BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Spectrum Policy Task Force	)	ET Docket No. 02-135
	)	
	)	

COMMENTS BY HYPRES, INC.

HYPRES, Inc. is submitting these comments in response to requests for relevant information related to the Spectrum Policy Task Force request for public comments on issues related to the Commission's Spectrum Policies.

HYPRES, Inc. is a manufacturer of exceptionally high-performance and cost-effective electronic equipment using Superconductor technology. HYPRES has demonstrated digital circuit capabilities that far exceed the performance currently available and forecasted with semiconductors and other implementations. The performance of these circuits enables real-time processing of RF signals in the digital domain at frequencies previously unattainable. HYPRES technology brings the power of digital processing to the RF domain. The technology is so accurate, it defines the volt; and so sensitive, it can measure brain currents. More information on these capabilities is included as Appendix C.

In these comments, HYPRES makes a general recommendation regarding next-generation technology, and provides information on several specific areas where next generation technology will provide solutions to the problems and issues under consideration by the Spectrum Policy Task Force.

General Recommendation

Current conventional technology cannot, in general, materially alleviate the issues and problems explicitly and implicitly cited in the request for comments. With current technology, policy actions will only serve as a temporary remedy. It will take significant enhancements in performance to provide long-term solutions. Next generation technology has the potential to alleviate or eliminate most or all of these issues.

We recommend that the Commission proactively and expeditiously support the development of next generation technologies that have the potential of materially affecting these critical issues, and that the Commission ensure that policy development and rule-making support insertion of new technology, enabling new approaches to spectrum management and relieving the current imbalance in spectral efficiency across different services using RF communication.

Reduce Complexity of User Terminals

User terminal (handsets, etc.) units in wireless service operate under severe constraints of size, weight, power, and cost. There are many advantages to keeping them as simple as possible, including reduced opportunity for security violations, increased battery life and reduced cost.

HYPRES recommends that policy for spectrum management take the view that complexity should, to the maximum extent possible, be removed from the user terminal to the base station and its supporting infrastructure. Putting the burden on the base station makes the terminal simpler, improves security, extends battery life, and provides more application flexibility to wireless systems.

Most participants (operators and suppliers) in the wireless marketplace agree with this strategy. The recommendations in this document are based on that premise, and are not intended to be applied to user terminals (although benefits do accrue to the user terminals).

Spectrum Management

One category of the breakthrough applications enabled by HYPRES technology is to incorporate a near real-time pipelined FFT in correlation-based receivers to dynamically monitor a broad area of spectrum and support acquisition of desired signals. HYPRES technology can provide the speed, resolution, and bandwidth needed to provide this functionality in near real time, unattainable with current (or forecasted) semiconductor-based technologies. With this approach, receivers sample relevant bands in real-time and pass details of observed signal characteristics to central controllers for evaluation. Continuous (or near continuous) monitoring is a much more effective approach to spectrum management than attempting to collect status from individual radios.

These techniques makes possible:

- Rapid identification and acquisition of desired signals (including hopping signals)
- Spotting interfering emitters to support adaptive cancellation and/or null steering of adaptive antennas
- Identification of intermodulation and spurious emission from emitters using coincident timing (enabling reduction of interference in real time)
- Use of simple and relatively inexpensive ancillary equipment (such as simple, broadband omni-type antennas)

There are a number of additional benefits from the performance improvements associated with the introduction of this monitoring capability. Some of the benefits that accrue to the user terminals are:

- Relaxation of user modem requirements (with attendant cost and performance benefits);
- Reducing the frequency stability requirement of the user transmitters (again, with cost and performance benefits)

HYPRES suggests that certification of equipment, compliance testing, and self-regulation of radio use is necessary but not sufficient to ensure continued compliance. By providing real-time information on the ambient spectrum, a number of event-driven spectrum management techniques are enabled, opening the way to move from monitoring spectrum to controlling it.

We also suggest that local changes in the spectrum profile may be indicative of events with security implications. We propose a monitoring program that adds provision for near real time verification of system operation and identification of anomalies. Such a system can also provide field data on actual spectrum utilization over time to serve as a basis for spectrum management.

For purposes of these comments, Appendix A presents an operational scenario of one approach to a monitoring system. We describe a monitoring system capable of providing both a monitoring capability that can generate an alert when certain circumstances arise and historical documentation of spectrum usage. Although there are many possible variations, this approach, which is presented as an example, permits consideration of a number of the attributes of such a system.

HYPRES proposes that the Commission support monitoring capability in the wireless system or other appropriate infrastructure to provide the data necessary for spectrum management, confirm compliance of stations to their certification, and provide security improved measures. HYPRES technology provides the speed, accuracy and resolution necessary to perform these functions in real time, and also improves the performance and lowers the cost of the infrastructure.

Interference Protection

The Task Force properly notes that as the radio spectrum becomes increasingly congested it is necessary to consider the implications of technological limits on radio operation, particularly with regard to control of interference between radio systems operating in the same area. Simply said, interference comes from sources that transmit signals. The measure of the detrimental effect of this interference is determined by the receiver. Like noise, the characteristic of the desired signal determines what is acceptable (in digital communications, it is the required Eb/No needed to provide an acceptable error rate). For noise dominated situations, it is the signal to noise ratio (S/N). For interference dominated situations, it is signal to interference (S/I).

Interference comes in two types. Type 1 interference is a result of the transmitting source "splattering" energy outside of its designated band and bandwidth. Type 2 interference is caused by transmitting source operating within its designated band and bandwidth, being propagated to a receiver operating in same frequency range, and its interfering signal being processed with the desired signals. (Signals arriving at the receiver that are outside of the receiver operating frequency range can be filtered out. For commercial base stations, the solutions for this issue are readily available today, from simple filters to high performance superconducting filters.)

As spectrum utilization increases, both types of interference increase, necessitating enhanced performance beyond the current standards.

On the transmit side, Type 1 interference is reduced with the use of spectrally pure carriers and ultra-linear power amplifiers at base stations. Spectrally pure carriers begin with multi-GHz clocks with clock jitter measured in sub-picoseconds. Fast digital circuits, using superconductor technology, enable digital pre-distortion on a multi-GHz RF waveform, greatly simplifying the algorithms and the complexity of signal processing over working at baseband. This performance enables a new linearization capability, a digital RF pre-distorter, with much greater linearity, bandwidth and efficiency than conventional baseband pre-distorter schemes and other approaches such as "feed forward" linearization.

Dealing with Type 2 interference involves cancellation of the interfering signals at the receivers, accomplished by digital processing and/or adaptive nulling antennas. Digital processing takes the form of successive interference cancellation and correlation based receivers. With regard to adaptive antenna nulling (versus large antennas with high levels of sectorization), since most systems are not power limited, it is better to reduce the I vs. increase the S in the quest for higher S/I, which allows the use of much smaller (and less expensive) antennas.

These benefits require digital processing capabilities that are not available with current or forecasted conventional technologies. However, software radios utilizing higher performance software architectures implemented on high-speed **Digital RF** platforms offer the potential to provide the needed capabilities.

Spectral Efficiency

The trend in commercial wireless is toward higher data rates to support applications based on data access and visual interfaces. Higher data rates require more bandwidth, which further exacerbates the spectrum issues.

Efficiency here is taken to mean actual realization of bits per unit area per unit time (e.g. bits per second per km^2) or equivalent measure. The solution is more bits/sec/hertz, which requires modulations using higher order constellations. Those modulation techniques require stronger S/N and/or S/I, over 20 dB more than voice for the higher rates.

In noise limited situations, HYPRES technology can very cost-effectively increase the “S” and reduce the “N”. Superconducting analog-to-digital converters (ADCs) can directly convert the RF signals to baseband (**Digital RF**), which enables the true (all digital) software radio. HYPRES **Digital RF** ADCs have no noise contribution, and are orders of magnitude better in sensitivity than conventional RF front-ends.

In interference limited situations, HYPRES technology can optimally increase the “S”, but more significantly, reduce the “I” in a very cost-effective manner, as described earlier in dealing with Type 2 interference. Further, these enhancements are applicable in both the forward (transmit) and reverse (receive) links

Further information is provided in Appendix B, where we describe a view of different perspectives on spectrum use.

Bandwidth on Demand

The ultimate solution to spectrum availability is bandwidth allocation on demand. Today, some segments of the frequency spectrum are substantially underutilized, while others are capacity limited. Part of this imbalance is historical. Some services in the past were given dedicated allocations of spectrum, and have installed systems based on exclusive use of specific spectrum. The result has been not only low use of major portions of spectrum, but also an inability of many services to communicate with each other. Operating procedures based on the inflexible capabilities of crystal-based channelization are also part of the history in many services.

Another factor impacting the divergence of utilization is economic. Wireless PCS operators have a strong incentive to maximize return on their allocated channels by improving spectral efficiency. On the other hand, many of the holders of lightly utilized channels operate without economic incentive to improve efficiency. As their primary need is for a high priority on response time, they demonstrate low spectral efficiency.

An economic approach would place a value on spectrum. Users operating under these guidelines would then pay for their actual utilization on the basis of spectrum consumed and their priority. With the correct technology, reservation of dedicated spectrum for low usage services would not be necessary. The advantage to them would be an ability to preempt vastly greater bandwidth than could ever be dedicated to their needs.

The Commission has a major role to play in improving overall spectral efficiency. It has the policy and rule making power to change entrenched attitudes based on the legacy of obsolescent system technology. The challenge is to present the picture in such a way as to make it attractive from a political and economic perspective.

Bandwidth on demand as a form of spectrum sharing may not be fully achievable considering all of the constraints. However, any migration in this direction will certainly help. HYPRES next generation technologies, in conjunction with software radios, offer the potential to enable spectrum sharing on a near real time basis.

Conclusion

We have cited a number of approaches to better managing spectrum by introducing performance improvements based on new technological developments. Those enhancements also provide significant economic and performance benefits that accrue to the operators, suppliers and users. We urge the Commission to take steps to expedite introduction of these capabilities and the policies that they make viable. We also recommend that operators and service providers be given incentives by the FCC to employ next generation technologies that have the potential of materially affecting these critical issues and garner the benefits accrued to all of the stakeholders

Respectfully submitted,

Jack Rosa
CEO and President
Vice Chairman, Board Of Directors
HYPRES, Inc. **July 5, 2002**

APPENDIX A

Spectrum Monitoring

Spectrum monitoring has a potential to improve understanding of how spectrum is being utilized, and to improve security by alerting the proper authorities when rule violations are occurring.

Monitoring Proposal

We describe a monitoring system capable of providing both a historical documentation of spectrum usage and a monitoring capability that can generate an alert when certain circumstances arise. HYPRES proposes that the FCC consider implementation monitoring capability in the wireless system or other appropriate infrastructure to provide the data necessary for spectrum management, confirm compliance of stations to their certification, and provide security improved measures. HYPRES' technology provides the speed, accuracy, and resolution necessary to perform these functions in real time, and also improves the performance and lowers the cost of the infrastructure. Although there are many possible variations, this approach permits consideration of a number of the attributes of such a system.

A SPECTRUM MONITORING SCENARIO

The city of Anytown, USA has 31 PCS base stations, operated by three service providers. Two of those operators have applied to provide State of the Spectrum (SOS) service from 18 of those sites. SOS is a service offering that monitors ambient spectrum usage, developing usage data and reporting anomalies.

Each of the SOS-equipped sites has radio equipment with a very sensitive RF front end and software defined radio (SDR) capability. These sites perform a number of monitoring services in the background of performing normal PCS. Some of those services are under contract the US Government while others are part of the service providers internal security program.

In order to implement SOS, every emitter operating under FCC license is assigned a 128-bit IPV6 Internet address. The organization holding the license under which that emitter operates is responsible for responding to IP traffic sent to that address. Content addressable central directories of service, spectrum authorization, IP address, and geographical location are available with an Internet connection. SOS sites receiving a signal can send a message to the IP address of an emitter, obtained from their data base of identified local systems or a central site. The content of the message contains, at minimum, the time and frequency on which the transmission was received, and indication as to whether a response is requested. Other signal characteristics are defined and may also be sent. Two protocols are defined for a response. The static protocol acknowledges with ACK, that the transmitter associated with that channel does transmit on the specified frequency, or NAK, that it does not. Emitter location information is also returned. The dynamic response indicates that, at the precise time specified in the message the designated transmitter was radiating. The dynamic response involves local buffering of transmit times to permit response to a delayed inquiry of up to 24 hours.

1. Baseline State of the Spectrum (BSOS)

Establishing the BSOS involves each SOS monitoring the received spectrum from 106 MHz to 2.9 GHz (or segments as desired or needed) for some period (<30 days) to built a data base of normal RF activity at that location. The BSOS is a one-time activity to develop a baseline database, so the spectrum can be monitored in a series of steps, where a convenient bandwidth is monitored for a short time. The result is a repeated sweep of the entire bandwidth adequate to develop a statistically significant pattern of the ambient RF environment.

This search for signals is conducted to the extent of processor time available after servicing normal system traffic. When an emission pattern is identified as statistically significant, an Internet message is sent to the central site where the emitter database is located. The central site returns the IP address associated with relevant emission patterns at that geographic location.

The intent of the baseline period is to identify as many local emitters as possible, and to build a local baseline database of local spectral use. Statistical data is also maintained to indicate the fraction of the time when the channel was seen to be active. That indication would vary from 1.00 for a full-time broadcast station to 0.00 for an emergency channel that was allocated, but never used during the baseline period.

This process "introduces" all of the regular communication services in Anytown to all of the SOS monitoring basestations, and, when the individual databases are merged, provides an RF map of the area.

2. Current State of the Spectrum (CSOS)

After the baseline is built, routine spectrum scanning is conducted on a regular basis. Each monitoring station camps on a specific frequency band range for a defined period to analyze the activity there. If a known emitter is active, the analysis looks for interfering signals.

Two types of monitoring are performed. One is the *activity monitor*, using a scanning algorithm coordinated so that each of the 18 active monitors is looking at a different band at any point in time. Signals not conforming to the pattern developed in the BSOS are flagged for further investigation.

Emissions found from CSOS scan are also recorded, and used to maintain the baseline scan in the case of new services being introduced in the area, such as a new base station or broadcaster coming on the air. Other emissions may be classified as noise, or identified as suspicious and reported for further investigation.

This is a scan that uses known local traffic patterns to identify CSOS anomalies in the area. Using statistical sampling techniques, it looks for high levels of usage on normally low utilization channels or sudden activity where there are no known emitters. Such activity can be an early indicator of an emergency or other activity that warrants attention.

The other type of monitoring is the *designated service monitor*, applied to specific bands where known services are operating. The characteristics of that service determine the details of the scan and what specific characteristics are reported. For example, interfering emitters might be identified in one specialized search pattern, while stations transmitting with excessive power are identified in another.

Any service active in the area can have a monitoring program tailored to its needs, such as system security. One PCS attack is a perpetrator who imitates the network to attract user telephones in an attempt to initiate a fraudulent connection. Legitimate base station sites in the vicinity can detect transmissions from the illegal one, and initiate a warning. Similarly, unauthorized rogue terminals may attempt to gain access, and can be detected. The features of these dedicated systems are specific to the security and monitoring needs of the service, but implemented in ways similar to the SOS monitors.

3. SIGNALS OF INTEREST

There are a number of circumstances where a law-enforcement, regulatory, or government authority wants to know if a specific type of emitter becomes active. With an SOS network in place, a signal description can be sent to all of the active stations, and a continuing watch posted. If that emitter is detected, an Internet message is immediately sent to the originator of the request who takes appropriate action.

One of the key applications of HYPRES technology is improved analog-to-digital converter (ADC) performance. Receivers implemented with this technology are able to use digital signal processing techniques to monitor signals of interest as a byproduct of their primary function as a receiver in a standard service. HYPRES technology features uniquely wide bandwidths, and uniquely high sensitivity and speed. Further, because of these attributes, the use of simple and inexpensive ancillary equipments are allowed, such as broadband omni antennas for the monitoring functions. HYPRES is submitting these suggestions to suggest how the application of such technology to the function of spectrum monitoring can provide empirical data to support detailed assessment of the actual state of spectrum usage. The result is a data base that reflects both the CSOS and historical data suitable for statistical analysis.

APPENDIX B

Spectrum Perspectives

The radio frequency (RF) communications over the air interface give wireless systems their major advantage, mobile voice and data communications without a wired connection. The popularity of mobile communications has led to substantial increased demand for spectrum. That demand has, in turn, increased market, legislative, and political pressures to revise the basis for allocation of spectrum, particularly to services whose operation is not efficient in its use of available spectrum. Efficiency is actual realization of bits per unit area per unit time (e.g. bits per second per km^2) or equivalent measure.

There are differing major perspectives on spectrum utilization, held by market participants whose different interests cause them to have differing concerns. These concerns lead them to emphasize different aspects of how the spectrum is used. We describe three such perspectives below, and indicate how

REGULATORS

RF spectrum is a shared and scarce resource. Regulators are concerned with mechanisms for selection of applicants for spectrum use, technical specification of regulations for spectrum use, and confirmation of conformant use of allocated spectrum by users.

Mechanisms for licensee acceptance and spectrum allocation are subject to change with evolving market demand, new technology, and political consideration of achieving the common good. Recent developments have also raised the level of concern about security issues associated with radio operation.

Operational conformance involves transmission only on designated frequencies within an approved envelope of radiated power levels. Different services have varying means of verifying conformance. In mobile communications certification of terminal equipment is the primary control on user terminals. Base stations are routinely field tested.

HYPRES **Digital RF** technology offers a step function in performance, particularly for base stations, that can serve as a tool for regulatory oversight of how spectrum is actually used, and a means to identify violators.

Licensees

Licensees have two primary considerations in the operation of radio equipment and any needed supporting infrastructure. One is the service provided to the user community and the other is their economic model. These parameters interact in different ways in different services.

Public safety systems are typically operated by local government organizations or their contractors to support local operations. Their primary objective is efficient execution of the service provided. Although the cost of operation is considered a normal part of tax-funded services, they strive to keep costs low. One approach to optimizing their requirements is to put spectrum on a paid basis. In the event of an emergency they would have priority access to large amounts of spectrum, configured to meet the demands of the occasion, including interoperation with other agencies not normally needed. In other times they would have a low cost level on the basis of low actual usage.

Personal communications service network operators have profitable operation as a primary objective, and tailor their service offerings to increase revenues and optimize profit. They use sophisticated technology to deploy geographically dispersed systems that maintain high spectral efficiency by localizing transmissions and minimizing transmitted power. Network operators are also intensely interested in detecting anyone attempting to access services without paying, or by stealing the identity of a legitimate customer.

Licensees in other services have varying motivations, but each must balance economic viability against service issues. But in every case, the licensee has a vested interest in rapid identification of interfering emitters, and eliminating the source of interference.

In some services, the licensee may be motivated to push or exceed the constraints imposed by license conditions. Self-regulation by licensees is now the rule, but just as police radar units mitigate highway speed, knowledge that the local spectrum is monitored is a strong incentive to be diligent in operating properly.

HYPRES technology has a dual role in meeting the needs of licensees. One is improving the spectral efficiency achieved by installed radio systems, allowing more communication capability in a given bandwidth. The other is an improved ability to detect and reject attempts to penetrate the system and to reduce non-revenue traffic.

USERS

Users are individuals and organizations that purchase communication services, usually as a commodity, without needing detailed knowledge of how the service is provided. Users want good system performance, privacy of information, and freedom from theft of identity. Some users place a great deal of importance in priority access to communications, and will pay for the right to preempt lower priority subscribers.

Users desires may be in conflict with other participant's interests. For example, a desire for high performance may lead a user to attempt to operate at higher power levels than the minimum necessary by installing rogue software in a terminal. The monitored environment can provide information to deter such inappropriate terminal behavior.

Identity theft may be attempted by a perpetrator imitating a base station, and enticing a user terminal to camp there. Doing so involves transmitting pilot channel information, and can be detected as a spectral anomaly in a monitored environment.

HYPRES technology supports these needs by providing improved system performance, and by improving overall system robustness in the face of attempts to compromise user privacy.

APPENDIX C

HYPRES Technology

HYPRES has demonstrated a superconductor technology that is fundamental to the performance requirements needed to implement the suggested operations, and also provides a number of operational benefits to system operators. HYPRES technology is able to produce the following:

Simultaneous wideband and high-fidelity digitization — Capability of producing 14 to 24 effective (true) bits with 100 to 160 dB Spur Free Dynamic Range (SFDR) over the 100 kHz to 2 GHz range (a 20,000 to 1 bandwidth).

Ultra-high Analog to Digital Converter (ADC) resolution — Capability of producing over 20 effective (true) bits with an SFDR exceeding 130 dB for 3G/4G bandwidths (60 to 100 MHz) at > 2 GHz level carrier frequencies.

Extremely Low-noise, High-sensitivity, and ultra low Bit Error Rate (BER)— Noise-free **Digital RF** front-ends (<< 1^{o} K noise temperature) with sensitivities 30 to 50 dB better (for any bandwidth) than conventional technologies, and Bit Error Rates (BER) less than 10^{-15}.

Spectrally-pure carriers –HYPRES high stability multi-GHz clocks coupled with our inherently-perfect Digital to Analog Converters (DAC) provide spectrally-pure GHz-frequency carriers for transmission via a single or multiple high-power amplifiers (HPA).

Ultra-Linearized Single HPA – Capability to directly synthesize digitally pre-distorted wideband waveforms for transmission, enabling multi-carrier operation via a single HPA, simultaneously optimizing in-band performance and minimizing out-of-band spurious effects far beyond current (or forecasted) technologies can achieve. This also represents a significant reduction in initial and operating cost, due to much higher HPA efficiencies.

Low-power Tera-OPS DSP – Execution of Digital Signal Processing operations at clock speeds greater than 100 GHz, including picosecond RAM/ROM access operations and programmable digital filtering, while dissipating only 1 mW/chip.

Extreme flexibility for monitoring the signal environment — With the ability to examine portions of spectrum defined by software directives, the infrastructure is capable of detecting the spectral footprint of in-band and out-of-band emitters, identifying inappropriate transmissions and providing real-time notification of violations.

Ultra-high Reliability & Durability – Similarly packaged products currently deployed in wireless communication base stations have exhibited up-times in excess of 99.997%.

Compatibility with Existing Systems – Although revolutionary in operation, HYPRES **Digital RF** products can occupy existing 19 in. racks (or other configurations) and interface to any standard bus configuration at a maximum speed limited only by bus performance.

"The technology is so accurate, it defines the volt;
and so sensitive, it can measure brain currents"

HYPRES technology offers many benefits to users in a variety of application areas. The following benefits accrue to operators of wireless networks and the FCC:

Lower Capitalization per Base Station – One digital radio performs the tasks of many conventional protocol-and frequency-specific base station radios. For example, the critical communication equipment is reduced by about 90% to about 10% of a traditional GSM base station. A single universal platform can be configured dynamically and/or periodically (in the factory or in the field) to suit many different services, independent of communication bandwidth or standard. This versatility significantly reduces the cost of base stations and the infrastructure provider's spares inventory needed to accommodate multiple protocols.

Reduced Infrastructure Capital Expenditures – HYPRES technology significantly expands base station range coverage, enabling a significant reduction of the total number of base-station sites required, thereby reducing total network capitalization by an order of magnitude. Our technology enables wideband 3G performance with 2G base station ranges.

Reduced Operating Expenses – Fewer base stations translates into fewer (costly) connected landlines and less power consumed. Less power consumed per base station is a significant further reduction. High reliability and nearly maintenance free operation further reduces operating cost. Resistance to surges and lightning strike effects means far less repair cost.

Enhanced Revenues and Margins – Because of the higher receiver sensitivity, resolution, and processing speed enabled by the HYPRES technology, more traffic for a given bandwidth allocation is possible, allowing additional users and/or services to be added at will, without upgrading the infrastructure. Our superior interference rejection results in higher call quality, few dropped calls, and, in turn, increased customer usage.

Boost Spectral Efficiency – Current state-of-the-art wireless systems only provide 0.5 to 0.8 bits/sec/Hz, in terms of their ability to exploit (i.e. generate revenue from) an allocated bandwidth. In contrast, the HYPRES approach can provide more than 8 bits/sec/Hz, a 10-fold improvement, vastly accelerating the return on investment for costly spectrum licenses.

Adaptability – Because the HYPRES technology enables universal interoperability among legacy, current, and future wireless protocols, it enables an agile business model that can quickly adapt to meet changing market environments and rapidly accommodate new initiatives (such as spectrum sharing, etc). Our platforms will accommodate generations of software upgrades and changes.

Extended Mobile Battery Life -- HYPRES base station products significantly extend the life of the battery of the mobile terminals**.** Transmit function consumes most of the power in a mobile terminal. The ultra high performance enabled by the HYPRES base station technology enables adequate link margin at a lower level of transmit power from the mobile units.

These performance characteristics permit the location of the ADC to a position adjacent to the antenna for reception and the corresponding DAC adjacent to the PA for transmission. This enables the next generation of true Software Defined Radio (SDR) technology throughout the base station, and facilitates development of near real-time frequency agile performance.[1] HYPRES technology totally supports the objectives of the commission[2]

HYPRES technology is an advanced superconductor technology, where electrical current flows indefinitely and fundamental performance characteristics are derived from quantum principles. Digital logic building blocks using this technology provide digital circuits with much higher performance than can be achieved with semiconductor circuits. The first ADC produced by HYPRES, using relatively crude 3-micron lithography technology, outperformed the best semiconductor ADCs in every aspect.

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[1] FCC 00-41, Policy Statement In the matter of Principles for Promoting the Efficient Use of Spectrum by Encouraging the Development of Secondary Markets, Adopted November 9, 2000 (hereafter 'PS'), Par. 35, 36.

[2] FCC 00-401, WT Docket No. 00-230, Notice of Proposed Rulemaking in the same matter, Adopted November 9, 2000 (hereafter 'NPRM'), Par. 3,4

Superconducting technology has already been embraced by the wireless community, demonstrating excellent performance characteristics and outstanding reliability. Many prominent participants believe that this technology is essential to widespread use of SDR.

HYPRES technology brings the power of digital processing to the RF domain.