

EX PARTE OR LATE FILED DOCKET FILE COPY ORIGINAL



Building The  
Wireless Future™

December 4, 1995

RECEIVED

DEC 4 1995

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF SECRETARY

CTIA

Cellular  
Telecommunications  
Industry Association  
1250 Connecticut  
Avenue, N.W.  
Suite 200  
Washington, D.C. 20036  
202-785-0081 Telephone  
202-785-0721 Fax

Mr. William F. Caton  
Secretary  
Federal Communications Commission  
1919 M Street, NW, Room 222  
Washington, DC 20554

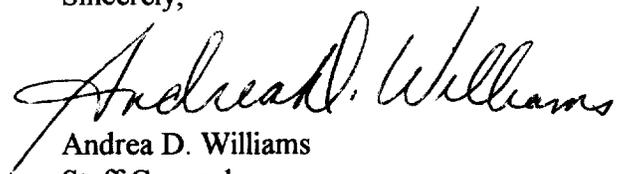
**Re:** *Ex Parte* Presentation  
RM-8658

Dear Mr. Caton:

On Tuesday, November 28, 1995, Dr. Ravi Ravindran, Director of the Center for the Study of Wireless Electromagnetic Compatibility at the University of Oklahoma ("EMC Center"), met with FCC and FDA staff members to discuss the on-going research efforts underway at the EMC Center, particularly the Hearing Aid Project which addresses issues raised in the above referenced proceeding. Dr. Ravindran was accompanied by the following persons who are involved in these research efforts: Mr. Don Bowen, AT&T Bell Laboratories; Ms. Candy Castle, AT&T Wireless Services; Mr. Chuck Eger, Motorola; Mr. Don Heirman, AT&T Bell Laboratories; Ms. Liz Maxfield, CTIA; and Mr. Ray Millington, Motorola. Attached is a list of the FCC and FDA staff members who attended the meeting.

At the meeting, Dr. Ravindran presented the attached documents. Pursuant to Section 1.1206 of the Commission's Rules, an original and one copy of this letter along with the attachments are being filed with your office. If you have any questions concerning this submission, please contact the undersigned.

Sincerely,

  
Andrea D. Williams  
Staff Counsel

Attachments

No. of Copies rec'd 021  
List ABCDE

**FCC Office of Engineering and Technology**

Mr. Richard Smith

Mr. Michael Marcus

Mr. Julius Knapp

Mr. Michael Buas

Mr. David Means

Mr. Dan Stanks

**FCC Wireless Telecommunications Bureau**

Mr. Dan Phythyon

Mr. Stan Wiggins

**FDA Representatives**

Mr. Howard Bassen

Mr. Don Witters

# *The University of Oklahoma*

CENTER FOR THE STUDY OF WIRELESS ELECTROMAGNETIC COMPATIBILITY

Sarkeys Energy Center, 100 East Boyd, Suite R208

Norman, Oklahoma 73019-0628

(405) 325-2429 FAX: (405) 325-2556

The Honorable Reed Hundt  
Chairman  
Federal Communications Commission  
1919 M. Street NW, Suite 800  
Washington, D.C. 20554  
FAX: (202) 418-2801

Dear Chairman Hundt:

We have recently been made aware of questions raised at an October 2 meeting at the FCC concerning the credibility and competence of the Center for the Study of Wireless Electromagnetic Compatibility at the University of Oklahoma. We are concerned that individuals from the Center were not present to defend the program and document its technical expertise. These allegations have the potential to seriously undermine research currently being conducted at the Center.

The University of Oklahoma Wireless Electromagnetic Compatibility Center has been addressing EMC issues for some time and is nearing completion of Phase I of an extensive test program examining the interaction of cellular phones and cardiac pacemakers. Preliminary results from the study were presented yesterday at the second annual EMC Forum in Dallas, Texas. Throughout this research program, the Center has worked closely with representatives from the FDA Center for Devices and Radiological Health (Donald Witters, Howard Bassen), Wireless Technology Research (George Carlo), the Medical Devices Bureau of Health Canada (Dr. Kok-Swang Tan) and numerous individuals from the wireless manufacturing industry, service providers, and the cardiac pacemaker industry.

The Center's broad-based mission includes not only research but education, training, standards, and technology management. The Center is directed by the University of Oklahoma School of Industrial Engineering in partnership with the OU School of Electrical Engineering and the OU Health Sciences Center. The Center utilizes one of the top five EMC test facilities in the country (AT&T Open Area Test Site in Oklahoma City, Oklahoma). The Center conducts its work under the direction of a world-class advisory board with participation from major manufacturers. The Center also utilizes an independent Board of Directors with representation from industry, government agencies, trade associations, other universities, and user groups.

The Center recognizes and will be responsive to the criticality of the investigation of the interaction of wireless phones and hearing aids. We have been actively working on this issue since May of this year and will begin testing shortly. Accomplishments to date include a planning meeting in Dallas, Texas in June 1995 to initiate the development of a test protocol, completion of a literature review of internationally conducted studies of hearing aid interaction, and two meetings of the Study Design Group to evaluate and modify the test protocol. This broad-based design group includes more than 45 U.S. and international representatives of wireless phone manufacturers and service providers including AT&T (Don Heirman), Motorola, Ericsson (US and UK), Qualcomm and Telecom Australia (Ken Joyner), hearing aid companies (Argosy, Siemens, Starkey), trade associations (CTIA, HIA, HIMA), government agencies (FCC, FDA, ), and hearing aid user groups (Self-Help for the Hard of Hearing). Under separate cover, we are faxing a complete list of our Hearing Aid Study Design Group members.

Our plan for developing solutions to the hearing aid interaction issue consists of the following three-pronged approach that includes both subject-based and instrument-based testing.

1. The top priority is identifying immediate solutions based on input from hearing aid manufacturers and users. These solutions will be evaluated utilizing a quantitative, subject-based test protocol involving both hearing-impaired and normal-hearing individuals. Testing of human subjects will begin shortly, with results reported by January 1, 1996. This research is in collaboration with the Hough Institute in Oklahoma City and other appropriate research groups.
2. Additional human subject testing to clearly determine the extent of the interaction of hearing aids with the variety of digital wireless communication technologies, and to identify and evaluate other solutions.
3. Instrument-based EMI testing with an emphasis on identifying the mechanism of the interaction and leading to the development and evaluation of longer-term solutions.

We believe it is critical that we meet with you at your earliest convenience to address the concerns raised about the EMC Center at the University of Oklahoma and its activities.

Sincerely,



Hank Grant, Ph.D.  
Chairman, EMC Center Board of Directors



A. Ravindran, Ph.D.  
Director, EMC Center

# **HEARING AID - CELLULAR PHONE INTERACTION STUDY**

## **Phase I Objectives**

- 1. Define the test protocol for physical measurement of the interference generated in hearing aids by cellular phone signals of varying types. The resulting protocol shall produce repeatable results and include parameters such as field strength, threshold distance of interference, and intensity and frequency of the resulting audio interference output;**

# **HEARING AID - CELLULAR PHONE INTERACTION STUDY**

## **Phase I Objectives (cont'd)**

**2. Define a standard methodology for measuring the immunity of hearing aids, including standards for acceptable “noise floors”; and**

**3. Define the test protocol for subjective measurement of the extent of the interference generated in hearing aids by cellular phone signals of varying types. The protocol shall include the use of both hearing-impaired and unimpaired individuals.**

# **HEARING AID - CELLULAR PHONE INTERACTION STUDY**

## **Phase II Objectives**

**(1) Determination of overall immunity levels for hearing aids and user guides for buying hearing aids with high immunity.**

**(2) Identification of appropriate measures to eliminate interference.**

- For phone technology (e.g. use of small cells, using dynamic power control, use of discontinuous transmission).**
- For hearing aids (e.g. reducing size, shielding the equipment, filtering, etc.).**

# HEARING AID - CELLULAR PHONE INTERACTION STUDY

## Phones to be Tested

1. Analog @ 800 MHZ
2. TDMA(D-AMPS) @ 800 MHZ (IS-54) and 1900 MHZ (IS-136)
3. MIRS
4. CDMA @ 800 MHZ (IS-95) and 1900 MHZ (J008)
5. PCS @ 1900 MHZ (J007)
6. GSM @ 900 MHZ (not used in US, but included for benchmarking against European studies)

# HEARING AID - CELLULAR PHONE INTERACTION STUDY

## Hearing Aids to be included

### Hearing Aid Types

- Behind the Ear (BTE)
- In the Ear (ITE)
- In the Canal (ITC)
- Completely in the Canal (CIC)

(ITE, ITC, and CIC comprise 80% of the market)

# **HEARING AID - CELLULAR PHONE INTERACTION STUDY**

## **Hearing Aids to be included (cont'd)**

**New devices vs. current patients**

**Specific manufacturers, models, units/model**

**Modes of operation, frequency response tolerances, telecoil  
operation**

# HEARING AID - CELLULAR PHONE INTERACTION STUDY

## Differences with respect to European tests

- Use of actual wireless phones instead of employing various RF signals provides the greatest realism in terms of actual signal structure including the format for control and voice traffic (e.g. paging, power control, channel changes).
- Subjective (Psycho-acoustic) measurements.  
Subjective evaluation of wireless phone interference is important since the detectability and annoyance depend on the individual hearing acuity of each user. Both hearing aid users and those with normal hearing will be included.

# **HEARING-AID CELLULAR PHONE INTERACTION STUDY**

## **Differences with respect to European Tests**

- **Most Europeans and Australian Studies are for GSM phones with 2W hand portable and 8W mobile phones. OU study would involve all the NADC (North American Digital Cellular) technologies (TDMA, CDMA, and PCS)**

# **HEARING AID CELLULAR PHONE INTERACTION STUDY**

## **DESIGN GROUP**

- **WIRELESS PHONE MANUFACTURERS**
- **HEARING AID COMPANIES**
- **HEARING AID USER GROUPS**
- **RESEARCHERS**
- **GOVERNMENT AGENCIES**

October 24, 1995  
Alpha by Company, then by last name

## HEARING AID DESIGN GROUP

COMPANY	NAME	FAX NUMBER
Alexander Graham Bell Foundation	Susan Coffman	202-337-8314
APREL Laboratories	Jacek Wojcik	613-820-4161
Argosy Electronics	David Preves	612-942-8159
AT&T Bell Laboratories	Don Heirman	908-834-1807
AT&T Bell Laboratories	Donald Bowen	201-386-7831
AT&T Global Products Compliance Lab	Michael Ruduski	908-834-1807
Callier Center for Communication Disorders	Ross Roeser	214-883-3022
City University of NT	Herry Levitt	212-642-2379
Consluting for Hearing Technology	Harry Teder	612-474-5367
CTIA	John Breaux	202-785-0721
CTIA	Liz Maxfield	202-887-1629
CTIA	Tom Wheeler	202-331-8112
Ericsson, Inc.	Nils Bojeryd	214-705-8550
Ericsson, Inc.	Jan-Anders Dalenstam	214-952-8782
Ericsson, Inc.	Barry Kratz	214-705-7666
Ericsson, Inc.	Lars-Goran Larsson	202-783-2206
Ericsson, Inc.	Douglas Neeley	214-705-7666
Ericsson, Inc.	Lars Nilsson	214-705-7666
FCC	Michael Buas	202-887-5637
FCC	Jay Jackson	202-418-1412
FCC	Steve Markendorff	202-418-1412
FCC	David Means	301-344-2050
FCC	Gerald Vaughn	202-418-0787
FDA	Howard Bassen	301-443-0023
FDA	Marlene Skopec	301-443-0023
FDA	Donald Witters	301-443-0023
Galludet University	Cynthia Compton	202-651-5324
Health Canada	Kok-Swang Tan	613-993-0281
HIA	Carole Rogin	703-684-6048
HIMA	Bernie Liebler	202-783-8750
Hough Ear Institute	Ken Dormer	405-947-6226
Motorola, Inc.	Ray Millington	708-523-5557
Motorola, Inc.	David Priniski	708-523-6060
Nokia Mobile Phones	Matti Kattilakoski	214-257-9988
Nokia Mobile Phones	Christopher Wallace	214-257-9988
Northern Telecom	Dinesh Pai	214-684-3662
Northern Telecom	Charles Spann	214-684-3662

## HEARING AID DESIGN GROUP

COMPANY	NAME	FAX NUMBER
Pacific Bell Mobile Services	Mike Patrick	510-227-3079
Pacific Telesis	Robert Deward	415-777-4957
Peoples Cellular	Melvin Munn	903-878-2433
Qualcomm, Inc.	Kevin Kelley	202-833-2161
Qualcomm, Inc.	Eber Lambert	619-658-2120
SBC Communications, Inc.	John Stupka	210-351-2029
SHHH	Brenda Battat	301-913-9413
SHHH	Mark Ross	203-487-4727
SHHH	Donna Sorkin	301-913-9413
Siemens	Richard Blake	407-633-6500
Siemens, UK	Julian Trinder	44-1794-833433
Southwestern Bell Mobile	Stan Sigma	214-733-2012
Starkey Laboratories, Inc.	Mike Sacha	612-828-6972
Telecom Australia	Ken Joyner	011-613-9253-6365
Unitron Industries Ltd.	Horst Arndt	519-895-0108

## UNIVERSITY OF OKLAHOMA

OU-EMC Center Chairman of the Board	Hank Grant	405-325-7555
OU-EMC Center Director	A. "Ravi" Ravindran	405-325-2556
OU-EMC Center, IE Dept.	Deji Badiru	405-325-7555
OU-EMC Center, IE Dept.	Shiva Raman	405-325-7555
OU-EMC Center, IE Dept.	Bob Schlegel	405-325-7555
OU, EE Dept.	John Cheung	405-325-7066
OU, EE Dept.	Leon Zelby	405-325-7066

## **HEARING AID-CELLULAR PHONE INTERACTION STUDY**

- **Hosted a planning meeting for the study in Dallas, TX in May 1995 which was attended by representatives from the phone and hearing aid industries. Topics discussed included Research Study Objectives, Phone and Hearing Aid Technology Reviews, and Testing Studies completed to date;**
- **Completed a literature review of studies performed to date on HA interaction and international test protocols used;**
- **Met with the main researchers to solicit their input and include them in the testing process;**

## **HEARING AID-CELLULAR PHONE INTERACTION STUDY**

- **Formation of the HA Test Design Group to review the test protocol to be used in the study;**
- **Held two meetings of the Test Design Group to formulate the Test Protocol;**
- **Developed the draft Audiologic Protocol in Cooperation with the Hough Ear Institute in Oklahoma City;**
- **Developed the Questionnaire to be sent to HA users to select the participants for the interference tests.**

## **PHASE II RESEARCH OBJECTIVES**

- 1. Extent of the interference problems to HA users**
- 2. Short term solutions to “Passer-By” interaction problems**
- 3. Short term solutions to “HA User” interaction problems**
- 4. Long term solutions to the “HA User” and “Passer-By” interaction problems**
- 5. Effects of various phone technologies on EMI**
- 6. Effects of various HA technologies on EMI**

# **DETAILS OF HUMAN SUBJECTS TESTING**

- 1. Done in cooperation with the Hough Ear Institute in Oklahoma City.**
- 2. Questionnaire**
  - A two-page questionnaire sent to 500 selected HA patients**
  - Questionnaires will be evaluated on the basis of**
    - HA Type**
    - Hearing Loss Configurations**
    - Severity of Loss**
    - Etiology of Hearing Loss**



**USE OF CELLULAR PHONES**

**Frequently    Sometimes    Never**

7. I have used a cellular phone ..... A            B            C  
    If you have never used a cellular phone, skip to item 10.

8. I have experienced difficulties when using a cellular phone ..... A            B            C

Comments on difficulties \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

9. I remove my hearing aids when I use a cellular phone..... A            B            C

10. I have had occasions when a cellular phone was used in close proximity... A            B            C  
    If you never had such an experience, skip item 11.

11. I have experienced interference to my hearing aid when a cellular phone  
    is used in close proximity... ..... A            B            C

List any situations that have caused interference or buzzing with the hearing aid \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

THANK YOU FOR COMPLETING THE SURVEY. IF YOU WOULD BE WILLING TO BE A POTENTIAL  
SUBJECT FOR TESTING CELLULAR PHONE INTERFERENCE WITH HEARING AIDS, PLEASE INDICATE  
BELOW:

\_\_\_\_\_ YES

\_\_\_\_\_ NO

### **3. SUBJECT SELECTION**

- **10 Normal Hearing Subjects**
- **65 Hearing Impaired**
  - **Age group 18-78**
  - **Using hearing aids > 6 months and > 4 hours/day**
  - **Psychologically stable and in good health**
- **Four Hearing Loss Configurations based on audiograms (various etiologies will also be identified )**

#### **1. Flat**

- **Little of no change across Speech frequencies**
- **15 Subjects (5 BTE, 5 ITE and 5 ITC)**

## **2. Sloping**

- **5-20 dB changes per octave across speech frequencies**
- **15 subjects**

## **3. Ski Slope**

- **Normal or nearly normal thresholds 250-1000 Hz with a 30dB or more drop off in the high frequencies**
- **15 subjects**

## **4. Rising**

- **Thresholds improve 5-20dB per octave over the speech frequency range**
- **15 subjects**



- **Five completely-In-The-Canal (CIC) HA users**

**(CIC's introduced recently, accounts for only 7% of the 1994 sales; hence, not very many users may be available for inclusion)**

- **Hearing Aid Types (Summary)**

<b>BTE</b>	<b>-</b>	<b>20 subjects</b>
<b>ITE</b>	<b>-</b>	<b>20 subjects</b>
<b>ITC</b>	<b>-</b>	<b>20 subjects</b>
<b>CIC</b>	<b>-</b>	<b>5 subjects</b>