSS on a secondary basis with respect to AMSS.

Allocates 2 megahertz of spectrum in the 901-902/940-941 MHz bands for a general purpose mobile radio service.

Temporarily holds the 849-851/894-896 MHz bands in reserve pending further consideration.

ALLOCATION FOR GENERAL PURPOSE MOBILE SERVICE

I. BACKGROUND

101. As an alternative to establishing additional cellular and private allocations, we also sought comment on a method that would not rigidly define spectrum uses. Under this approach, reasonably large frequency assignments would be licensed by lottery. The frequencies would be deployed for mobile purposes, but details regarding service type and system design would be made by individual licensees. In seeking comment on this allocation scheme, we noted that several attractive uses of these frequencies had come to our attention, and we recognized that some uncertainty may exist as to the best use of radio spectrum at any particular time or place. We suggested that a more flexible approach that would place greater reliance upon market forces to apportion spectrum among the various mobile services might be in the public interest.

II. DISCUSSION

A. General

102. Fewer than half of all commenting parties addressed this proposal. Most of these parties did not speak to the specific details of the proposal, but instead focused on the overall concept from broad policy, legal, and technical perspectives. These are considered in turn.

B. Policy Issues

103. A number of parties opposed the alternative allocation plan on policy grounds stating that it would favor large companies at the expense of

services with more pressing needs, such as public safety. Some commenters were particularly concerned that since radio is only used as an adjunct to their primary business, private users would be unable to compete successfully for frequencies against firms who are in the business of providing communications services. Opponents also said that using a lottery to assign channels initially would encourage speculation and create an administrative burden on the Commission. Opponents further contended that a non-uniform nationwide allocation would create regulatory uncertainty, and thereby increase costs and discourage investment.

104. Proponents of the proposal, on the other hand, asserted that there would be significant benefits in allowing spectrum use in each area to be shaped by local conditions and consumers' wishes rather than by a uniform nationwide allocation established by a government agency. Thus, proponents argued that a general purpose mobile service would enhance economic efficiency and consumer welfare by substituting marketplace decisions for Commission judgments. As one public safety commenter noted, "Precisely because the demands of cellular, MSS and other commercial uses relate to future demand and are market driven, the [alternative] approach is feasible and will yield a rational, marketplace solution to the overall problem of spectrum allocation." Another commenter noted the difficulty of rendering "a judgment now as to the best use of this valuable last portion of the available spectrum below 1 GHz," and argued that the "marketplace can be better relied upon to sort out the various conflicting claims of superior use -- to reflect where the strongest demand truly lies."

105. We find considerable merit to the proposition that permitting market forces to determine how to apportion the spectrum among various mobile services is in the public interest. As an initial matter, we observe that there was no consensus of opinion expressed in the comments as to how this scarce spectrum can best be allocated. Mobile satellite interests, for example, argued that more UHF capacity should be set aside for their use and less for cellular purposes. Similarly, personal users argued that no additional spectrum should be given to cellular, and that, instead, the Commission should establish a consumer-oriented personal radio service. Air-to-ground proponents also took issue with our tentative conclusion that providing the cellular service additional allocations was in the public interest. A significant policy advantage to establishing a General Purpose Mobile Service is that these, and other new services, will be free to make their way if consumers find them attractive.

106. We also observe that in at least one instance where user flexibility is now permitted (i.e., the Domestic Satellite Service), innovative technologies and services seem to flourish. This fact was recognized by many parties commenting in General Docket 84-1234 who were unenthusiastic about the Commission restricting the services offered over mobile satellite systems. While raised in the context of satellite services, these concerns are equally relevant to terrestrial allocations.

107. We are aware that for some licensees communications service is a product, while for others it is a way to improve the efficiency of their businesses. But this fact should not affect whether user flexibility will achieve an efficient mix of communications services. Even though communications is not a direct revenue source for many private radio licensees, it is nonetheless a component used in the production of other goods and services. Cost savings achieved due to communications contribute to profitability in the same manner as do savings realized in other ways. As in other areas, firms' actions here are driven primarily by profit motivations. Thus, making firms bear spectrum costs only makes explicit those costs that society is already bearing, and indeed provides incentives to reduce these costs.

108. Finally, because of our decision to allocate spectrum to the cellular and private services, delays in making assignments in the General Purpose Mobile Service should not impose significant costs on either cellular or traditional private radio users. However, the potentially large administrative cost of processing many thousands of applications for assignments in this new service does concern us. To limit the number of applications we receive and to keep our processing expenditures in check, we shall not use lotteries to make assignments in this service. We would prefer to make these assignments through an auction. An auction would substantially reduce the amount of public and private resources consumed in preparing and processing applications; it would increase the likelihood that in the first instance the assignment would be made to the party valuing it the most; and it would raise substantial revenues for the Treasury. If Congressional authority to use auctions is forthcoming, we fully intend to use it in the assignment of General Purpose Mobile Service licenses. If auction authority is not received, we shall consider making these assignment through comparative hearings. Both these possibilities will be examined carefully in a Further Notice of Proposed Rule Making.

C. Legal Issues

109. Several parties opposed the flexible allocation proposal on the grounds that Sections 303(a)-(c) and 307(b) of the Communications Act prohibit such services. They also contend that permitting licensees to have greater discretion in deploying their assignments would be inconsistent with the 1982 Amendments to the Communications Act and its legislative history. In particular, they refer to the legislative history of Subsection 331(a) where the conferees indicated that ". . . by providing the guidelines in this subsection, the Conferees intend to specifically prohibit the Commission from employing auctions or similar economic methods in managing the private land mobile spectrum." H.R. Report No. 765, 97th Cong., 2d Sess. 53 (1982). Similarly, others argued that the courts have found that the Commission has the responsibility for allocating spectrum and cannot leave that process to the marketplace.

110. We find these arguments unpersuasive. Nothing in Sections 303(a)-(c) suggests the Commission is not permitted to take into account marketplace forces when exercising its spectrum allocation responsibilities under the public interest standard. Cf. FCC v. WNCN Listeners Guild, 450 U.S. 582 (1981). See also 47 USC §331(a)(2). Indeed, the Commission has exercised its judgment to permit licensees similar flexibility in other services. For example, in proceedings involving direct broadcast satellites and broadcast subcarriers, among others, the Commission has afforded licensees broad discretion to offer a multiplicity of services based upon the particular demands of their markets or communities. Moreover, as we discussed above, we believe that permitting mobile service licensees broader service options in this spectrum is consistent with the public interest. Within the mobile radio services, the demand for particular services varies across the country. The allocation of additional frequencies to any particular service may not reflect these differences in need. Accordingly, we believe that allocating some mobile service spectrum for flexible purposes will provide an efficient mechanism for determining mobile radio spectrum utilization.

111. We also do not consider Section 307(b) to be a bar to our actions today. On its face Section 307(b) concerns only the manner of distributing frequencies among various states and communities, not the particular uses for which spectrum may be allocated. Moreover, Section 307(b) is not applicable in the non-broadcast services. See Orange County Radiotelephone Service, Inc., 5 FCC 2d 848 (8 RR 2d 1143) (1966); Answerite Professional Telephone Service, 68 FCC 2d 1473, 1476 (41 RR 2d 552, 557) (1977).

112. Finally, we do not agree with the opposing commenters that our action is contrary to Section 331(a) or its legislative history. In allocating this spectrum, some of which may be used for private land mobile services, we have carefully considered the statutory criteria set out in Section 331(a) and, as discussed above, believe our action in this instance will "improve the efficiency of spectrum use...based upon marketplace demands." Section 331(a)(2). The legislative history indicates the Commission is not permitted to use auctions or any "similar method which turns upon a user's monetary ability to pay for a frequency allocation..." House Report, supra at 53. However, our action herein does not assign spectrum to any user based upon ability to pay. Accordingly, we believe our decision fully complies with Congress' current intentions.

D. Technical Issues

113. Technical arguments were raised against the establishment of a general purpose mobile service based on issues of spectrum efficiency, interference, and equipment compatibility. Opponents said that the proposed exclusive assignment scheme would discourage geographic re-use of frequencies and sharing because there would be no Commission-mandated re-use or sharing standards. It was further suggested that since licensees would be profit-motivated, absent a Commission mandate they would be less inclined to invest in the development of spectrum-saving technologies. These parties contended that the present regulatory approach provides necessary order and promotes efficient spectrum utilization with mandated frequency re-use and sharing. Opponents also argued that as spectrum rights are transferred and used for different purposes, the lack of coordination procedures and the difficulty in obtaining site and operational data would complicate the identification and resolution of interference. Finally, cellular interests expressed concern that without Commission-defined allocations and equipment standards, nationwide compatibility (with concomitant lower equipment prices) might not occur.

114. In contrast, parties favoring the concept of greater licensee discretion in the deployment of assignments stated that this approach would encourage innovation and the introduction of newer technologies because licensees would have the means and the incentive to find cost-effective ways to use their assignments as fully as possible. Furthermore, the view that greater user freedom would impede the introduction of new technology and reduce spectrum efficiency, for example, was not universally shared. One equipment manufacturer stated that "...only the alternative regulatory approach is sufficiently flexible to unleash the full thrust of technological innovation to accomplish the needed efficiencies." This commenter argues that the incentives inherent in the alternative proposal would encourage newer technologies and technological innovation which "would provide long term solutions for the problem of spectrum shortage."

115. Moreover, in the context of discussing the traditional allocation approach, many commenters refuted arguments that economic incentives would be ineffective in bringing about economy in spectrum use. These commenters urged us to reject the use of "spectrum efficiency" standards and to rely instead upon flexible technical standards and market forces to bring about greater spectrum utilization. Cellular companies, in particular, argued that they have a strong economic incentive to adopt more efficient technology as their system capacity is exhausted.

116. We are not persuaded that user flexibility will lead to significant technical problems. We concur with the views of those commenters who declare that economic rewards will provide users with a powerful incentive to make intensive use of their assignments. As to the issue of equipment compatibility, we acknowledge the possibility that local licensees might not be in a position to capture a significant portion of the benefits of equipment compatibility, and they would, therefore, be less apt to offer services that are compatible with other systems. This is another issue which we will be considering in a Further Notice of Proposed Rule Making, when we examine the desirability of issuing licenses on a national basis. At this point, however, we are not inclined to place too much importance on the possibility of this problem actually arising due to the fact that in other services and in other industries compatibility has evolved when it is cost-effective as a natural working of the marketplace.

117. With regard to the charge that interference would be a significant problem under the alternative approach, we observe that no substantive analysis was offered to support this claim, nor were suggestions made as to how these problems might be ameliorated. Obviously, we are extremely concerned with the control of interference, especially that which occurs among different licensees. A scheme that rigidly defines technical and operational parameters of radio systems may help control interference, but it is not the only method available. We have had considerable success, for example, in accommodating a variety of different uses in the same band on frequencies above 1 GHz using less rigid rules, and we intend to explore in the Further Notice of Proposed Rule Making whether these coordination procedures may be applied to the General Purpose Mobile Service. Fundamental to any interference plan we adopt will be the explicit definition of licensees' interference rights and responsibilities and the establishment of resolution liability based upon the assignment of these rights.

III. DECISION

118. As we discussed above, we today conclude that the demand for cellular and private radio services is so strong that the public interest is best served by apportioning a significant amount of spectrum exclusively for these services. Nonetheless, the record in these proceedings reinforces our earlier conclusion that there are many possible services that could profitably use this spectrum and that the optimum amount of spectrum that should be allocated to any particular communications use depends on many factors, including several that may be peculiar to a given geographic area. Consequently, we conclude that the creation of a general purpose mobile spectrum allocation is in the public interest. Together with the allocations we establish for private and cellular communications uses, the creation of a service that gives users a greater say in how their assignments are used provides a fair and efficient solution to the complex allocation problems we face, both now and in the future. Accordingly, we are allocating 2 megahertz (901-902 MHz and 940-941 MHz) to a General Purpose Mobile Service. This new mobile service will be accessible to all land mobile, maritime mobile, and aeronautical mobile uses, including cellular and private land mobile.

119. While we are convinced of the merits of creating this new service, we believe that amplification of the details of how it should be structured is desirable. As already noted, most comments on the proposal were related to the concept of the service, rather than on the specifics of how the service would operate. Therefore, we will be issuing a Further Notice of Proposed

Rule Making in the near future proposing specific rules for this service. In this further proceeding, we will also be considering the desirability of various assignment sizes and whether they should be made on a local, regional, or national basis, or some combination of these.

ALLOCATION FOR A MOBILE SATELLITE SERVICE

I. BACKGROUND

120. On November 21, 1984, in response to a petition (RM-4247) filed by the National Aeronautics and Space Administration, we adopted a Notice of Proposed Rule Making in Gen. Docket 84-1234 (Notice in Gen. Docket No. 84-1234) in this proceeding, proposing the establishment of a new Mobile-Satellite Service.

121. There were two principal motivations in proposing an MSS. First, it offers the prospect of land mobile service for the first time to areas of the country that are too remote or sparsely populated to be served by terrestrial land mobile systems. Second, MSS holds promise for a host of new services based on its ability to provide communication between virtually any points in the country, irrespective of separation distance. MSS appears particularly attractive for trucking and other transportation industries involved with large-area or nationwide route systems. Applications also exist in the oil and gas industries and other industries operating in remote regions. For further discussion of the potential uses of MSS see paragraph 4 of the Notice in Gen. Docket 84-1234.

122. Based on the information available at the time the Notice in Gen. Docket 84-1234 was adopted, we estimated that about 20 MHz of spectrum would be needed to accommodate MSS in the long term. In the Notice in Gen. Docket 84-1234 we concluded that it would be in the public interest to propose an allocation in the 800-900 MHz UHF land mobile reserve frequency bands. However, we had also been presented with several other requests to allocate portions of the remaining UHF land mobile reserve for a variety of services. Accordingly, we took several actions to dispose of these requests. We proposed to make 8 MHz available for MSS in the UHF region of the spectrum. In companion rulemakings, we proposed to allocate the remaining parts of the reserve for private land mobile use and for expansion of the cellular radio service.

123. In the Notice in Gen. Docket No. 84-1234, we proposed a two-part allocation for MSS utilizing 8 MHz (821-825 MHz and 866-870 MHz) from the UHF region, along with additional spectrum to come from that portion of the Aeronautical Mobile-Satellite (R) spectrum at L-band (1545-1559 MHz and 1646.5-1660.5 MHz) not required for that service. We speculated that "hybrid" MSS satellites could be developed capable of combined operation on both UHF and L-band frequencies. We solicited comment on this hybrid arrangement and queried whether it might be feasible instead to accomodate MSS alternatively entirely at L-band. We so stated that, should we decide not to allocate UHF spectrum to MSS, we would consider employing these frequencies for other land mobile uses.

124. We also proposed policies and procedures to govern the licensing and operation of MSS facilities. Concurrent with the Notice in Gen. Docket 84-1234 we requested that applications for a mobile satellite system be submitted. Further, we indicated that this rulemaking proceeding, together with the applications filed, would be used to determine the extent of any necessary regulation of this service. In response to our Notice in Gen. Docket 84-1234 we received numerous comments from various companies; local, state, and federal government agencies; and individuals. A list of parties that filed comments and reply comments is given in Appendix A.

II. DISCUSSION

A. GENERAL

125. There was general agreement among the commenters that MSS would be a desirable and worthwhile service. MSS can provide mobile communications, including telephone service, to rural and remote parts of the United States. Further, MSS is uniquely suited for meeting the needs of the transportation, petroleum and other vital industries. MSS could also meet some rural public safety needs and could provide emergency communications to any area in times of emergencies and natural disasters. Evidence of interest in this service and its potential viability can be found in the 12 applications that have been filed. The applicants proposed many of the services indicated above and pointed to the potential of providing other new and innovative services in the future. Based on the overall record before us, we find that the provision of MSS services would benefit large segments of the public, and, in particular, rural and remote areas. Accordingly, we believe that an allocation for MSS would be in the public interest.

B. UHF Considerations

126. While there was general support for MSS, there was strong disagreement over whether UHF frequencies should be used. Land mobile interests, particularly the public safety community, generally opposed a spectrum allocation for MSS in UHF spectrum. Although land mobile interests noted that MSS could offer worthwhile service, including certain applications for public safety, they stated that MSS can be satisfied entirely with an L-band allocation. They asserted that the public interest would be far better served by allocating the UHF spectrum for terrestrial land mobile purposes. On the other hand, most MSS proponents generally supported the proposed hybrid UHF/L-band allocation and argued against an allocation only in L-band. The reasons cited for the necessity of a UHF allocation were: technical/economic advantages of UHF; compatibility with cellular radio systems; and, compatibility with Canada's planned MSS system. These areas are discussed below.

127. Technical/Economic Advantages of UHF. Several parties presented detailed technical analyses comparing MSS system performance with and without a UHF allocation. Further, they explained how system costs would be affected. Hughes Communications Mobile Satellite Services (Hughes) and Skylink Corporation (Skylink) claimed that there is a 6 to 8 dB "handicap" in useful signal level at L-band due to higher system losses than at UHF. On the other hand, Wismer and Becker/Transit Communications, Inc. (W&B/TCI) and Motorola Inc. (Motorola), asserted that the added losses at L-band are on the order of 1.5 to 2 dB. While a variety of design parameters (i.e. efficiency of power amplifiers, loss of antenna feeds, etc.) was cited in comparing system performance at UHF and L-band, the principal source of the disagreements can be traced to differences in estimates of propagation loss.

128. The MSS proponents cited several propagation studies. The studies showed that the estimated propagation loss depends on: (1) the type of environment (i.e. urban areas generally exhibit greater propagation loss than rural areas) and (2) elevation angle to the satellite (i.e. propagation loss is greater in northern latitudes, such as Canada and Alaska, where elevation angle to the satellite is low).

129. The commenters based their estimates of propagation loss on assumptions about the appropriate availability of service and areas to be covered. Hughes indicated that 99% availability of service is required for MSS and this necessitates an allowance of 5.5 dB for greater propagation loss at L-band than at UHF. Skylink claimed that 95% to 99% would be acceptable, corresponding to an allowance of 3 to 5.5 dB. W&B/TCI and Motorola stated that 90% would be acceptable, corresponding to an allowance of about 1.5 to 2.0 dB. W&B/TCI and Motorola asserted that current land mobile systems, including those used for public safety, operate satisfactorily with the equivalent of 90% availability of service. Further, Motorola submitted the results of a computer simulation of the performance of an MSS system, using actual propagation data, and claimed that performance was, in its judgment, satisfactory.

130. Most commenters argued that the remedies available for counteracting the additional losses at L-band are limited. They claimed that it is not practical to make up the losses by increasing transmitter power at the satellite or by utilizing a larger satellite antenna. They indicated that satellites capable of producing the needed power or utilizing a larger antenna are not cost-effective for commercial applications at this time. Several parties stated that they already plan to use an antenna as large as they consider practical for a first generation MSS system. Hughes and Skylink asserted that the only practical way to compensate for the increased losses at L-band would be to use a mobile terminal having a high gain directional antenna.

131. They indicated that a high gain directional antenna is acceptable for services where the antenna can be pointed towards the satellite and remains in a fixed position. In fact, some MSS proponents plan to use L-band for fixed and transportable services, such as rural telephone service. However, the MSS proponents stated that for mobile operation at L-band, a high gain directional antenna is required along with a means of keeping the antenna constantly aligned with the satellite, which results in a costlier design. Skylink and Hughes believe that provision of an affordably priced mobile voice service is a key to success for MSS. Therefore, Hughes, Skylink and several other MSS proponents seek to employ a low-cost omnidirectional mobile antenna that has low gain and does not need to be pointed toward the satellite. They believe this can be accomplished only at UHF.

132. Hughes claimed that an L-band terminal having a high-gain directional antenna would retail for $6001 compared to $3189 for a terminal at UHF that uses an omnidirectional antenna. It did not discuss impact on user charges. Skylink stated that a mobile UHF terminal will cost $850 to $2250 and a mobile L-band terminal will cost $3500. Skylink indicated that in order to recover this cost it would need to increase the rates for service from about $.40/minute to about $3.00/minute. Skylink asserted that such an increase would substantially reduce the potential market for mobile services. This potential loss in market will, according to Hughes and Skylink, increase the investment risk. Skylink claimed that the increased risk will make it more difficult to obtain the financing necessary to construct an MSS system and initiate service.

133. Motorola stated that, based on its assessment of system performance, a mobile terminal with an omnidirectional antenna can be used satisfactorily at L-band. Accordingly, Motorola estimated that the mobile terminal would cost at most 15% more at L-band than UHF. Motorola pointed out that fixed system costs, such as cost of the satellite and supporting system architecture, must be taken into account when calculating the percentage increase in user charges. The 15% cost increase in the terminal would translate to only about a 3% increase in cost to the user, according to Motorola. Motorola expects that by the time MSS is put into operation, further technological developments at L-band will have caused the price difference to become nominal. W&B/TCI also stated that a mobile terminal with an omnidirectional antenna would perform satisfactorily at L-band and would cost only about $214 more (total price of $1725) than one at UHF.

134. W&B/TCI claimed that there are overall technical/economic advantages at L-band, and submitted a report supporting these claims. W&B/TCI stated that spectrum efficiency will be better at L-band due to the ability to implement spot beams more easily than at UHF. For a given size satellite antenna, the footprint of an L-band signal will be about one-fourth that of a UHF signal. With smaller footprints, the same frequencies can be reused in different locations, thereby improving spectrum efficiency. According to W&B/TCI, when one takes into account such factors as increased complexity of a hybrid UHF/L-band satellite, greater spectrum availability at L-band, potentially more efficient spectrum use at L-band and a variety of other factors, an L-band only system is more attractive. W&B/TCI did not elaborate on how these factors specifically impact on user charges.

135. Another point of contention among the commenters was the availability of suitable technology at UHF and L-band and its importance in facilitating early introduction of a first-generation MSS system. Proponents of UHF argued that technology at UHF is available now by drawing upon technologies employed by terrestrial land mobile systems already operating in the UHF region. They generally contended that this was not the case for L-band. On the other hand, W&B/TCI asserted that technologies employed by INMARSAT for systems operating in L-band would be applicable to an L-band MSS. W&B/TCI also stated that technology developed for the Global Positioning System -- a world-wide radiodetermination satellite system developed by the U.S. Government and operating on L-band frequencies -- can be applied and used in an MSS system.

136. We have considered carefully the technical and economic arguments regarding the need to utilize UHF frequencies. We are not convinced, however, that the impediments to provision of a full complement of services at L-band are substantial.

137. The basic argument of UHF proponents is that system losses will be higher at L-band, resulting in unacceptable cost increases for mobile satellite service. We believe this argument is overly pessimistic. We note that propagation loss is a problem associated more with operation in urban areas and in high latitudes. Propagation at L-band appears not to be a problem throughout most of the United States, where elevation angles to the satellite are high. We also note that for many MSS services, such as rural telephone, there appears to be little or no disadvantage to operation at L-band. With regard to urban areas, while we recognize there may be some advantages to UHF operation, we continue to believe that L-band is workable and that an L-band MSS can play an important role in meeting urban mobile communications needs. We also recognize that many other radio services are available for these areas; and our primary motivation for establishing MSS is to provide service to rural and remote areas.

138. We also note that much of the cost differential between UHF and L-band is derived from the quality of service deemed desirable for MSS. The record indicates that many of the potential MSS providers envision a quality of MSS service considerably higher than presently provided by traditional terrestrial land mobile services. We find no reason why this should be the

case. We believe substantial flexibility exists for an L-band MSS to provide higher service quality (such as 99% availability) in L-band. While service at L-band may require more expensive equipment initially, we feel that such cost differentials should be minimal as MSS becomes established due to economies of scale, technical improvements and initial recovery of development costs.

139. With regard to the availability of technology, we are not persuaded that there is a decided advantage for either UHF or L-band. At UHF, certain technology can be borrowed from current land mobile systems; however, these are terrestrial systems and much of the technology is not applicable to a satellite-based system. At L-band, there is also technology that may be applicable by borrowing from satellite systems such as that used by INMARSAT and the GPS. Thus we do not consider the availability of technology to be of decisional significance.

140. In summary, from a technical/economic standpoint we find no reason why MSS could not operate entirely at L-band. While there may potentially be higher costs for mobile services at L-band, in our estimation the cost increase need not be substantial nor does it represent a significant barrier to the initiation of this service.

141. Compatibility with Cellular Radio Systems. The proposed UHF allocation for MSS is adjacent to the frequency bands currently used for cellular radio service. A number of commenters pointed out that one factor favoring such an allocation is that a common piece of equipment could be made to switch automatically between terrestrial cellular service and MSS. Mobile Satellite Corporation, for example, stated in its comments that it could achieve compatibility with cellular systems by using a system that is completely flexible as to such design aspects as modulation.

142. While several MSS proponents have held out the promise of a combined MSS/cellular terminal as a reason to implement the proposed UHF allocation, very little information has been forthcoming as to how precisely this would be accomplished. The fact that the cellular and proposed MSS frequency bands are adjacent to each other would, we acknowledge, make it easier to design a combined radio capable of operating in both services. However, other factors also need to be considered. The MSS systems described in the applications utilize a different type of communication technology than present cellular systems. Moreover, the technologies are not directly compatible; that is, an MSS radio would not necessarily work with a cellular radio, even if they were tuned to the same frequency. We have little doubt that it may be possible to construct a radio capable of operating in both the MSS and the cellular service. However, the two technologies are sufficiently different that it is not at all clear that a "combined" terminal would have much cost or performance advantage over two separate radios. We therefore dismiss the argument that a UHF allocation is needed for compatibility with the cellular radio service.

143. Compatibility with Canadian MSS System. In our Notice in Gen. Docket No. 84-1234, we explained that Canada was contemplating an MSS system operating on UHF frequencies. We recognized the fact that a Canadian MSS could not employ the same frequencies as U.S. terrestrial land mobile systems without causing substantial mutual interference. We noted also that MSS systems in both countries could potentially share the same spectrum without interference. Further, we anticipated that, should the same allocation be made in both countries, it may be possible to develop a joint North American regional MSS system. This, we expected, would facilitate the possibility of a cooperative arrangement between the U.S. and Canadian licensees, whereby system development costs could be shared. This was attractive in light of the economic investment and risk involved.

144. Most of the MSS applicants have indeed proposed a joint-venture between the United States and Canada and cite this as a strong reason for MSS to use the UHF frequencies proposed in our Notice in Gen. Docket 84-1234. An important element to these agreements is the provision for mutual back-up between the U.S. and Canadian satellites; in other words, if one country's satellite should fail, the other's would provide service to both countries. Several commenters stated that back-up is needed in order to provide reliable service; however, according to the MSS proponents, it would not be cost-effective for each country to launch its own satellites for back-up.

145. We acknowledge that the possibility of back-up is attractive; however, we find that possibilities for back-up are not restricted to UHF. Canada is also considering operation at L-band in addition to UHF. Therefore, back-up would be possible even with an L-band only allocation in the United States. Further, we continue to believe that there are sufficient incentives for U.S. MSS providers to develop joint ventures with Canada. We believe that considerable systems development costs could be shared. We note that signalling protocols, up-links, computer programs, etc. needed for MSS are not dependent on the sharing of frequencies.

146. Representatives of the Governments of the United States and Canada have had ongoing discussions concerning the spectrum allocation for MSS. While propagation losses are greater due to Canada's higher latitude location and corresponding lower elevation angle to the satellite, we disagree with Canada that such losses necessarily mandate use of UHF frequencies. On the contrary, we believe that a viable L-band MSS system can satisfactorily provide mobile voice service to both Canada and the U.S. However, if deemed appropriate based on principles of mutual comity, we will consider a possible joint Canadian/U.S. MSS system using 4 MHz of UHF spectrum placed in reserve as an adjunct to an L-band MSS system. This matter is discussed below.

C. L-Band Considerations

147. In the Notice in Gen. Docket No. 84-1234, we proposed to reallocate spectrum for MSS in the L-band frequencies, 1545-1559 MHz and 1646.5-1660.5 MHz. These frequencies are currently allocated to Aeronautical Mobile-Satellite (R) Services [AMSS (R)] for communications to support domestic and international air traffic, including air traffic control (ATC). There are no AMSS systems in operation at this time.

148. Aeronautical interests generally opposed the proposition that L-band could be shared between MSS and AMSS. In particular, the FAA, Air Transport Association of America, Aeronautical Radio, Inc. and the International Civil Aviation Organization indicated that the future needs for aeronautical communications are sizeable and that AMSS (R) spectrum may not readily be shared.

149. In its comments, the National Telecommunications and Information Administration (NTIA) stated that it is unlikely that AMSS (R) will need to use the entire L-band on an exclusive basis. NTIA suggests two options for a shared allocation between AMSS (R) and MSS in the 1545-1559 and 1646.5-1660.5 MHz bands:

Option 1. AMSS (R) is designated as the primary allocation for these bands with MSS and non-AMSS (R) services being given secondary status.

Option 2. MSS and AMSS (R) are given an allocation in part of this band on a co-primary basis, with a footnote provision that AMSS (R) would take precedence over other satellite services.

NTIA urged the Commission to establish an allocation using the first option since the second option would require an advance determination of the amount of spectrum required for non-AMSS (R), AMSS (R) and MSS. NTIA also indicated that clear guidelines must be established for distinguishing between AMSS (R) services and non-AMSS (R) services. NTIA stated that an explicit categorization is needed to know which particular functions meet the definition of safety-related services and that these guidelines should be developed in a joint effort among NTIA, FAA and FCC.

150. NTIA identified two possible AMSS (R) functions that cannot share frequencies with other satellite communications systems. The first is an air traffic control (ATC) system using terrestrial facilities for communicating voice and data between aircraft in high density areas. The second is an ATC system using an independent satellite to serve as the primary surveillance source. NTIA claimed that the total non-shareable spectrum for these functions is about 10 MHz. However, NTIA indicated that aeronautical safety requirements should have priority access to the entire 28 MHz at L-band.

151. We generally concur with NTIA's comments. We agree with NTIA that AMSS (R) and MSS are compatible services that can operate in the same band. We also believe L-band provides sufficient spectrum to wholly satisfy the needs of both MSS and AMSS(R). However, we do not believe that NTIA's first option, that MSS should be allocated on a secondary basis, is the most appropriate course of action. We find it unreasonable to expect major investment to be made in an MSS satellite system that is not afforded interference protection in some portion of the allocation. Therefore, we believe a more logical approach is that suggested under NTIA's option 2.

III. DECISION

152. The land mobile satellite service has much to offer. We attach a high premium to its promise of offering land mobile service to parts of the population that currently have no other alternative available. We recognize that it could meet non-urban public safety needs also, particularly during times of emergency and natural disasters. The service appears technically feasible and economically viable. Based on the overall record before us, we find that it is in the public interest to allocate spectrum for a mobile satellite service.

153. As discussed above, it appears that a complete range of services, including mobile voice, could be offered viably at L-band frequencies. In light of the other services seeking allocations from the UHF reserve, we believe it is in the public interest to utilize the available reserve spectrum for terrestrial land mobile services and provide for MSS at L-band.

154. Currently at L-band there are two 14 MHz paired bands allocated to AMSS (R) (i.e., 1545-1559/1646.5-1660.5 MHz). In following the proposal made by NTIA, we are establishing an allocation as follows:

- Two 4.5 MHz band segments will remain allocated for AMSS (R) on a primary basis (i.e., 1545-1549.5/1646.5-1651.0 MHz) with MSS permitted on a secondary basis.
- Two 9 MHz segments will be set aside for shared use by AMSS (R) and MSS (1549.5-1558.5 MHz/1651-1660 MHz) with a footnote indicating that AMSS (R) will have priority access over MSS use.
- The current two 0.5 MHz segements at 1558.5-1559 MHz/1660.0-1660.5 MHz will remain unchanged.

155. We believe this sharing arrangement strikes a proper balance between providing for aeronautical/mobile requirements and allowing viable mobile satellite services to develop. Although we set out in this proceeding to allocate 20 MHz of spectrum to MSS, we believe that the above arrangement, where MSS has the potential to share 27 MHz of spectrum with AMSS, should prove satisfactory. The shared allocation provides incentives to commercial operators to develop services useful for both land mobile and aeronautical mobile purposes. This will encourage rapid and economical development of both services. While certain separate aeronautical systems may be required, we envision shared-service satellites to provide both generic MSS and dedicated aeronautical functions.

156. As an additional allocation matter pertaining to MSS, we stated in the Notice in Gen. Docket No. 84-1234 that the use of the fixed satellite bands for MSS feeder links is appropriate and would avoid a separate allocation for such uses. We believe there is adequate spectrum allocated to the Fixed Satellite Service (FSS) to support MSS feeder links. If the 4 and 6 GHz and 11 and 14 GHz FSS bands are not able to support the entire spectrum needed for MSS links, then we would expect the next higher frequency FSS bands (i.e., 18 GHz and 28 GHz bands) to be used. We do not anticipate any further allocation proceedings to address this particular matter.

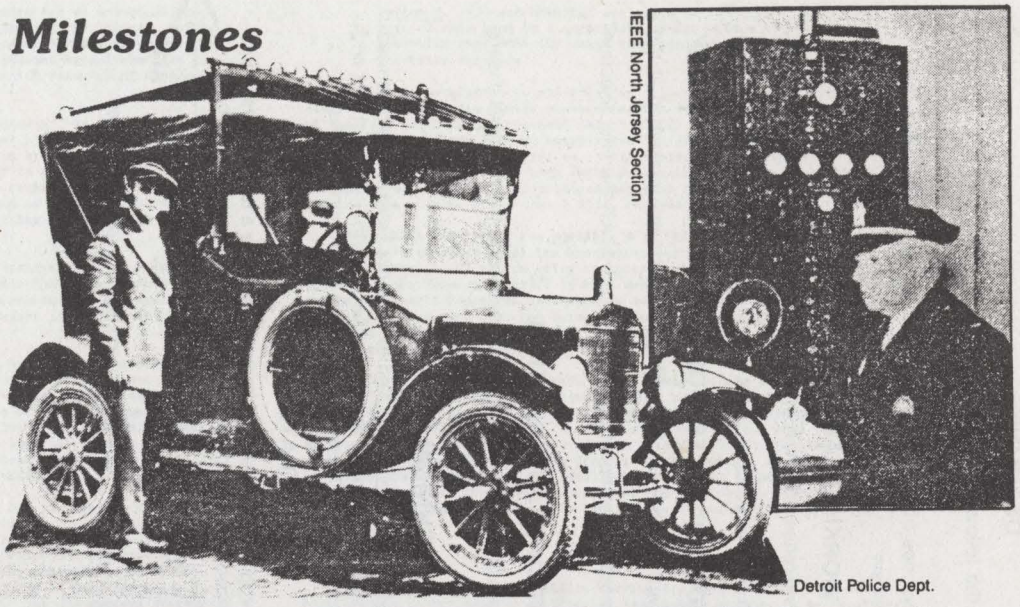
DISPOSITION OF REMAINING RESERVE SPECTRUM

157. In the decisions reached today, we have allocated 28 MHz in the UHF band and 27 MHz at L-band to a variety of services. At this time we intend to leave 4 MHz (849-851 MHz and 894-896 MHz) of the original 32 MHz temporarily unallocated. In further examination of this 4 MHz of spectrum, we will consider a variety of possible services, including such terrestrial services as Basic Exchange Telecommunications Radiotelephone (BETR) for rural use and air-to-ground telephone service, and a possible joint Canadian/United States MSS system to be used as an adjunct to an L-band system.

158. While we continue to believe that a MSS system can be operated successfully using L-band spectrum, The Government of Canada has stated a strong interest in utilizing UHF spectrum for MSS service at least in the first generation of satellites. If deemed appropriate based on the principle of mutual comity, we are willing to consider the possibility of a joint Canadian/United States MSS system at UHF as an adjunct to an L-band MSS system. This would entail discussions with the Canadians. It should be clear that these discussions constitute only one of the many elements in the ultimate Commission decision. If, however, these discussions can be successfully concluded, and the Commission is satisfied that an allocation of UHF spectrum to MSS can be reconciled with its mandate to maximize public interest benefits in spectrum allocations, we will consider proceeding expeditiously toward an allocation for MSS within this 4 MHz of spectrum. However, should United States/Canadian discussions on this matter fail to close successfully, we cannot continue to keep the remaining 4 MHz in reserve and will proceed to allocate this remaining 4 MHz for use within the United States.

Three Mobile-Radio Milestones

Three pioneering achievements in land-mobile radio have been approved as national Electrical Engineering Milestones by the IEEE. Nominated by the Southeastern Michigan, North Jersey, and Connecticut Sections, in conjunction with the IEEE Vehicular Technology Society, the Milestones mark three breakthroughs in the history of mobile radio prior to World War II.



IEEE North Jersey Section

Detroit Police Dept.

Fred M. Link

Three breakthroughs in mobile-radio technology have been designated as IEEE Electrical Engineering Milestones. Antenna wires were strung along the roof of the first Detroit police radio car in 1921 (upper left); Bayonne's police dept. started using a two-way system in 1933 (upper right); experts inspect the Connecticut State Police's two-way FM system in 1940 (above).

The first of these occurred at Detroit on 7 April 1928, when that city's Police Department commenced one-way radio communications with its patrol cars on a permanent basis. The project had begun in 1921, when Police Commissioner William Rutledge authorized setting up an experimental station at police headquarters and predicted that the "wireless telephone will bring a new era in police work." Seven years passed before that era began, however, as problems with low-gain vacuum tubes, interference from motor noise and trolley power lines, and changing licensing decisions by the Federal Radio Commission (FRC) plagued the Detroit system. Many of the problems were resolved in late 1927 when Patrolman Kenneth Cox and Robert L. Batts, an engineering student, designed a much-improved receiver around the newly invented screen-grid tube. Moving the radio station away from the noisy downtown area, devising a better antenna system, and providing fixed tuning also contributed to the success of the station that proved the practicality of land-mobile radio.

The feasibility of two-way police communications was demonstrated five years later by the Bayonne, NJ, Police Department, site of the second Mobile-Radio Milestone. Lieutenant Vincent J. Doyle, the radio operator for the Bayonne unit, applied for a construction permit from the FRC for a two-way station on 7 October 1932, and was granted the permit on 22 December. In March 1933, Doyle and Frank A. Gunther, chief engineer at Radio Engineering Laboratories (REL) on Long Island, went on the air with a two-way system consisting of superregenerative receivers and noncrystal-controlled transmitters built by REL. Since the equipment operated at 34,600 kc, more than ten times higher than the frequency of one-way systems, it was cheaper, lighter in weight, and less prone to many types of interference. Two-way police radio became standard throughout the country following the well-publicized work at Bayonne.

The third Mobile-Radio Milestone marks the introduction of FM. In 1939, Edward J. Hickey, Commissioner of the Connecticut State Police, asked Daniel Noble, a professor of electrical engineering at the University of Connecticut, to design a mobile-radio system for the State Police. A one-way system was suggested, but Noble, who had designed two-way AM and FM broadcast stations, recommended a two-way, FM station. Receiving the go-ahead from Hickey, Noble drew up a circuit design and specifications, from which a practical unit was built by Fred Budelman, chief engineer of the Fred M. Link Company. Noble later said that the success of the system was due to choosing phase modulation, selecting proper station sites, using rooftop antennas on the cars, and employing different transmitting frequencies for the base station and mobile units. The system began operations at Hartford in 1940, signaling the nationwide switch from AM to FM.

Ceremonies dedicating the Milestones will be held in Detroit, Bayonne, and Hartford this spring.

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