THIS IS A CORRECTED COPY - IMPORTANT ERROR IN ORGINAL 225-400Mhz here instead of 225-400Khz in original. No other substantive changes

As researchers who have completed 3 years of Wireless Field Tests for the National Science Foundation, with particular attention to the utility of FCC Part 15 spread spectrum radios in both urban and rural, high and low bandwidth use, foreign and domestic, we have studied your Notice of Inquiry and the questions you have posed.

While the majority of the NOI discussion and questions are focused on the narrow specialized uses of low power, short range, limited distribution UWB wireless devices, such as for new forms of radar, there is a much broader set of issues about FCC Part 15 Rules for general-use spread spectrum data radios. We do not agree that an NPRM should be issued which only addresses, as stated in the NOI: "We understand that UWB systems will operate at very low spectral power densities, producing noise-like signals. Further, it appears that UWB systems will operate over very short distances."

Instead, based upon the following comments, we recommend that TWO NPRM be issued based on this NOI; one for the support of very limited, specialized, UWB devices being proposed by U.S. Radar, Inc, Time Domain Corporation, and Zircon Corporation, whose needs are most discussed in the NOI, and another one for revision of those portions of the Part 15 Rules which, based on the same underlying advances processor controlled digital communications, can be used in new generations of broadly useful digital radios so long as the technical rules are changes. In the spirit of the NOI statement: "We believe that UWB technology has unique attributes that could lead to a wide variety of new beneficial uses that may be in the public interest."

You state "The Commission has a long history of facilitating the introduction of new technologies under Part 15 of its rules. For example, in the mid-1980's the Commission provided new rules for spread spectrum technology that led to the growth of an industry and a wide array of products. In the past few years, the Commission has amended Part 15 to provide for unlicensed personal communication service devices, unlicensed national information infrastructure devices and millimeter wave technology. We are initiating this Notice of Inquiry to determine what, if any, changes to our rules may be appropriate to facilitate the development of UWB technology and what standards and operating requirements are necessary to prevent interference to other users of the radio spectrum."

It is to the larger need for rule modification in the broadest public interest, expressed repeatedly by Administration, Congressional, and FCC officials as that the comments below are addressed. These broader public interests can be catagorized into 3 are as:

a. Universal public access to advanced telecommunications capabilities.

b. Universal service access to advanced telecommunications and information services for all public schools, health services, and libraries, urban and rural.

c. Ability of local Internet Service Providers (ISPs) to better and more cheaply deliver 'last mile' telecommunication services without tying up

Common Carrier switches originally designed and priced to carry only voice traffic in infrequent, short durati on, telephone calls.

Spread spectrum radios operating under Part 15 Rules, modified to permit operations at lower frequencies than those currently authorized, and wider bands than now permitted, and, in at least rural areas, at greater power, can meet those expressed public goals.

Below we comment on all three seperate but related public interest areas listed above in terms of why radios built under existing rules are inadequate.

## GENERAL ADVANCED TELECOMMUNICATIONS CAPABILITIES

a. Univeral public access to the advanced telecommunications capabilities, including access to the Internet. There is a statutory basis in the 1996 Telecommunications act for this public goal. Section 706 of the Act is a Congressional mandate to the Commission to examine the availability of advanced telecommunications capability to all Americans. Section 706(a) directs the Commission and each state commission to "encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans." The statute defines "advanced telecommunications capability," "without regard to any transmission media or technology, as high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology."

It should be noted that this mandate to the Commission uses the term 'telecommunications capability' and not the term 'telecommunications services' which can be confused with the regulatory environment for common carrier or other commercial, traditional, communications 'services.' Thus 'device' based communications technologies, where the economic costs are only in the purchase of digital radio devices, their planning and installation, and NOT in per minute or monthly service charges, such as can be provided by no-licence radios, is, in our opinion, covered by this Congressional mandate. Congress, on behalf of the American people, wants everyone to have access to the most advanced telecommunications technologies; new generations of spread spectrum radios can deliver on the promise far better than it is now, if manufacturers are permitted to unleash its power in mass produced devices.

Data radios that take advantage of ultra-wide frequency bands, current and projected processor gains by still-increasing capability chipsets, software and firmware by companies which have accumulated 13 years of experience with Part 15 radios, and some expertise transferred via engineers from 40 years of Defense Department development of advanced national security radios, together with intelligent and flexible FCC rules that, while paying due diligence to the potential problens of unwanted interference, represent a revolution in general public data communications. And it is precisely the ability to make radios whose emanations over a wide band appear only as background noise, that opens this possibility up on a large scale. But the key is to open up, even on a shared basis with other spectrum uses, much wider frequency bands than are now permitted under Part 15 rules.

The common public belief is that common (telephone) carriers can, or will, meet the need for advanced telecommunications services for all urban

users, and that the problem for rural and high cost areas can be met by FCC directed subsidies, such as being considered under Universal Service funding schemes, or by eventual 'trickle down' diffusion of advanced services to lesser markets as has slowly happened with cell phone services. But the reality is that 'advanced' services as delivered by ISDN, or ASDL, or cable modems continue to be available only in high-density urban areas, with short distances between the modified telephone company central switches and the end user, require high quality copper lines or cable, additional premisis equipment, and always with a recurring cost payable to the telephone or cable companies only for the connectivity, not Internet or other end services costs. Its an elusive dream. It is also represents attempts to squeeze a few more bits per second out of obsolescent telephone infrastructures and technologies, while spread spectrum radio technologies capable of order-of-magnitude increases in capability remains barely tapped.

Yet, already, even under existing FCC Part 15 spread spectrum radio rules adopted in 1985, with their power limitations of 1 watt at the radio, 4 watts EIRP for 915Mhz band radios, (greater gain for 2.4Ghz and 5.8Ghz antennas) and with the severe line of sight and obstacle penetration limitations imposed by the higher frequency bands, still, over 70 companies have managed to produce relatively costly radios from very short range wireless office LANs to longer range Point to Point radios, which have demonstrated the potential of spread spectrum for the very type of high bandwidth, lowest possible cost (zero) data communications for a very wide portion of the population and its institutions. As one of the footnotes of your NOI states, with some suprise:

"While Part 15 does not specifically restrict operating distance, the technical standards inherently limit the range for most devices to 100 meters or less. We recognize, however, that certain Part 15 devices use high gain, directional antennas to achieve operating distances of 30 kilometers or more for point-to-point operations."

The problem is, that there is no relationship between what it has taken to achieve those ranges in the face of problems such as the requirement for very clear line-of-sight conditions, with outside roof or tower mounted outside antennas to produce sufficient gain, and very limited building, wall, and vegetation penetration capabilities, and the public need that approaches the goal as stated in the Telecommunications Act.

All that has been demonstrated so far is potential - not its full realization on a large consumer scale, with radios affordable at the lower end by individual end users, to the higher end with 100Mbps long range communciations and able to function both between points where people actually use their computers, at home and in offices and the nearest commercial or institutional ISPs, in point to multipoint, full duplex, and smart-radio modes. (see our explanation in April, 1998, Scientific American of the value of such an approach)

Since the promulgation of the 1985 Part 15 rules, as modified, the same advances in digital signal processing gain that is cited in the NOI as now making ultra-wide-band low power low range radar possible with acceptable levels of interference, even over shared-use spectrum, can be applied to spread spectrum radios designed for general computer to computer communications uses. As you state " When combined with appropriate modulation techniques, UWB devices also may be used for communications

purposes, such as the transmission of voice, control signals, and data."

Radios made by Clarion, Solectek, and Karlnet already have achieved 11Mbps data rates - a very useful Ethernet speed - but only at ranges possible with 1 watt of power, and with penetration possible for 2.4Ghz signals - which in our experience and testing is limited usually to 2 walls in short ranges, and is diffused by wet leaves in almost all others, losing long distance signal.

The newly developed Harris Semiconductor direct sequence Prism Wireless LAN Chip Set is an example of the growing capability of companies to produce chipsets with increasing processor gain. And Harris is now prepared to produce frequency hopping chipsets that will permit at least 1Mbps data rates. The Part 15 rules need to be modified so that makers of both chipsets and radios can not only use much wider bands, but those in lower frequencies - such as in the 225-400Mhz area. The key to minimize interference is for the FCC to specify the minimum processing gain to be achieved - such as frequency hops, or direct sequence chipping rates - and to encourage the development of 'smart radios' which, like the Internet can be self-regulating (power, protocols, patterns) rather than as now, largely by limiting power and antenna gain.

In fact, given the extremely dynamic nature of improvements in processor controlled wireless devices - which far more resembles the dynamic change in computer technology than traditional radio technology, we believe that even the FCC's rate of rule-making change is a major inhibitor to the conversion of technological advances into marketplace products and services. The Part 15 Rules for spread spectrum are already 18 years old, while great advances have been made during that time in capabilities which challenge the premises of those rules. We of the NSF Wireless Field Test project have even noted large advances in capabilities in the 3 years we have been field testing radios - from only a few products which could deliver T-1 or E-1 rates for 5 miles or less, to Clarion radios which deliver 11Mbps over 25 miles now, with no liberalization of the rules, is a strong examples.

Accordingly we recommend the FCC, as part of revised Rules, begin to alter the assumptions that minimum radio standards (for the prevention of harmful interferences) should be in concrete indefinitely. They should be revised, automatically, on the FCCs own initiative and research, at least every 5 years. Our strongest example is are the radios used by Metricom in their municipal (Washington, Seattle, Bay Area) network services. Their Richochet 915Mhz spread spectrum radios, which were made to minimize frequency hopping rules promulgated in 1985, are too noisy today. They will interfere too much with other, early-rule radios. As Metricom seeks to develop better radios as part of their - and any other company's normal technological-improvement strategy - the FCC should long since have revised the Part 15 rules for frequency hopping, to require better - and less interference-prone - radios, which improved processor technology now permits. In short, the FCC needs to regulate spread spectrum radios at a rate closer to computer-improvement technology, than very slow development cycles of technologies like television (HDTV). Or else the FCC becomes the problem, rather than the enabling solution to very large scale deployment of powerful 'advanced telecommunications technologies' while still insuring that new forms of emissions are not harmful.

FOR SCHOOLS, LIBRARIES AND HEALTH-CARE FACILITIES

While many factors will influence how fast advanced telecommunications capabilities will be diffused throughout society through general market forces a very high and special priority has been put on getting schools and libraries connected, down to the classroom. The 1996 Telecommunications Act details this requirement as 'universal access.' As stated in Section 254 of the Act, UNIVERSAL SERVICE, Paragraph (b) the goal is this:

> "(b) UNIVERSAL SERVICE PRINCIPLES- The Joint Board and the Commission shall base policies for the preservation and advancement of universal service on the following principles:
>
> (1) QUALITY AND RATES- Quality services should be available at just, reasonable, and affordable rates.
>
> (2) ACCESS TO ADVANCED SERVICES- Access to advanced telecommunications and information services should be provided in all regions of the Nation."

This is such a high priority that Congress authorized the FCC to allocate up to $2.5 BILLION (since modified somewhat) to subsidize telecommunications 'services' to schools on an annual basis. The money coming from special assessments on all rate payers. There are 84,000 public schools in 16,000 School Districts, and 15,000 public libraries. It is astonishing to we of the NSF Wireless Field Tests - many of them undertaken for the sole purpose of evaluating the contribution of wireless to information-age education, to see the right hand of the FCC vigorously, and at great public cost, supporting the subsidy of traditional and obsolescent telephone data recurring-cost services, while the left hand has virtually ignored the decisive contribution no-licence spread spectrum radios can make toward the goal of connecting up all schools and libraries, at a one time, not annual 'local loop' costs basis. It may be the powerful lobbying forces of the telephone companies who pressure both Congress and the FCC Commissioners to perpetuate their past monopoly on communications services, but we of the NSF Wireless Field Test Project - $500,000 in serious studies and practical, not theoretical deployment of radios - after having filed on NPRMs, and appeared at En Banc Hearings suspect it is far more the ignorance of sections of the FCC which do not grasp the economic, as well as technological potential of Part 15 type data radios to go a very long way towards solving the school-library connectivity 'problem' at the lowest possible cost, and in places no telephone line will ever go.

Schools have three bandwidth-cost problems of connectivity: from the nearest POP to the principal school building of a district, between the schools of a District, and to the classrooms inside of buildings. In our NSF studies of schools we found that the greatest need for urban schools is high bandwidth links - at least 10Mbps - between buildings, while the greatest need in rural areas is for sufficient range to bridge the distance between distant POPs and their main building - at least at T-1 data speeds .

The FCC claimed, in its Report and Order that establish the new UNII service in the 5.8Ghz that it had essentially solved the problem of

Internet connectivity by its technical rules decision.

In its summary of actions taken on this issue, the FCC's Public Statement about the "Wireless Classrooms" said:

"The NII/SUPERNet proceeding may make it easier for schools to connect to the Internet without wires - an especially good option for asbestos-laden schools.

On May 6, 1996 the FCC issued a Notice of Proposed Rulemaking in response to petitions filed by Apple Computer, Inc. and WINForum, that seeks comment on making spectrum available for use by new unlicensed equipment called NII/SUPERNet devices. The proposal is relevant to schools since these devices could help link classrooms to the Internet by wireless means, thus providing schools an alternative to installing wires in classrooms. In response to the NPRM, 52 comments and 26 reply comments were filed. On January 9, 1997 the Commission released an Order amending FCC rules to make 300 megahertz of spectrum available for use by this new category of unlicensed equipment, now called Unlicensed National Information Infrastructure ("U-NII") devices."

However, two years after this new service rule was adopted, there has been very little manufacturing activity, and none is forecast.

1. Only two known companies have brought out radios operating under the UNII rules. RadioLan and Wireless, Inc and no schools are using them. The assumption that there are many schools with an 'asbestos problem' has been largely discounted. A very small percentage of all schools have such a problem. Spread spectrum radios operating at lower frequencies that the 5.8Ghz UNII bands, which can penetrate walls better, are more suitable. In fact there is far more demand at RadioLan for its 2.4Ghz radios than its UNII band one, even with its price lowered.

2. The 'spectral density' rules for the UNII band, which permitted the use of 1 watt of power only if the bandwidth delivers 20Mbps in data rate doomed this service never to solve the most important need of the schools - which is at least T-1 of service to the school from the POP, connections between the buildings across the diameter of a District.

3. The manufacturers of the latest UNII band radio which has been produced by Wireless, Inc found:

a. The radios cannot be made to operate successfully over more than 3 miles of range because of the spectral density rules. While our NSF findings, expressed repeatedly in Comments to the FCC on earlier NPRM actions show that radios which cannot operate with at least T-1 data speeds over 15 miles are nearly useless.

b. The radios that have been produced are extremely costly, one in the range of $9,000. No school will buy such radios with such limited functionality.

4. At a UNII Band conference held at Rutgers University's WinLab in the summer of 1998, attended by a Co-PI for this NSF Wireless Field Test Project, where manufacturers attended to see whether there was a market for such UNII band radios, after the presentation from the chief engineer who designed the Wireless, Inc UNII radio concluded there was no such market. And most present stated their lack of interest in developing such

a radio.

5. RadioLan has positioned its UNII band radios, rated at only 800 meters range and 10Mbps, for the cross-campus market. It makes no attempt to advertise its radio as applicable to K-12 school networking.

Our NSF Wireless Field Test staff considers the UNII Band initiative by the FCC a failure, and the claims that it has materially helped American schools get connected to the Internet extremely misleading. We refuse to consider the rules which promulgated such radios, as having any substantive value in solving the connectivity problem for general schools or libraries, and believe the name 'UNII' is so misleading to the public, given the limited capabilities of such radios for educational use that it should be withdrawn.

There is, instead, a clear and present need for radios made under Part 15 rules that permits at least 15 miles range in a MULTI-USER, not Point to Point mode operating in bands below the current 915Mhz frequency range. The reason is simple and demonstrable - 14,000 of the 16,000 non-overlapping School Districts in the United States are multi-building school systems, in which from 2 to 50 or more buildings across an urban city require being connected at a minimum of 10Mbps data rates. RBOCS cannot deliver such data rates. Except in special fractional use situations, schools can only get T-1s or T-3, 45Mbps service (which can range to $20,000 a month cost)

While a superficial look at the typical costs for common carrier T-1 services in urban areas, from $250 to $1,000 per month does not look excessive, those recurring cost connections in larger districts do not 'scale.' An example is School District 20 of northern Colorado Springs, which has 25 school building stretched across a rolling hill district at least 10 miles in radius. US West bid $1.5 million to install T-1 services to all schools, and $12,000 a month in recurring charges. The 10 year cost of a wired, bid telco solution was $2.9 million. Fortunately a small wireless company was in the city, which, because there is such a low sales volume of Part 15 radios, is a rare occurance, bid $601,000 10 year cost for a wireless solution without recurring costs. One fifth the US West bid cost. Several of the schools were too far out for the range-limited Part 15 radios to serve.

A far higher volume of lower cost radios producing at least 10Mbps of data rate with improved ranges to at least 15 miles from a 12DB Omni antenna placed on a one story school building at the center of a District in an urban area is the key requirement. T HIS would serve the primary needs for at least 75% of all US Public schools.

Rural Schools pose an entirely different connectivity challenge. The problem for rural areas is distance, not density of electromagnetic signals. The 3d Principle expressed in the UNIVERSAL SERVICE section of the Telecom Act, states:

"(3) ACCESS IN RURAL AND HIGH COST AREAS- Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information services, including inter-exchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas and

that are available at rates that are reasonably comparable to rates charged for similar services in urban areas."

The need for radios which can operate over 50 miles, with repeating capabilities of over 100 mile ranges, and deliver at least T-1 data speeds, full duplex, is very great in rural areas. Large tracts of the American West and Alaska pose large challenges to schools and libraries in smaller towns in such areas. For example there are 30 seperate towns with 14 seperate school districts in the poor San Luis Valley of Colorado. This valley is 100 miles long and averages 50 miles wide. Only one town, Alamosa, with a population of 15,000 is large enough to support the bringing of a T-1 via the telephone company into the valley from Denver or Pueblo. The major problem is the delivery of data services from that central point to the other 29 communities that range up to 50 miles away. Standard T-1 rates from the telephone companies range to $1,500 per month, just for the local loop costs, not any Internet service costs - an utterly unaffordable cost for schools in towns of under 1000 population. But radios operating under current Part 15 rules are unable to span the 30 to 50 mile distances with sufficient bandwidth to be useful.

Additionally, rural health-care facilities require higher data rate bandwidths, to carry reliably video scanned images and real-time interactive diagnostic services. 10Mbps - or Ethernet speed is considered a minimum useful speed for such public services.

What is required in rural areas are rules that permit power levels that can bridge these distances, point to point. In fact we have accumulated enough evidence of need, and the difference between the needs of urban and rural schools, that we hold that Part 15 power levels for rural areas should be substantially higher than urban ares.

And what can be used to mark that distinction? We submit it is the same criteria the FCC uses to differentiate rural from urban schools in its subsidy for universal services. That FCC definition was adopted in Docket Number 96-45 of the Federal-State Join t Board on Universal Service:

"The Commission directed the administrator to classify schools and libraries as urban or rural in accordance with definitions adopted by the Department of Health and Human Services' Office of Rural Health Policy (ORHP/HHS). ORHP/HHS uses the Office of Management and Budget's (OMB) Metropolitan Statistical Area (MSA) designation of metropolitan and non-metropolitan counties (or county equivalents), adjusted by the most currently available Goldsmith Modification, which identifies rural areas within large metropolitan counties. The Commission adopted this approach because it represented the least administratively burdensome approach for schools and libraries to determine eligibility for the additional incremental discount and because it was consistent with the approach adopted with respect to health care in the Universal Service Order."

Thus there is already a definition in FCC use which corresponds to the more disadvantaged for reasons of rural, low density population areas, and corresponding higher distance-related costs of telecommunications.

As for potentially increased interference occasion by the use of greater power than 1 watt, we believe that in the rural environment, the rule that requires the operator of a transmitter to take steps to eliminate harmful

interference is sufficient.

Thus we recommend that Part 15 rules be revised to either permit radios producing 5 watts of power for rural use, or corresponding changes that insures that radios at the lowest ultra-wide-band frequency can operate at least 50 miles with non-amplified directional antennas tuned to the frequencies.

GIVING LOCAL INTERNET SERVICE PROVIDERS (ISPs) RADIOS CAPABLE OF PROVIDING T-1 DATA RATES DIRECTLY FROM THEIR SERVERS TO INDIVIDUAL AS WELL AS INSTITUTIONAL CUSTOMERS

Giving local ISP's more ability to provide higher-bandwidth, than 28.8 modem speed telecommunications links to end-use customers without increasing loads or costs on the telephone company is an important goal.

As expressed by the FCC in its own Q&A section under the heading 'The FCC, Internet Service Providers, and Access Charges' it states:

"A: Since 1983, there has been an ongoing debate about whether enhanced service providers should be required to pay access charges, based on the contention that these companies use local networks in the same manner as long-distance carriers. In June 1996, four local telephone companies (Pacific Bell, Bell Atlantic, US West, and NYNEX) submitted studies to the FCC concerning the effects of Internet usage on these carriers' networks. The companies argued that the existing rate structure did not reflect the costs imposed on local telephone companies to support Internet access, and that Internet usage was causing congestion in part of the local network. In connection with these studies and other pleadings, several local phone companies have asked the FCC for authority to charge interstate access charges to ISPs, although they have not filed a formal petition for rulemaking."

The point here is that the only way the vast majority of Internet service users can connect to the net at affordable rates, is by voice grade telephone modems. There are several distinct problems with this huge, but dysfunctional model.

1. The switched telephone company residential and business telephone business is based upon voice traffic being accessed intermittently for relatively brief periods. The rise in modem traffic has burdened these companies 'tying up their switches' to the point they have sought relief by charging, through ISPs, by-the-minute rates just for local loop access.

2. So far the FCC has resisted imposing such a drastic measure on consumers and ISPs. (among other things it would destroy flat-rate priced Internet services such as those provided by AOL). It has done so largely on the grounds that the growth of the use of the Internet needs to be supported. This does not solve the legitimate problems of the telephone company.

3. Twisted copper pair wires, the basis for almost all voice telephone traffic are limited in the bandwidth they can carry except for special conditions endemic only to central cities with very modern telephone company infrastructures. Even though various companies have

attempted to develop and market so called '56Kbps' data rate modems, the fact is that very few deliver close to such speeds. The quality of telephone lines are a major hindrance. Yet the now least capable Spread Spectrum Radios, such as t hose manufactured by FreeWave of Boulder Colorado, can deliver 115Kbps of data at 915Mhz. This is not a universal solution, however, because the 915Mhz frequency range severely limits their use in built up urban areas (wall penetration), the restricted spectrum spread limits the total bandwidth an individual radio can handle in a multi-user mode, thus the company feels it must market the radio to government or businesses, at a price of $1,250 which is at least double what the average user of network services will pay.

There is, in fact, no radio on the market which permits an ISP to deliver to multiple individual computer user customers out to a range of 15 miles through modern construction building, bandwidth of 56Kbps or higher. This is in spite of the fact that over 5,000 ISPs exist in the US, and if some or all of them could bypass traditional local loop telephone services to their subscribers, both the load on the RBOC central switches would be lowered, and end users could have much higher data rate services at lower costs.

The FCC should modify the Part 15 Rules to take advantage of much wider bandwidth, at lower frequency levels, so that manufacturers can produce mass market devices that still, using current processing gain chipsets, minimize interference not only with foreign devices, but also permit manufacturers to offer 'band selections' as well as hopping patterns to minimize interference even with like radios in the same local area.

## SUMMARY

We who have evaluated a wide variety of spread spectrum radios designed according to FCC Part 15 rules, in a wide variety of urban, rural, and even foreign (Mongolia) settings for clearly have come to know the practical needs of organizations for affordable bandwidth.

We agree with the recognition forwarded in the NOI that, 'as technology advances, this type of modulation is capable of spreading the signal levels over such a wide bandwidth that the emissions would appear to be similar to background noise.' In other words the emissions will not noticeably interfere with other uses of the same spectrum. For we have followed closely the findings of the 1995 MIT doctoral thesis by Timothy Shepard, in "A Channel Access Scheme for Large Dense Packet Radio Networks" where he asserts that millions of radios can operate in the same urban space at hundreds of megabits per second, without interference. ftp://ftp.lcs.mit.edu//pub/lcs-pubs/tr.outbox/MIT-LCS-TR-670.ps.gz

Thus we strongly believe the time has come for the FCC boldly to revise Part 15 Rules in ways that manufacturers can take advantage of the 'advances in technology' and produce radios which can, in economically revolutionary ways, provide advanced telecommunications services that are desired by the public, and mandated by Congress.

In short, while we applaud the first NOI since 1981 which opens questions on the future of Part 15, or processor controlled, spread spectrum radios, we think the NPRMs which issue from the comments and replies should aim much higher than just the basis for enabling highly specialized advanced technologies in narrow fields. Every citizen's personal computer could be

linked wirelessly with high bandwidth, at the lowest possible cost, over time, if the rules set in motion by this NOI were wisely crafted. And we submit that the charge by Congress is a fundamental mandate from which the FCC Staff and Commissioners should proceed.

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