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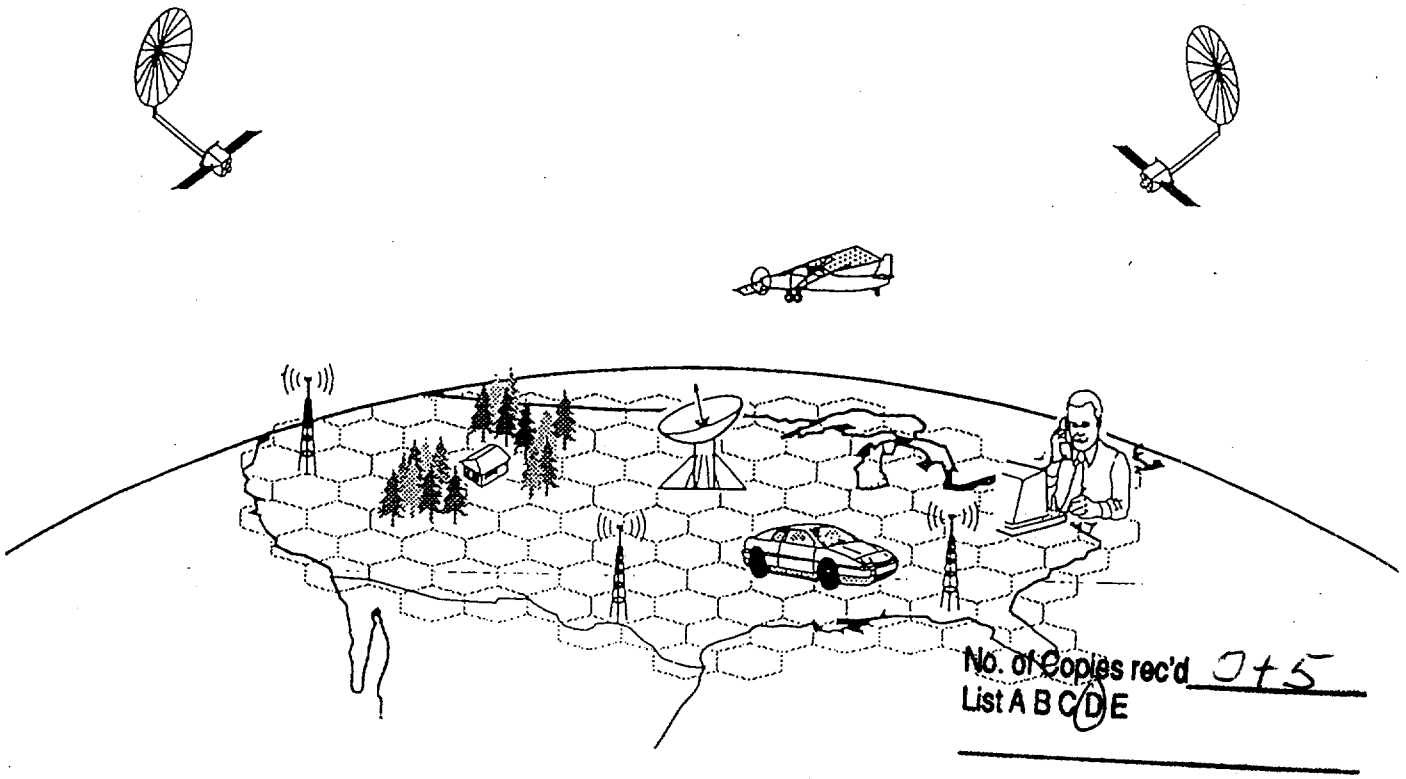
BEFORE THE

Federal Communications Commission

In the Matter of AMENDMENT OF PARTS 2, 22 & 25 OF THE COMMISSION'S RULES for an Allocation of Frequencies and Other Rules for a New Nationwide Hybrid Space/Ground Cellular Network for Personal/Mobile Communications Services	__ Docket No. ____ RM NO. _____

PETITION FOR RULEMAKING

CELSAT



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The hybrid personal communications network concept described in this petition is larger and more comprehensive than any single radio-based personal communications system or service proposal ever before considered by the Commission. In terms of potential subscribers, an HPCN such as proposed by CELSAT is potentially as large or larger than the existing analog wireline and non-wireline cellular industry systems combined, plus all the proposed MSS/RDSS satellite systems, all operated together as one huge domestic space/ground radio communications network. As such, its capacity and potential not only to serve subscribers but also to revitalize American industry and leadership in the production and supply of wireless devices and supporting network infrastructure subsystems and space components is equally enormous.

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BEFORE THE

Federal Communications Commission

In the Matter of	)
AMENDMENT OF PART 25 OF THE COMMISSION'S RULES	)
for an Allocation of Frequencies and Other Rules for a New Nationwide Hybrid Space/Ground Cellular Network for Personal/Mobile Communications Services	)

PETITION FOR RULEMAKING

SUMMARY

CELSAT, INC., a California corporation based at 3033 Science Park Road, San Diego, California 92121, by its attorney, hereby requests the Commission to initiate a rulemaking to support a new class of mobile telephone service which affords a quantitative and qualitatively new standard of service to the mobile communications user. This generic concept is referred to herein as a *Hybrid Personal Communications Network* ("HPCN"). The Commission is further asked to allocate at least one band pair of either 37 or 32 MHz in either the S-Band or L/S-Band, respectively, on an exclusive, primary basis for an HPCN and associated personal/mobile, voice, data, video and position determination services.

CELSAT's **CELSTAR** system, for which application is being made contemporaneously, is, to **CELSAT**'s knowledge, the first instance of such an HPCN -- a pioneering example of the feasibility

of the HPCN concept. **CELSTAR** is a truly integrated space/ground cellular network system, designed from the ground up to take maximum advantage of the very flexible and powerful service opportunities uniquely afforded by HPCN.

As shown below, HPCN is in the public interest because:

- **It extends the proven benefits of ground cellular service to a vast new population not presently served;**

- **It provides dynamic reallocation of service capacity, in space and time, between the various satellite and ground service elements;**

- **Such dynamic reallocation capability provides a new responsiveness to local or national emergencies;**

- **It maximizes the reuse of the satellite spectrum over the U.S. (more than 100 times), and is extraordinarily spectrum efficient (up to 1900 VG space circuits/MHz);**

- **It promises the greatest variety of personal/mobile services at the lowest price (less than 25¢/min. per VG circuit) to the largest number of users (10-30 million subscribers);**

- **It's geosynchronous satellite will provide continuous, uninterrupted and ubiquitous coverage over the entire U.S., Alaska, Hawaii, and Puerto Rico/Virgin Islands, total redundancy over CONUS, and can be deployed quickly;**

- **It will generate new jobs and commercially viable market opportunities for many different suppliers of devices and various supporting infrastructure systems and components, and a new level of wireless competition;**

- **It will support wideband synchronous and asynchronous data, multimedia and compressed video, and other "intelligent" services and features at variable bandwidth on demand, up to 144 kbps; and**

- **It offers the only seamless, nationwide, intelligent space/ground wireless network for "one number" personal/mobile voice, data, position determination and other information services.**

* * * * *

I. INTRODUCTION

CELSAT, Inc. was formed, for among other purposes, to develop certain principal resources -- (1) a wealth of technical expertise in the planning, design, system engineering, and system testing of large scale aerospace systems and associated launch services; (2) a design for the essential CDMA elements which make it possible to reuse a single spectrum block in a super high capacity hybrid space/ground cellular-like telecommunications network; and (3) certain related patent rights. CELSAT desires to construct and operate an innovative and extremely spectrally efficient *Hybrid Personal Communications Network* which combines the best of mobile satellite and ground-based cellular and other wireless technologies and capabilities. The system which **CELSAT** proposes will:

- Achieve a new standard of spectral utilization and efficiency -- over 55,000 voice circuits serving the U.S. in the first generation space subsystem alone; ultimately, about 700,000 additional ground-cell circuits. This space-only capacity exceeds competing systems by an order of magnitude, and by two orders of magnitude if the ground capacity is included.

- Require only a single, very light-weight (4-7 oz), minimum battery power transceivers (0.1 W avg.) in either satellite of ground mode, thereby ensuring long battery life and relatively low cost.

- Utilize a large, high gain antenna to provide the smallest possible, multibeam footprints.

- Utilize fixed position, geosynchronous orbits to ensure stable, low cost and predictable coverage, integratable with ground elements.

- Utilize the emerging CDMA ground cellular standard.

This powerful technology and concept and the services which it will bring are so novel and innovative that they are not

specifically accommodated by any existing spectrum allocation or elsewhere in the Commission's rules. **CELSAT** has identified at least two spectrum bands which could accommodate a HPCN very efficiently. One at S-Band consists of 37 MHz of the 80 MHz which the Commission has recently recommended for generic mobile satellite services (MSS) at the WARC 92 conference;[1] the other is 32 MHz of the L/S-Bands currently allocated for domestic RDSS services.[2] Of the options, **CELSAT** submits that an HPCN would be slightly more spectrally efficient in the RDSS L/S-Band (1,903 VG space circuits/MHz). However, to the extent that it might be interpreted that **CELSAT** is precluded by the June 3, 1991 cut-off date for new applications requesting use of this spectrum[3] **CELSAT** is hereby both petitioning for a new rulemaking for an allocation in the S-Band of 2.1 to 2.4 GHz while requesting, in the alternative, that the Commission re-open the cut-off date for new applications in the RDSS L/S-Band and include the rule proposal

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[1] See, *An Inquiry Relating To Preparation for the International Telecommunications Union World Administrative Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum*, Gen. Docket 89-554, 6 FCC Rcd. 3900, released June 20, 1991.

[2] A HPCN system could also be operated in at least part of the 220 MHz between 1.85 GHz and 2.2 GHZ recently recommended for reallocation to new services, such as PCN. See, FCC News Release, January 16, 1992, ET. Docket No.92-9.

[3] See, FCC Public Notice, DA 91-407, Report No. DA-1068. **CELSAT** does not, however, believe that the cut-off notice precludes consideration of either this petition or of its **CELSTAR** application.

herein among the others under consideration in the context of that spectrum re-allocation.[4]

II. A HYBRID PERSONAL COMMUNICATIONS NETWORK IS NEEDED TO MEET GROWING MARKETS FOR MOBILE SATELLITE AND GROUND CELLULAR/WAN/PCN COMMUNICATIONS SYSTEMS AND SERVICES

The HPCN concept offers a technically and economically feasible solution to many application and end user requirements for wireless personal/mobile communications which are presently either grossly under served, served only at a very expensive price, cannot be totally served by one licensee/provider, or for which, without HPCN, stand no chance of being met.

A. There Exists Both Unmet Needs and Enormous Public Demand for Low Cost, Wireless Personal Communications

CELSAT's HPCN proposal and its **CELSTAR** design have been inspired by both the successes and the shortcomings of popular contemporary wireless technologies, including conventional mobile satellite and cellular telephone, and the emerging personal communications and wide area data networks ("PCNs" and "WANs"). HPCN offers a practical solution to the conflicting problems of spectrum shortages and escalating demand for low cost, wireless personal/mobile communications; it might offer the only technically

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[4] See, Petitions for Rulemaking, American Mobile Satellite Corporation, Constellation Communications, Inc., Ellipsat, TRW, Inc., RM-7806 -7771, -7773, and -7805 respectively.

feasible solution to the emerging needs for wireless high speed data and multimedia applications.[5]

The continuing and seemingly unsatisfiable demand for conventional cellular services, alone, is indisputable -- the need for more and improved personal, portable and mobile cellular services is growing, with no end in sight in many markets.[6] As the many applications for mixed-use and even single purpose RDSS, voice and data mobile satellite services unanimously attest, there exists a similarly undisputed, demand for even basic mobile voice and RDSS services in certain applications for which satellite technology offers the only satisfactory solution.[7]

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[5] See, "REPORT OF THE BELL COMPANIES ON COMPETITION IN WIRELESS TELECOMMUNICATIONS SERVICES, 1991", filed in *United States v. Western Electric Co., Inc. et al.*, Civ. Action No. 82-0192 (MFJ Proceeding), October 31, 1991 (hereafter "Bell Report").

[6] Id.; also, "State of the Cellular Industry", Cellular Industry Telephone Association (CTIA), August, 1991; and *Amendment of the Commission's rules to Establish New Personal Communications Services*, Gen. Docket No. 90-314, *Policy Statement and Order*, released October 25, 1991, 6 FCC Rcd. 6601.

[7] See,e.g., pending satellite applications of Motorola Satellite Communications, Inc., File No. 9-DSS-P-91(87), CSS-91-010; Ellipsat Corporation, File No. 9-DSS-P-91(87), CSS-91010; AMSC Subsidiary Corporation, File No.'s 1625/1626 DSS P/L-85, et al., Amended DSS-MP/ML-91(2); and also the MSS/RDSS applications of Constellation Communications, Inc., Loral Cellular Systems, Corp., and TRW, Inc. See, also, In the Matter of Amendment of Section 2,106 of the Commissions Rules to Allocate Spectrum to the Fixed Satellite Service and the Mobile Satellite Service for Low Earth Orbit Satellites, RM 7334,-7399, and -7612. The Commission has recently expressed a policy favoring PCN personal wireless development, Notice of Proposed Rule Making, ET Docket No. 91-280 (FCC 91-305) released October 18, 1991, 6 FCC Rcd. 5932. It's agenda continues to be ladened with yet other new proposals for wireless information transfer. See, e.g., Petition of Video/Phone System, Inc., for 1000 MHz for video, voice and data services, Telecommunications Reports, Vol. 58, No. 3, pp. 19-20, January 20, 1992; Petition For Rulemaking, Suite 12 Group, for a reallocation in the 28 GHz band for Multichannel Local Distribution Service filed September 24, 1991; Petition For Rulemaking, "Data-PCS", RM-7618, Apple Computer; and Petition For Rulemaking, Now Nationwide Wireless Network Service, Mobile Telecommunications Technologies, Corporation (MTEL), filed November 12, 1991.

As for the shortcomings, each planned or existing wireless personal/mobile system and/or technology has one or other major disadvantage. For example, both the proposed mixed-use MSS/RDSS mobile satellite systems and existing ground cellular telephone systems fall far short of the capacity needed to satisfy even existing demand, let alone the more contemporary requirements anticipated for later this decade and on into the early 21st century. Current wireless transmission and/or multiplexing schemes either permit only packet-type data transfer, or otherwise lack the continuity necessary for high speed transactions. None of the emerging ground-based technologies offers ubiquitous coverage; conventional cellular cannot offer privacy; satellite-based paging cannot offer voice communications or significant other information delivery; neither cellular nor PCN offers position determination; initial PCN systems will only originate communications and cellular subscribers cannot automatically receive communications while outside their home system area; both MSS and ground cellular systems are expensive to use; neither conventional cellular nor MSS can reliably transmit asynchronous data or data at bit rates above 9600 bps; and ground cellular suffers from frequently dropped and blocked calls, and noise interference. These are among the most significant problems -- all of which can be cured with HPCN.

Finally, while spread spectrum code division multiple access (SS CDMA or "CDMA") technology would bring substantial relief to cellular's privacy and capacity problems, the cellular industry has yet to recover its investment in analog systems and is therefore not anxious to change. Those systems facing capacity shortages will not wait for the newer CDMA technology. Meanwhile,

the only fully endorsed industry digital standard is TDMA.[8] There is still a significant probability that the industry ultimately will split its system conversions between TDMA, CDMA and yet other alternatives including NAMPS. As a result, at worst, CDMA might be passed over as the cellular technology of choice; at best, it will be adopted in only a fraction of the nation's cellular systems resulting in either a high degree of incompatibility or the need for expensive dual mode transceivers.

Several of the proposed mobile satellite service applications, on the other hand, plan to use CDMA, but their respective system designs lack sufficient capacity to achieve maximum cost effectiveness in terms of their ability potentially to reduce the cost of handsets and supporting infrastructure components.[9] While deployment of CDMA in PCN networks could possibly ensure a role for CDMA technology, the capital intensiveness required to achieve satisfactory coverage in stand-alone PCN systems leaves its economic viability yet to be proven.

Together, these trends and developments substantiate **CELSAT**'s position that many present and near future personal/mobile services and market applications -- many of which, either for lack

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[8] See, CTIA "Cellular Industry Report", Vol. 7, No. 12, p. 2, December, 1991.

[9] It has been projected that the price of other CDMA-based and similar handheld and other portable special purpose transceiver devices for alternative proposed systems will range of between $1,200 - $3,500. In contrast, **CELSAT**'s tremendous capacity and subscriber base will permit very large volume production of basic and special-purpose user devices which should bring terminal costs down to well under $500 per basic unit. To the extent that existing cellular systems convert to CDMA and thereafter require CDMA-compatible terminals there is no reason to believe that cellular customer handsets will cost any less than those for HPCN -- in effect, cellular customers will pay just as much for a device that gives them less service.

of coverage, capacity, or functionality, cannot be served at all by existing or proposed alternative systems -- could be served very efficiently by one super high capacity, *hybrid* space/ground CDMA-based digital telecommunications network capable of a broad range of data rates and functions. **CELSAT** has designed such a system, and hopes to be authorized by this Commission to construct and operate it.

B. An HPCN Satellite System Will Offer Huge Capacity For Seamless Personal/Mobile Wireless Communications

Using the 37 MHz proposed in S-Band, **CELSAT** can demonstrate that an HPCN operated in just the space-only mode can attain up to 56,000 space-based VG circuits, all over the United States; with only 32 MHz from the requested L/S-Band it can attain 60,900 U.S. circuits.

However, the HPCN is not intended to be operated in a space-only mode. HPCN spectral subband capacity can and should be flexibly and dynamically apportioned between space and terrestrial operating modes, depending on demand, quality, grade of service desired, and geographic location. If, as anticipated in **CELSAT**'s application, about 7% of the total HPCN subband capacity were used terrestrially it would allow for up to 700,000 additional ground-based VG circuits. The satellite or space-cell capacity, on the other hand, would be reduced just slightly, to nominally 55,000 VG circuits.[10]

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[10] This number assumes an S-Band allocation of 37 MHz. The number of available satellite channels would be correspondingly higher under the proposed L/S-Band request.

The *hybrid* or HPCN communications concept utilizes both mobile satellite and ground cellular technologies. It promises the widest array of seamless, nationwide voice, data, position determination, compressed video and other imaging capabilities possibly attainable from one single service network. What is important is that HPCN has the capacity to make these new services commercially viable and widely available and will, thereby stimulate U.S. opportunities in the emerging worldwide industry of personal/mobile *information* communications.

As shown schematically in **FIGURE 1**, HPCN reuses the same frequency spectrum in a configuration of overlapping space-cells and ground-cells. The "tightness" and directionality of the space-cells ensures 100% ubiquitous geographic coverage with very high end-user capacity. The ground-cells, which are confined by the space-cell beam coverage, allow for even much higher capacity in the same geographic area. Using the same handset or other portable/mobile device, and without switching from one mode to another, an end user can initiate or receive a call to or from any destination using either a space-cell or, where available, a ground-cell channel.[11] Similarly, the user can move readily between ground-cells, between space-cells, or from ground-cell channels to

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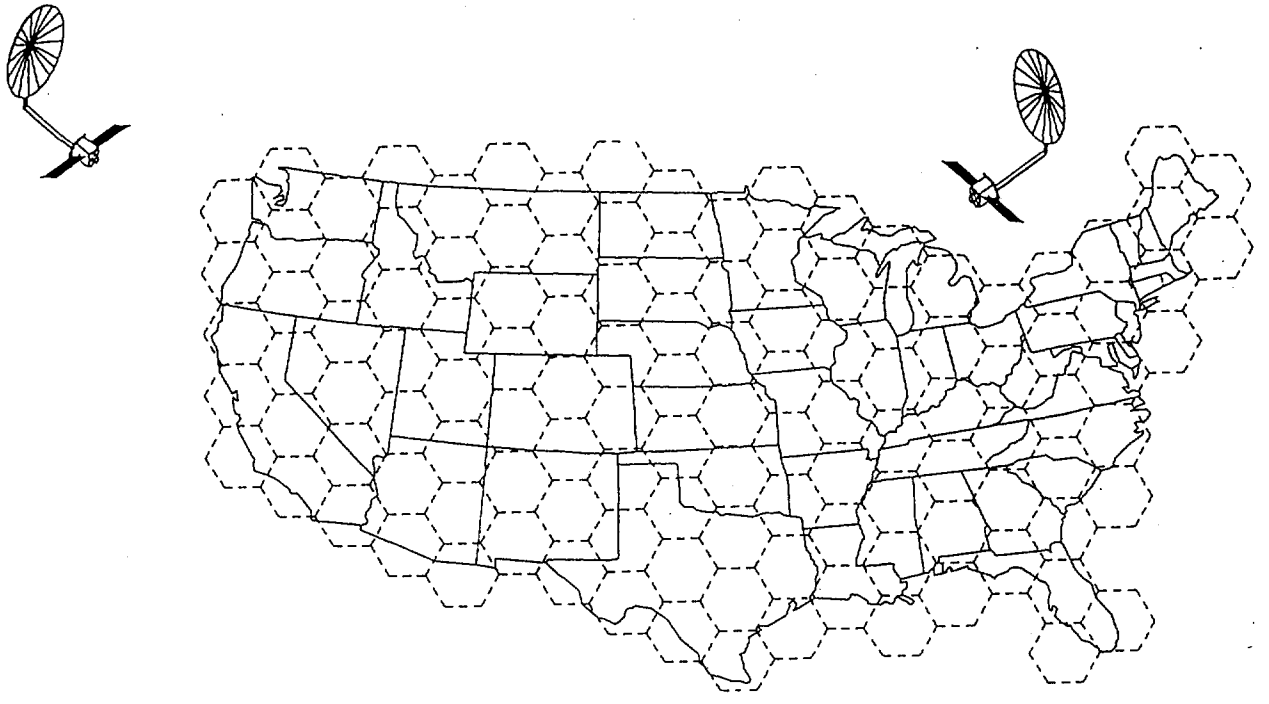
[11] It has been recently announced that both AMSC and Motorola are proposing that the terminal devices to be used with their respective proposed MSS systems will be able to operate in a dual mode (using a mode switch) so as to communicate with either their respective satellite services or a compatible ground cellular service. Other applicants, including TRW and Ellipsat, have also indicated a potential compatibility with ground-based CDMA services using dual mode devices. It should be understood that what CELSAT is proposing is <u>not</u> a system requiring a "dual mode" device but one system in which the device operates automatically with either space- or ground-cells. HPCN devices will be operated under the influence of a network controller and will use the same frequency band for both space- and ground-cell use. With HPCN, dual mode switches and circuitry will not be necessary. But it will be possible, if desired, to make HPCN devices also compatible with other CDMA-based wireless systems using a dual mode operation.

space-cell channels (and vice-versa) and be "handed off" from one to the other with no perceptible interruption in signal. HPCN thereby overcomes several of the significant disadvantages of existing ground-based cellular and other mobile systems.



HPCN SPACE-CELL OR "FOOT PRINT"
CONFIGURATION USING LARGE ANTENNA

FIGURE 1

III. THE HYBRID PERSONAL COMMUNICATIONS SPACE/GROUND NETWORK ("HPCN") DESIGN PROMISES TWENTY FIRST CENTURY WIRELESS COMMUNICATIONS USING PROVEN TWENTIETH CENTURY SYSTEMS AND TECHNOLOGY

The *system architecture* necessary to achieve HPCN's performance *is unique* and, to **CELSAT**'s knowledge, has never been previously proposed. This configuration of high technology elements, currently available only in the United States and first

recognized by **CELSAT**, results in superior performance, seamless communications, low cost and other functional capabilities heretofore not attainable. Other configurations might be feasible, but **CELSAT** has no knowledge of any that would be as well suited to a super high capacity HPCN.

A. Components of An HPCN System

The key elements to a working HPCN system include the combination of: (1) a large, unfurlable high gain antenna (i.e., 20 meters) with over 100 image feeds; (2) use of geostationary orbits; (3) spread spectrum CDMA technology with forward error correction (FEC); (4) low power, omnidirectional transceivers; (5) a high degree of power and frequency coordination using a network controller; and (6) associated ground system elements.

An overview of the **CELSAT** HPCN system components is included as Appendix A to this petition, and helps provide convincing evidence of HPCN's complete feasibility.

B. An HPCN System Permits Dynamic, Selective Apportionment of Satellite Spectrum for Use In Even Still More Efficient Ground Cells

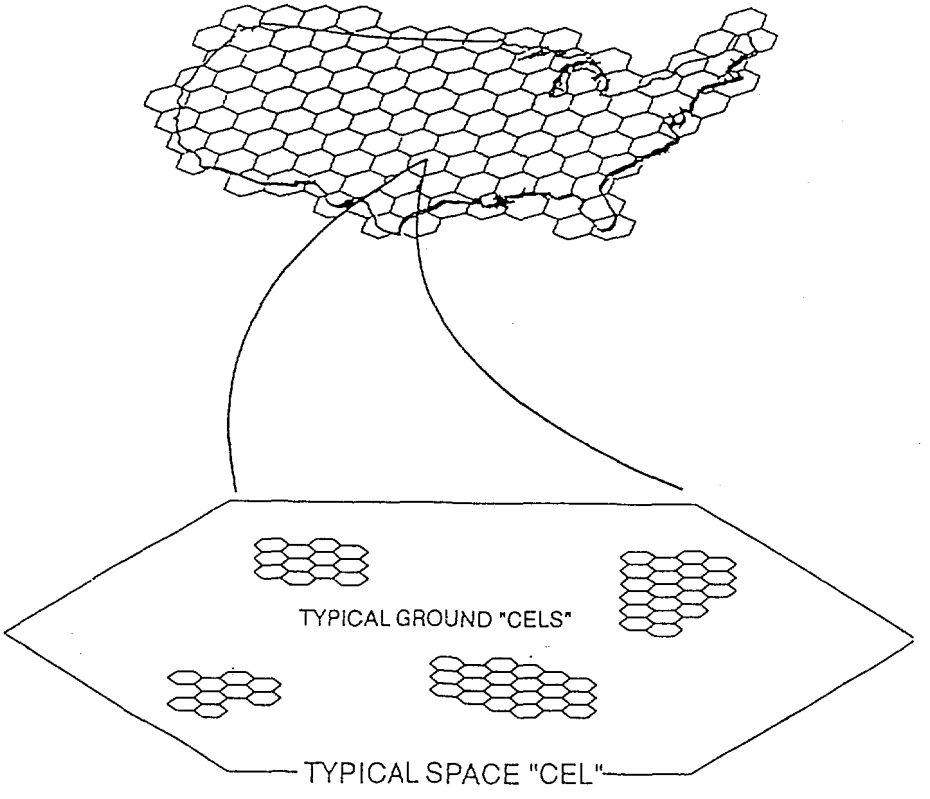
After its shear capacity, herein lies another of the important and innovative features of the *hybrid personal communications network* concept --the ability to reuse the same spectrum in both a space- and ground-based operating mode.

Each HPCN space-cell can reuse the full amount of the same satellite spectrum allocation. But in any or all space-cells the spectrum can be further apportioned on a space-cell-by-space-cell basis for use in a conventional ground-based cellular-like

system. The redistribution results in only minimal reduction in the number of satellite circuits available in the affected space cell(s).

Specifically, for an S-Band HPCN configuration (i.e., using 37 MHz as proposed), the spectrum allocation in each space-cell could be divided into 14 communications subbands of 1.25 MHz each. Each subband, in turn, would have a capacity of approximately 36 equivalent digital VG channels, for a total of about 507 such channels per space cell. Any number of the 14 individual space-cell subbands could be apportioned selectively via a network controller for ground-cell use on an as-needed basis. For each space-cell subband so apportioned the same 1.25 MHz of spectrum will yield the equivalent of 59 VG circuits when used with a terrestrial subsystem, or 61% more capacity per subband then is possible in the space-only mode. The net reduction in space-cell satellite capacity is less than 2%. In geographic markets where ground-cell capacity will not be needed (expected to include approximately 50% of the space cell coverage areas), the full 100% of the subbands would continue to be used 100% of the time for space-cell communications at maximum space-cell capacity.

The total capacity of the ground-cell system within each space-cell can be increased simply by increasing the number of ground-cells within the coverage area. *What is important, however, is that each additional ground-cell reuses the same space-cell subbands apportioned for ground use.*



HPCN GROUND-CELLS DISPERSED THROUGHOUT SPACE-CELL

FIGURE 2

The number of ground-cells deployed in any space-cell will vary depending on the population and/or market characteristics of the corresponding space-cell service area. While the terrestrial HPCN capacity is theoretically very high, **CELSAT** has projected a potential in-service ground-cell deployment in excess of 700,000 equivalent voice grade circuits by the end of the satellites' design life. This is *additional* system capacity, in excess of the nominal 55,000 satellite space-cell circuits described above.

Ground-cells are the key to meeting the high volume demand for personal/mobile communications in major urban and larger

population centers or space-cell "regions";[12] In addition, ground-cell communications will not experience a quarter second delay transitting through the satellite and therefore quickly will become the preferred mode for predominantly voice transactions.[13] HPCN ground-cell capability could be developed contemporaneously with the construction of the HPCN satellites allowing a number of ground-cell systems to be in place and operational by the time the space-segment is launched, or even slightly before.[14] Thereafter, ground-cell systems will be deployed as demand for additional capacity and higher quality voice communications dictate, and ultimately will account for the vast bulk of the HPCN system capacity.

C. An HPCN Will Use Very Light-Weight, Low Power Terminal Devices For Many Different Voice, Data, Multimedia and Position Determination Functions

An HPCN such as proposed in **CELSAT**'s application will utilize CDMA spread spectrum technology and will make maximum use

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[12] **CELSAT**'s proposed HPCN design contemplates that space-cells will be "clustered" in groups of up to ten cells each, corresponding to the maximum number of space-cells to be served by a ground-hub and regional network controller. Such clusters generally will overlay the major metropolitan market areas of the country, and thereby will serve as natural, logical regional service boundaries for defining the breadth of the corresponding ground-cell markets. As explained above, HPCN communications within such "clusters" will be treated more-or-less as very large "local exchange area" communications.

[13] Ordinary voice communications transitting a GEO satellite, including the HPCN space-cells, experience an approximately one quarter second delay which is perceptible to most users. To the extent, however, that voice users are routed over ground-cells they will not experience this delay phenomenon. **CELSAT** expects that the space segments will be used predominantly by non-voice transactions for which the satellite delay presents no problem.

[14] As noted above in the context of the HPCN system redundancy and backup characteristics, the space- and ground-cell systems can be operated independently of each other, such as in the event of a satellite or ground-based failure. In fact, although the full benefits of the HPCN system would not be realized, it is feasible to begin limited ground system service even before the satellites are deployed. **CELSAT** intends to demonstrate this as part of its request for experimental license authority which it will file shortly.

of the best that that technology promises for the mobile market. Personal/mobile transceivers will be correspondingly small and light-weight (handheld, pocket-sized), and will operate with very low power consumption -- 0.1 Watt average for a VG circuit communication via a satellite, less when communicating over a ground cell.[15] In addition to conventional personal/mobile voice, paging and messaging, and position determination services, the HPCN will be used heavily with wireless laptop, notebook, and pen-based personal computers, video and other special-purpose fixed, mobile and portable terminals. Many transceivers will be customized with special features and enhancements for making use of **CELSAT**'s broad selection of available functions, selectable bit rates, and its adaptability to special market applications.

Moreover, because the same frequency bands and CDMA coding will be used by both space- and ground-cells, user terminals will communicate in a single mode, with complete continuity between hand-offs from one cell-type to another. HPCN will not require dual mode, switchable devices to communicate via satellite or terrestrially.[16]

IV. HPCN WILL SATISFY THE GREATEST ARRAY OF PERSONAL/MOBILE SERVICE NEEDS, AT LOWEST COST, WITH A HIGHLY ROBUST, NATIONWIDE INTELLIGENT NETWORK

The HPCN represents an opportunity to merge the best of the state-of-the-art in radio technology with the impressive

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[15] This compares to today's analog handheld phones which operate at about 0.6 Watts, which accounts for their short battery life.

[16] Id., n. 17. On the other hand, HPCN devices could be compatible with many other CDMA-based wireless services, even operating in different frequencies, provided the device was equipped for dual mode operation.

achievements in post-divestiture digital intelligent wireline networks into at least one, nationwide wireless system. The combination of network intelligence with low cost, high capacity radio communications will yield an extraordinarily robust and evolving menu of services unlike anything the wireless user community might have otherwise envisioned.

A. Compared to Other Mobile Satellite Proposals The HPCN Space Segment Can Be Deployed At Lowest Cost

One measure of the cost effectiveness of the *hybrid personal communications network* concept is to compare its space segment costs to those of other contemporary satellite proposals currently pending before the Commission.[17] For this purpose, **CELSAT** has analyzed the cost data for the systems proposed by Motorola (IRIDIUM), Loral/Qualcom (Globstar), TRW (Odyssey), Ellipsat (Ellipso I and II), and Constellation (Aries).[18] These costs are compared in **TABLE I.**

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[17] A large portion of the HPCN's cost, of course, will be related to the construction of the ground-cell systems. For purposes of this petition, and in order to make an apples-to-apples comparison, neither these costs nor the additional circuit capacity that the investment would add have been included. In general, however, it would be reasonable to state that the cost of the ground-cell system would resemble the cost experience of the current cellular industry, adjusted to reflect the potential added capacity and scale economies available through the one system operator HPCN concept.

[18] American Mobile Satellite Corporation (AMSC) has not been included because its system design is not directed at the same high quality voice/data market, such as indicated by a requirement for low power transmitters and low gain antennas. AMSC is perceived by **CELSAT** to serve a different market than that contemplated by HPCN.

PROPOSAL	EQUIVALENT VOICE CIRCUITS, U.S.	ANNUAL COST PER EQUIVALENT VOICE CIRCUIT (SATELLITE)	FREQUENCY EFFICIENCY (EQUIVALENT VOICE CIRCUITS PER MHz)
CELSTAR	54,000	$640	1465
A	7,600	$7,960	152
B	6,960	$12,080	275
C	4,600	$5,380	139
D	864	$19,411	26
E	200	$60,000	12

TABLE I

HPCN's relative capacity (**CELSTAR**) is compared to those in **TABLE I** above.[19] The HPCN is shown to have 6.6 times more space capacity than the next closest system (Globstar). This capacity, alone, will accommodate an order of magnitude more subscribers.

Of course, to serve the broad cross section of users at the penetration levels anticipated for HPCN, the price to the end users must not only be reasonable, but at or lower than the price for alternative wireless services. **CELSAT** has computed that the amortized capital cost of each VG circuit over the life of one HPCN satellite will come to less than one cent/VG channel/year -- low enough to ensure comparably low end user rates. (See **FIGURE 3.**)

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[19] For this comparison **CELSAT** assumed an HPCN satellite system operating at the proposed S-Band, with about 4% of the space-segment capacity apportioned for ground-cell use, leaving about 54,000 equivalent VG circuits of space capacity. The other systems, A - E, of course only operate in the space mode. Therefore all potential U.S. space capacity has been considered.

This, in turn, is supported by HPCN's much lower deployment cost. To achieve the equivalent of full time, total coverage over the U.S. **CELSAT** would have to launch only one of its two proposed geostationary satellites. The cost to construct and launch one such HPCN satellite compared to the cost of building and launching the multiple satellites required by the other systems to attain the same full U.S. coverage is compared in **FIGURE 4.** HPCN is clearly

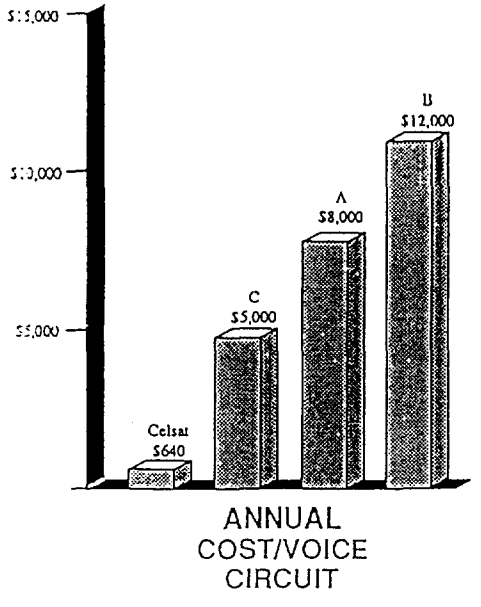

FIGURE 3

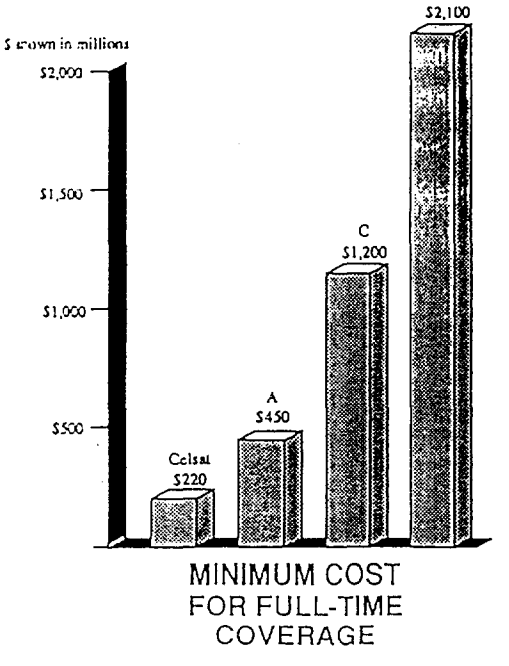

FIGURE 4

shown to be the most cost effective way to offer personal/mobile satellite service.

B. An HPCN Offers Competition and Maximum Functionality Over One, Common Wireless System

The Commission has recently authorized several individual separate satellite and/or terrestrial-based single-purpose wireless

systems, and has many others still under consideration.[20] In addition, of course, there are conventional cellular, BETRS, SMDR, and traditional mobile radio and paging systems which have been around for some time. An HPCN will offer healthy competition to a very broad range of existing and planned wireless services, and will be relatively inexpensive compared to most of them. Nevertheless, for many users and applications, existing services and many planned new ones will continue to have a role in the marketplace for wireless technologies.

On the other hand, HPCN is not a single-purpose service, but a sophisticated personal information communicator/navigator system for the near and intermediate future -- that is, into the early 21st century. For slightly more in terminal device costs[21] an HPCN terminal or service user will not only receive a lot more function for his/her investment, but many basic services (e.g., ubiquitous voice) will be available at lower usage charges than other existing or planned alternatives.

As to its versatile functionality, an HPCN will offer the ability selectively to call up any desired bit rate -- i.e., so-

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[20] These include, for example, nationwide paging (SkyTel), air-to-ground systems (Airfone); vehicle locator, (Fleetcall, Geostar), RDSS (VITA). Also, others are pending before the FCC including, in addition to the several applicants for mixed-use mobile satellite services, applications by MTel, Suite 12 Group, Video/Phone Systems, and others for combined voice/data/video service.

[21] HPCN is designed especially for personal information communications of a higher level than ordinary voice grade transactions. As such, HPCN transceivers will become an integral component of more sophisticated personal voice/data/video devices such as notebook and palm-sized computers, personal/mobile navigators, and other devices which are likely to relatively high priced even without the HPCN interface. Thus, the incremental cost of adding HPCN compatibility to otherwise multifunction products will be relatively modest.