Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	}	
	}	
Revision of Part 15 Rules of the Commission's	}	
Rules Regarding Ultra-Wideband	}	ET Docket No. 98-153
Transmission Systems	}	

Reply Comments of the Geophysics Community

The undersigned representatives of the geophysical community, submit these additional reply comments in response to the Notice of Proposed Rule Making (NPRM), FCC 00-163, and the request for comments on testing (performed by NTIA and others) in the proceeding referenced above. These comments specifically address the most recent undated submission provided to the FCC under this docket by Ben Sternberg, apparently on 24 April 2001, and by Sprint and others of 25 April 2001.

In Sternberg's comments, paragraph 2 beginning with "Nevertheless" assertions are made about potential interference with a simple test. In the report of that test, many questions arise, which we have listed in an appendix to this reply comment. These questions bear directly on the issues of whether the GPR was being used under normal or manufacturer recommended operating conditions, with optimum polarization and coupling for the ground, and so forth, or even whether something else (like change in atmospheric path conditions or a nearby notebook computer) was the source of the qualitative "change in reception". Such anecdotal, non-quantitative and poorly documented tests as Sternberg's add little to these proceedings. Sternberg's description of possible interference is an example of how easily an observation can lead to misleading or unsubstantiated conclusions. We note that *any* transmitter can *potentially* cause interference when deployed incorrectly or used outside the boundaries of the manufacturer's recommendations -- the question is whether or not it is probable to occur and results in harmful interference. However Sternberg's anecdotal observations are not consistent with decades of geophysical industry, academic and government experience using commercially available geophysical equipment without complaints of harmful interference.

In paragraphs 5 and 6, beginning "I would like to suggest...", Sternberg makes the suggestion to use multiple narrow bandwidth frequencies at "much larger transmitted powers" in the "bands reserved for industrial, scientific, and medical users." There are two problems with this approach. First, such types of instruments have been studied and the mathematical requirements for them to work adequately require the availability of many frequencies per order of magnitude (commonly called a "decade") in frequency. There are not enough frequencies available (allocated in the ISM bands or elsewhere) to be able to resolve and solve the kinds of problems under the wide range of soil and rock conditions known to exist (and already addressed by earlier comments in these proceedings by Olhoeft, Butler, Wright and others). Further, expected spectrum allocation and use pressure will reduce the availability of these existing bands. Second,

if these geophysical tools are all forced into these limited and narrower bands, and to partly compensate for lost frequency bandwidth, consequently have to push to higher powers levels, then they will interfere with each other and with other users of those bands. This would be further complicated by the consequences of electronics failure in one of these higher power, narrow band devices, causing it to drift out of its allocated frequency range, possibly in a fashion unknown or unnoticed by the users of the device. Further, in the tradeoff of power versus bandwidth, experiments corroborate theory in showing that wide bandwidth at low power wins over narrow band signals at high power in achieving high resolution, while beating geometric spreading and exponential material losses to penetrate. Overall, low power spread over a wide bandwidth would be preferable and offer less potential for harmful interference. This is supported by the decades of experience with current low power, wide bandwidth, commercial geophysical devices that have produced no complaints of interference to our knowledge (related in the comments earlier in these proceedings by Olhoeft, Wright, Butler, Johnson, Annan, and others), especially as regards the use of geophysical equipment without interference in proximity to GPS receivers, which are also vital to our own geophysical applications (see in particular the comments by Wright and Johnson and photo below).

In response to the potential interference concerns voiced by Sprint, the Air Transport Association, ARRL, U.S. GPS Industry Council and others, the UK Radiocommunications Agency recently required the keeping of logs of GPR use, and when those logs were "subsequently distributed around all their regional offices and compared to the record of interference events. There was no interference event that could be attributed to GPR." (quoted from the European GPR Association submission to the similar deliberations of the European Telecommunication Standards Institute). Also, interference between a GPR and a cell phone was reported in a recent peer reviewed journal article (Olhoeft, G. R., 2000, Maximizing the information return from ground penetrating radar: J. Appl. Geophys., v. 43/2-4, p. 175-187). In those tests, the GPR suffered operational inhibiting interference from the cell phone (it could no longer image a sewer under a concrete floor nor the thickness of the concrete with the cell phone in use that had been possible with the phone off), but the GPR could only be made to interfere with the cell phone when both were operated within one meter of each other in the basement of a large building where the cell phone had the disadvantage of strongly attenuated cell phone levels.

Sprint's comment stated "UWB proponents have had nearly three years to demonstrate that their devices can coexist with licensed services below 3.1 GHz without causing harmful interference. The UWB industry has not met its burden of proof." However, in geophysics, we have many decades of academic, industry and government experience using commercially available geophysical equipment confirming this ability to operate in coexistence with licensed services without complaints of harmful interference. For electromagnetic geophysical investigations into the earth's subsurface, we would like to support the FCC's proposal of 10 May 2000 to "…consider permitting the operation of ultra-wideband (UWB) technology on an unlicensed basis, which could have enormous benefits for public safety, consumers and business. UWB devices appear to be able to operate on spectrum already occupied by existing radio services without raising interference." Others have already commented on the public health and safety (and other) benefits of applying this proposal to electromagnetic geophysical investigations and the necessity to perform such investigations at frequencies below 3 GHz.

500 MHz center-frequency impulse ground penetrating radar (GPR) used to map snow depth shown with GPS antenna for location positioning mounted right on top of GPR antenna without interference to either (photo courtesy of Wintechnik, 3Dgeophysics and Snowscan). In this photo the GPR is being used to locate avalanche victims.

Respectfully submitted, 7 May 2001

(The signatures below were solicited over a period of one week from a representative but not exhaustive cross-section of the academic, industrial and governmental geophysical community. They are listed in the order received. Some of the signatures are from individuals and do not necessarily represent the positions of their organizations, in which case their affiliations are shown for informational purposes only. Some of the signatures are from outside the United States as geophysics is an international community of equipment manufacturers and users, and the rules set by the FCC often influence other foreign and international agencies.)

Gary R. Olhoeft, Ph.D.
Professor of Geophysics — 303-273-3458 of, -9202 fax
Colorado School of Mines — golhoeft@mines.edu
1500 Illinois Street — http://www.mines.edu/~golhoeft
Golden, CO 80401-1887 — (Chair, 3rd Int'l. Conf. on Ground Penetrating Radar, 1990)

Gary N. Young, General Manager — 641-621-8027
Underground Imaging Technologies, LLC
A Partnership between Vermeer Manufacturing Company
and Pinnacle West Capital Corporation
1210 Vermeer Road East
Pella, IA 50219

Dwain K. Butler, Ph.D., P.G.
Senior Research Geophysicist — 601-634-2127 of, -3453 fax
Engineer Research and Development Center (CERDC-GS-R)
U.S. Army Corps of Engineers
3909 Halls Ferry Road — butlerd@wes.army.mil
Vicksburg, MS 39180-6199 — (Chair, 1st GPR Gov't Users Workshop, 1991)

S. Gogineni, Ph.D.
Deane Ackers Distinguished Professor
Electrical Engineering and Computer Science Department
The University of Kansas
1013 Learned Hall
Lawrence, KS 66045

Harry M. Jol, Ph.D.
Associate Professor
Department of Geography
University of Wisconsin-Eau Claire

Dr. David Noon
Senior Research Fellow
CRC for Sensor Signal and Information Processing
The University of Queensland, Qld 4072
AUSTRALIA — (Chair, 8th Int'l. Conf. on Ground Penetrating Radar, 2000)

Richard C. Benson, PG
President — 305-634-4507 ph
Technos, Inc. — 305-635-4109 fax
3333 NW 21 Street — info@technos-inc.com
Miami, FL 33142 — http://www.technos-inc.com

Richard A. Hopkins, RPG
Marrich, Inc. 865-573-4188 ph
PO Box 9179
Knoxville, TN 37940-0179

George Moussally, Ph.D.
Executive Vice President 408- 524-7905 ph
Mirage Systems 408-524-7903 fax
1031 East Duane Avenue, Suite F geojm@ieee.org
Sunnyvale, CA 94085-2626

Karl Zipf, Ph.D. P.E.
Branch Chief 509-354-8090
NIOSH - Spokane Research Laboratory
315 East Montgomery Ave.
Spokane WA 99207

John F. Hermance, Ph.D.
Professor, Environmental Geophysics/Hydrology
Department of Geological Sciences 401-863-3830 ph
324 Brook Street 401-863-2058 fax
Brown University John_Hermance@Brown.Edu
Providence, RI 02912-1846

Miro Bosnar
President 905-670-9580 ph
Geonics Limited 905-670-9204 fax
8-1745 Meyerside Drive geonics@geonics.com
Mississauga, ON L5T 1C6 http://www.geonics.com
Canada

Dennis Johnson
President 603-893-1109 ph
Geophysical Survey Systems Inc. 603-889-3984 fax
13 Klein Drive dennis@geophysical.com
North Salem, NH 03073 http://www.geophysical.com

A. Peter Annan, Ph.D.
President 905-624-8909 ph
Sensors & Software Inc. 905-624-9365 fax
1091 Brevik Place apa@sensoft.on.ca
Mississauga, Ontaro L4W 3R7 http://www.sensoft.on.ca
Canada

David W.A. Taylor, Ph.D., P.G.
Director, Applied Geophysics 336-632-1200 ph
ENSCO, Inc. 336-632-1225 fax
5400 Port Royal Road taylor@ensco.com
Springfield, VA 22151

Peter Swanson, Ph.D.
Geophysicist pswanson@cdc.gov
Spokane Research Laboratory 509-354-8072 of, -8099 fax
National Institute for Occupational Safety and Health
Center for Disease Control and Prevention
315 E. Montgomery Ave.
Spokane, WA 99207

Rosemary Knight, Ph.D.
Professor of Geophysics
Mitchell Building
Stanford University rknight@pangea.stanford.edu
Stanford CA 94305

Michael Zhdanov, Ph.D.
Professor of Geophysics 801-581-7750 ph
University of Utah 801-581-7065 fax
Department of Geology and Geophysics
135 South 1460 East, Rm 719 mzhdanov@mines.utah.edu
Salt Lake City, UT 84112

Roelof Versteeg, Ph.D.
Associate Research Scientist/Adjunct Assistant Professor
Columbia University
New York, NY versteeg@ldeo.columbia.edu

Mark Vendl
U.S. EPA 312-886-0405 ph
77 W. Jackson Blvd.
Chicago, IL 60604 vendl.mark@epa.gov

Gerald Schuster, Ph.D.
Professor of Geophysics
University of Utah
Department of Geology and Geophysics
135 South 1460 East, Rm 719 schuster@mines.utah.edu
Salt Lake City, UT 84112

Raymond L. Sterling, Ph.D., P.E.
CETF Professor and Director
Trenchless Technology Center
P.O. Box 1034
Louisiana Tech University
Ruston LA 71272-0046

318-257-4072 ph
318-257-2777 fax
sterling@coes.latech.edu
http:// www.latech.edu/tech/engr/ttc/

Dennis J. Lachel, P.G., R.E.G.
President
LACHEL & Associates Inc.
P.O.Box 5266
Golden, CO 80401

303-279-4321 ph
303-279-0414 fax
dlachel@lachel.com
http://www.lachel.com

Jim Doolittle
Research Soil Scientist
National Soil Survey Center
USDA-NRCS
11 Campus Boulevard, Suite 11
Newtown Square, PA 19073

610-557-4233 ph
610-557-4136 fax
jdoolittle@fs.fed.us
http://members.aol.com/plysoil1/gprgps/gprgps.htm

Jeff Daniels, Ph.D.
Graduate Chair
Department of Geological Sciences
377 Mendenhall Laboratory
125 S. Oval Mall
Columbus, OH 43210

614-292-4295 ph
614-292-7688 fax
jeff@geology.ohio-state.edu
http://www.geology.ohio-state.edu/~jeff
(Chair of 2nd & 3rd Gov't GPR Users Workshops)

Leon Peters Jr., Ph.D.
Professor Emeritus
Electrical Engineering
211 Electroscience Laboratory
Ohio State University
1320 Kinnear Rd
Columbus , Oh 43212

614-292-6153
lpj@esl.eng.ohio-state.edu
http://esl.eng.ohio-state.edu/topics/gpr/gpr.html
(IEEE Fellow for GPR Achievements)

Richard J. Wold, Ph.D.
President
Blackhawk GeoServices, Inc.
301 Commercial Road, Suite B
Golden, CO 80401

303-278-8700 ph
303-278-0789 fax
rwold@blackhawkgeo.com
http://www.blackhawkgeo.com

Henning F. Harmuth, Ph.D.
Retired Professor of Electrical Engineering
The Catholic University of America
Washington DC
(current address 757 Bayou Dr., Destin, FL 32541-1846)

H. Frank Morrison, Ph.D.
Professor of Geoengineering
Dept. of Civil and Environmental Engineering
University of California at Berkeley
Berkeley, CA 94720

George A. McMechan
Ida Green Professor of Geosciences
and Director,
Center for Lithospheric Studies
University of Texas at Dallas
P.O. Box 830688
Richardson, TX 75083-0688

Marvin A. Speece
Professor of Geophysical Engineering
Montana Tech
1300 West Park Street
Butte, MT 59701-8997
406-496-4188 ph
406-496-4133 fax
mspeece@mtech.edu

G. Clark Davenport
Forensic Geophysicist
California Registration #44
GeoForensics International
Lakewood, CO 80215-7066
303-462-3447 ph
gforensics@aol.com

George R. Jiracek, Ph.D.
Professor of Geophysics
Department of Geological Sciences
San Diego State University
San Diego, CA 92182-1020
619-594 5160 ph
619-594 4372 fax
jiracek@moho.sdsu.edu

Doug Crice
President
GeoRadar Inc.
19623 Via Escuela Drive
Saratoga, CA 95070
408-867-3792 ph
408-867-4900 fax
dcrice@georadar.com

Lawrence B. Conyers, Ph.D.
Assistant Professor of Archaeology
University of Denver
2000 E. Asbury St.
Denver, CO 80208.

Alan Langman
Department of Electrical Engineering
University of Cape Town
Private Bag
Rondebosch 7701
South Africa

Peter Ulriksen, Ph.D
Geophysics development
Engineering Geology
Lund University of Technology
PO Box 118
221 00 Lund
SWEDEN

+46 (46) 222 89 91 ph
+46 (46) 222 91 27 fax

peter.ulriksen@tg.lth.se
http://www.tg.lth.se

Roy J. Greenfield, Ph.D.
Professor of Geophysics
Geosciences Department
The Pennsylvania State University
441 Deike Building
University Park PA 16802

814-237-1810

roy@essc.psu.edu

Tommy Leijon
President
Mala GeoScience AB
Skolgatan 11
S-930 70 Mala
Sweden

+46 953 345 50 ph
+46 953 345 67 fax
tommy.leijon@malags.se
http://www.malags.com

I.J. Won, Ph.D.
President
Geophex, Ltd.
605 Mercury St.
Raleigh, NC 27603

919-839-8515 ph
919-839-8528 fax

http://www.geophex.com

Richard Plumb, Ph.D.
Professor and Chair 607-777-4846 ph
Department of Electrical Engineering 607-777-4464 fax
State University of New York at Binghamton
Binghamton, NY 13902 (Chair, 7th Int'l. Conf. On Ground Penetrating Radar, 1998)

Michael Inggs
Dept. Electrical Engineering +27 21 650 2799 ph
University of Cape Town +27 21 650 3465 fax
Private Bag
Rondebosch 7701 http://rrsg.ee.uct.ac.za
South Africa http://rrsg.ee.uct.ac.za/URSI

John A. Grant, Ph.D.
Geologist
Center for Earth and Planetary Studies 202-357-1494 ph
National Air and Space Museum 202-786-2566 fax
Smithsonian Institution
4th and Independence SW
Washington, DC 20560-0315

Steven A. Arcone, Ph.D.
U.S. Army Cold Regions Research and Engineering Laboratory 603 646 4368
Hanover, NH 03755

Russel C. Hertzog, Ph.D.
Physics Discipline Leader 208-526-4092 ph
Subsurface Science Initiative 208-526-5327 fax
Idaho National Engineering Laboratory
P.O. Box 1625 hertr@inel.gov
Idaho Falls, ID 83415-2211

William J. Steinway, Ph.D.
Executive Vice President 407-325-0522
CyTerra Corporation
85 First Avenue
Waltham, MA 02451

George Schneider 208-526-6789 ph
Director, Environmental Research and Development
Department of Energy 208-536-6249 fax
Idaho Operations Office schneigj@inel.gov
Idaho Falls Idaho 83402

William Frangos, Ph.D.
Assistant Professor of Geophysics
James Madison University
Harrisonburg, VA 22801

540-568-6567 ph
540-568-8058 fax
frangowx@jmu.edu

Matthew Wolf
President
Mala GeoScience USA, Inc.
PO Box 80430
Charleston, SC 29416

843-852-5021 ph
843-769-7397 fax
sales.usa@malags.se

Clark Jorgensen
Geophysicist
Big Sky Geophysics
P.O. Box 353
Bozeman, MT 59771

406-587-6330 ph
406-587-6394 fax
clark@bigskygeo.com

Don Heimmer, PG
President
Geo-Recovery Systems, Inc.
6601 Indiana Street
Arvada, Colorado 80007

720-898-0800 ph
720-898-0900 fax
georec1@ix.netcom.com

Doria Kutrubes
President & Geophysicist
Radar Solutions International
51 Riverview Avenue
Waltham, MA 02453-3819

781 891 4492

radar@world.std.com

Michael Oristaglio, Ph.D.
Chief Scientist
Witten Technologies, Inc.
295 Huntington Ave, Suite 203
Boston, MA 02115

617 236 0019

http://www.wittentech.com

Joerg Endom
Geophysicist
Ingenieurbuero fuer Bodenradartechnologie
Butendoor 25
D-24576 Bad Bramstedt
Germany

+49.4192-81 33 44 ph
+49.4192-81 33 60 fax
jendom@bodenradar.de
http:// www.bodenradar.de

Motoyuki Sato, Dr.Eng.
Professor
Ctr for Northeast Asian Studies
Tohoku University
Kawauchi, Sendai 980-8576
Japan

sato@cneas.tohoku.ac.jp
http://cobalt.cneas.tohoku.ac.jp/users/sato/index-e.htm
(Chair, 6th Int'l Conf. on Ground Penetrating Radar, 1996)

Prof. Dr. Hans-J. Kuempel
Section Applied Geophysics
Geological Institute
University of Bonn
Nussallee 8
D-53115 Bonn
Germany

+49-(0)228-73 3060 ph
+49-(0)228-73 2584 fax
kuempel@geo.uni-bonn.de
www.geo.uni-bonn.de/members/kuempel

John W. Lane Jr.
Acting Chief, Branch of Geophysical Applications
U.S. Geological Survey
Office of Ground Water
11 Sherman Place
Storrs CT 06269

860-487-7402 ext 13 ph
860-487-8802 fax
jwlane@usgs.gov

William E. Preeg, Ph.D.
Vice President and Director
Schlumberger Austin Product Center
P.O.Box 200015
Austin, TX 78720-0015

Appendix - Questions about Sternberg's Interference Tests

In Sternberg's comments, paragraph 2 beginning with "Nevertheless" assertions are made about potential interference with a simple test. In the report of that test, many questions arise. These questions bear directly on the issues of whether the GPR was being used under normal or manufacturer recommended operating conditions, with optimum polarization and coupling for the ground, and so forth, or even whether something else (like change in atmospheric path conditions) was the source of the qualitative "change in reception".

Was the AR8000 the now discontinued, English made AOR (UK) Ltd. AR8000? With what kind of antenna was it fitted? In what receiving mode was it operating (AM, NFM, WFM, USB, LSB, CW) and what were the receiver settings? What was the type and where was the source of voice transmissions?

Was the GSSI GPR system a current model and deployed as manufactured or was it modified (and if modified, how)? Was it in good repair and deployed as recommended by the manufacturer? How was the GSSI 3200 antenna coupled to the ground and what were the soil type and moisture conditions (or the soil electrical and magnetic properties)? What were the GPR data quality and depth of investigation at the site? (A site that produces poor data quality and depth of investigation will usually have adverse soil conditions that reduce coupling into the ground, hence increasing radiation into the air, and thus also would not be a site where GPR would or could typically be used.)

What was the geometry, and how were the voice transmitter, AR8000 receiver, and GSSI GPR 3200 antennas oriented with respect to each other, nearby objects, and the ground? What were the "various frequencies and distances"? Were there any other RF radiating devices nearby, such as a notebook or other computer as commonly used with GPR's to record data (was the AR8000 computer link active)? Where were the computers and what were their operating characteristics? Were tests done to minimize the interference from the computers?

In this year of large solar storms causing auroras as far south as Mexico, what date and time were these tests performed and where?

These same questions can be asked about the following paragraph where unspecified "change in reception" was noted.