PIPER & MARBURY
1200 NINETEENTH STREET, N.W.
WASHINGTON, D. C. 20036-2430
202-861-3900
FAX: 202-223-2085

BALTIMORE
NEW YORK
PHILADELPHIA
LONDON
EASTON, MD

MARK J. TAUBER
202-861-3913

September 14, 1993

HAND DELIVERY

William F. Caton
Federal Communications Commission
1919 M Street, N.W.
Room 222
Washington, D.C. 20554

Re: GEN Docket No. 90-314
Call Sign KK2XCV
File Number 2174-EX-PL-91

Dear Mr. Caton:

On behalf of Omnipoint Corporation ("Omnipoint"), we are depositing two copies of a video tape supplementing Omnipoint's August, 1993 "Semi-Annual Experimental License Progress Report." The configuration of the system displayed in the tape is set forth in detail in that Report.

Should you have any questions, please contact the undersigned.

Sincerely,

Mark J. Tauber

Enclosures

Omnipoint
CORPORATION

Copy

RECEIVED
AUG 1 9 1993
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	GEN Docket No. 90-314
	)	
Omnipoint Corporation	)	Experimental License Report:
	)	Call Sign KK2XCV
Amendment of the Commission's	)	File Number 2174-EX-PL-91
Rules to Establish New Personal	)	And STAs:
Communications Services	)	Call Sign KK2XCV
	)	File Number S-1223-EX-93
	)	Call Sign KK2XCV
	)	File Number S-1200-EX-93

Omnipoint Corporation

Semi-Annual Experimental License Progress Report

August 1993

Omnipoint
CORPORATION

All tests to date, including those by Omnipoint's customers, of Version 1.X of the system and pocket phones have been performed at peak transmit powers of 40 to 100milliWatts at both the base station and the handset. This is in stark contrast to systems which transmit 5-40Watts of power. Omnipoint's system has frequently been compared to CT2 systems due to Omnipoint's low transmit powers. Yet upbanded 1.9Ghz CT2 systems generally transmit 30mW to 40mW to deliver one voice channel within a 100KHz, transmitting at a 72Kbps simplex data rate. Omnipoint's system has achieved data rates which are over seven times the CT2 data rate (and then TDMA this to support many users) with only 2 -2.5 times the peak transmit power, and performed with high quality over several thousand feet, i.e. distances far in excess that of CT2 systems. Further, Omnipoint's system operates at vehicular speed mobility, can perform frequency agile handoff to any of 28 center frequencies across the entire 140Mhz of the 1.9Ghz band, handles two way calling, messaging, packet data as well as high speed data, and can be used for both symmetric and asymmetric high speed data applications. Finally, Omnipoint's system has been documented to cause significantly less interference to incumbent OFS users than other PCS systems.

3 System Configuration

Omnipoint's system uses a proprietary direct sequence spread spectrum modulation technique to drive the data rate up to very high levels without the need for expensive and power consumptive equalizers. We then use a TDD/TDMA scheme to multiplex users within a cell. Immediately adjacent cells are on separate frequencies (FDMA), which allows for an N=3 pattern to provide at least one cell separation before reusing frequencies. When frequencies are reused, the cells can employ different code sets or different code offsets in addition to different time slots to reduce interference from cochannel interferers.

A number of major benefits are achieved by employing this hybrid architecture. First, there is no near/far problem within a cell since every user is on at a different time. Thus, the need for precision adjustable power controls is eliminated as well as the requirement that every cell be under the control of one centralized network, employing a centralized packet router and requiring separate compare and select functions for every user which is in soft handoff (which has been estimated by others at 50%-70% of all active users). All of that adds significant, linear, expenses to the per user infrastructure costs. Second, Omnipoint's system allows for independently owned and operated base stations, which is critical for use in the unlicensed bands. This allows one handset to be used in both public and private applications. Third, Omnipoint's system allows for one Common Air Interface which can provide both variable rate vocoder rates, variable rate packet data rates, and high speed data channels from 64Kbps to 256Kbps full duplex, and up to 512Kbps in an asymmetric broadcast mode with slow speed ACKs. Fourth, because only one transmitter is on at any instant in time on any given RF channel and because the energy is spread across the OFS receiver's bandwidth, the interference to the incumbent OFS users is dramatically reduced (as documented by numerous experimental reports); and Fifth, because the Base Stations only require one RF card and one correlation chain regardless of the number of users per RF channel (up to the maximum of the RF channel's capacity), the cost per delivered channel is inversely proportional to the number of users. This allows for dramatic cost savings of the PCS infrastructure relative to technologies such as FDMA and CDMA-only which have inherently linear costs per user.

With regards to spectral efficiency comparisons to other PCS systems, Omnipoint has been extremely reluctant to make capacity claims until much more extensive testing has been done in highly loaded conditions. However, we offer the following outline of the basic system parameters and production targets, knowing we will be critiqued by our competitors prematurely.

The Omnipoint system can be configured in multiple ways along several dimensions. Given that all the other Omnipoint system parameters are fixed we can calculate what the maximum achievable data rate is for any given bandwidth. To date, Omnipoint has only explored bandwidths between 10Mhz and 5Mhz, as we noted in our pioneers preference application, replies, and accompanying experimental reports. For illustrative purposes, and ease of comparing capacity to a narrowband CDMA-only system, we can analyze the lower bound of the bandwidth configurations tested. Omnipoints architecture can straight forwardly achieve a bearer channel rate of 512Kbps, after all overheads, within a 5Mhz simplex bandwidth for operation in TDD mode, using an N=3 frequency reuse pattern.[1]

This results in a delivered data rate efficiency of:

(5000Khz/512Kbps) = 9.766Hz/bit x N=3 = 29.297Hz/bit

By way of comparison, the FDD, N=1, 1.9Ghz Qualcomm system as estimated by APC provides 18.8 users in 2.5Mhz. Since Qualcomm has stated that the system achieves its maximum number of users at a vocoder rate of 3.2Kbps per user, this system delivers (18.8 x 3.2) = 60.16Kbps in 1.25Mhz, which when used in an FDD mode results in a delivered data rate efficiency of:

(2500Khz/(60.16Kbps x 2)) = 20.778Hz/bit

At this point in any capacity comparison, one has to agree on the ground rules.[2] Whereas one PCS system may be optimized for compressed voice and have upper limits on achievable data rates of 9.6Kbps per user, Omnipoint's system is optimized for higher speed voice and data

[1]Overheads include addressing, a 500bps "D" channel per voice channel, error detection, and guard time for TDD and ramp up/ramp down time.

[2]Note that if one makes the comparison based on aggregate transmitted data as opposed to bearer channel data, the Hz/bit of the two systems becomes even closer.

services[3] Consider PCS applications which are more asymmetric in their data flows such as data broadcasting, image transmission, or even Faxes. How does one compare the "efficiency" of delivering digitized video for remote diagnostics when Omnipoint's system can provide this service and the other system can not. Or consider that Omnipoint's system can be used to broadcast a 3.5Mbyte database such as an electronic newspaper in 55 seconds whereas a 9.6Kbps system would take 49 minutes and a system with a 3.2Kbps average rate would take 2 hours and 35 minutes to transmit the file. Or with respect to an even more common application, which PCS system is more efficient: one that uses 400Khz per delivered Fax channel or one that uses 281Khz per delivered Fax channel?

Finally, consider perhaps the most difficult comparison: Omnipoint's system is designed to also operate in the unlicensed bands as well as the licensed bands. But if the capacity of independently owned systems operating in the unlicensed bands is the criteria for capacity comparisons then a CDMA-only system would experience tremendous capacity losses. CDMA-only systems would be unable to operate in an N=1 reuse with nearby independently operated systems on the same frequency. Further, CDMA-only systems would experience capacity reductions across all users in a network due to collisions from even one transmitter from another network. In contrast, Omnipoint's systems would only experience collisions on individual time slots from systems on the same frequencies, which can be resolved through time slot interchange.

There are even more subtle problems with comparing the "capacity" of such disparate PCS systems. With a CDMA-only system, as cell sizes shrink and more cells are operating in proximity, interference rises. One recent study by Rappaport and Milstein, ("Effects of Radio Propagation Path Loss on DS-CDMA Cellular Frequency Reuse Efficiency for the Reverse Channel", IEEE Transactions on Vehicular Technology, August 1992) indicates that <u>CDMA-only systems will experience a six-fold reduction in capacity as cells are reduced from 10 kilometer to 2 kilometer radii.</u>

Omnipoint's system is primarily a TDMA system within a cell, thus Omnipoint does not need to design cell site reuse locations based on worst case C/I ratios since Omnipoint's system can use time slot interchange within a cell to mitigate collisions occurring between individual users operating on cochannel frequencies but in different cells. Coupled with an N=3 reuse pattern, Omnipoint's system capacity in microcells is far less affected by the increase in potential interference sources.

[3] Some parties argue that significant sectorization gains are only possible with CDMA-only systems. Omnipoint does not agree with this but is not yet ready to release data on how much sectorization gain can be achieved with the Omnipoint system. Also, Omnipoint is working on implementing voice activity detection (VAD) as well.

In summary, Omnipoint has avoided capacity claims and capacity comparisons to date because it has focused on developing its vision of a PCS service offering, which provides:

- Wireline quality voice, data, digitized compressed video, and multimedia
- Delivered wirelessly to pocket sized devices
- Allowing handsets to be used with both public or private base stations, in licensed or unlicensed frequencies
- Providing full coverage and full mobility
- At substantially reduced costs

4 Manhattan Tests

4.1 Incumbent OFS Coordination

In order to perform a detailed test in Manhattan as outlined above, multiple Base Station locations were required to support simultaneous transmissions in an N=3 re-use pattern. Omnipoint's current Experimental License for the OFS Band (No. KK2XCV, File No. 2174-EX-PL-91) allows for only 3 Base Stations and 24 Handsets to operate simultaneously anywhere in the continental United States.

Eventual large scale test plans in Manhattan called for up to 100 Base Stations and 200 Handsets, which is well beyond the scope of the original Experimental License. In order to proceed with these large scale tests, Omnipoint requested and received a Special Temporary Authorization (STA) for Manhattan that permits simultaneous use of up to 100 Base Stations and 200 Handsets.

Omnipoint has agreed to coordinate the with all incumbent OFS users in the area surrounding New York possibly affected by Omnipoint's system and to notify the local FCC field office. Prior to over-the-air testing under authority of the STA in Manhattan, an extensive survey of all OFS users within a 50 kilometer radius of Midtown Manhattan was performed by LCC, Inc., of Arlington, Virginia. LCC is a recognized leader in the industry for RF site acquisition and planning, and conducted it's survey through an extensive data base of users and signal propagation simulations and analysis of those sites thought to be potentially affected by the tests.

LCC OFS Interference Analysis Methodology

Analysis - PCS to OFS interference is the most important aspect of the frequency selection process. Avoidance of any possibility of interference to fixed microwave from an Omnipoint PCS technical trial is extremely critical, therefore, very conservative assumptions were employed in the analysis. In order to simplify the analysis, the receive center and adjacent frequencies of the two microwave sites located immediately adjacent to the coverage objective were eliminated from consideration as clearly unusable. The remaining sites were analyzed to predict the co-channel signal level that the microwave receiver would receive from a PCS Base Station within the coverage objective area. Each center frequency was evaluated based on the co-channel received signal strength at each microwave receiver on levels to microwaves on adjacent frequencies.

Assumptions -

1) Per TSB10-E, the maximum allowable PCS signal at the input of any microwave receiver is 10dB below the noise floor of the receiver. For the worst case of a 5MHz microwave, this corresponds to -106dBm, so the maximum allowable PCS signal is -106dBm - 10dB + 3dB (noise figure) = -113dBm. This is a very conservative criterion, since it:

a) Assumes that noise in the receiver is equal to thermal noise in a 5MHz bandwidth, when the actual noise floor is certainly at least a few decibels (only three assumed for this analysis) higher due to the noise figure of the receiver.

b) Protects the microwave receiver in a fully faded condition

c) TSB10-E analysis assumes narrowband interference into the microwave receiver. Omnipoint's wideband direct sequence CDMA signal cause 10 - 20dB less interference into a target microwave receiver than would narrowband systems (See Omnipoint Communications Request for Pioneer's Preference, May 4, 1992). However, narrowband signal analysis was employed in the study, giving even greater margin of safety.

2) Propagation predictions used the Hata/Okumura model and are based on USGS 3-second terrain data. They include the actual antenna gains, line losses, and transmitter output powers of the microwave transceivers. They do not utilize the actual patterns of the microwave antenna, which were not available, but rather use a worst case assumption of beam width and

front-to-back ratio based on Part 94.75 of the FCC Rules. This results in predictions of PCS-to-OFS interference levels which are as high as could possibly be generated by a microwave antenna which is in absolute minimum compliance with the law. Actual antennas generally have a much better performance than this worst case assumption.

3) The initial target coverage area is defined as the area bounded by 59th Street to the north, 42nd Street to the South, 6th Avenue to the West, and 3rd Avenue to the East. While it was assumed that all Handsets and Base Stations are operated only inside this boundary, operation several blocks outside would not cause any further problems than those analyzed inside the coverage area.

4) Substantial blockage caused by the height and density of the buildings in Manhattan should keep the PCS signals well contained. However, as an additional margin of safety, no attenuation due to building clutter is included in the analysis.

OFS Analysis Results

As a result of this analysis, LCC determined that there were only three OFS channels (1910MHz , 1925MHz, and 1970MHz) which were available for testing without having to go to extreme coordination lengths. While these particular tests were not designed to analyze the sharing problem, it is clear that the problem of dodging the OFS beampaths will be a significant one if only 20MHz per PCS operator is authorized. Note that two of the three channles which would not conflict with any OFS beampath were in the portion of the band targeted for Unlicensed PCS only.

In order to further assure that incumbent OFS systems in the area experience no disruption, a series of steps were taken:

1. Omnipoint notified all pertinent OFS operators (co-channel and adjacent channels) and the local FCC field office (See Appendix 1, Omnipoint Manhattan Technical Trial Contact List) prior to commencement of the tests, and continues to notify all parties on a daily basis when tests are being conducted.

2. All affected parties have been supplied with initial locations of the Base Stations, informed of the nature of the tests being conducted, and provided with technical parameters of

the Omnipoint system. Due to the nature of the tests, which involve different placements of Base Stations within midtown Manhattan, daily notification of changing sites is also given.

3. All parties on the contact list have been provided a representative at Omnipoint in the event that interference to the incumbents occurs. This contact has the authority to terminate all testing until it can be determined the source of the interference.

4.2 Manhattan Site Identification and Description

Manhattan Test Configurations

As detailed in the executive summary, Omnipoint believes that envisioned PCS services will be successful only as they become highly cost effective to the end user. In order to meet this goal, minimal network infrastructure costs are a requirement. A dense urban environment such as Manhattan, with its severe attenuation characteristics, will tax the economic structure of PCS services as the number of cells required to provide coverage increases. Omnipoint's very small, low cost, Base Stations may be installed on the sides of buildings to provide high quality service into these canyons while maintaining the cost parameters required for successful economic implementation of PCS.

For Manhattan, 10 Sites were initially selected, and chosen based on a general model of propagation patterns and the fact that cells look more like lines and crosses than circles in urban canyons. For these initial 10 sites, environments included a combination of single and multi-lane streets and avenues varying in width from 60 to 200 feet, flanked by 30 to 60 floor high rises creating deep urban ravines, as well as 5-10 story shallow RF "crevasses". Base Stations were installed between the 5th and 11th floors, and signal strength measurements were taken and plotted in the vicinity of each location. Additionally, coverage plots of the Omnipoint system at each site were generated, and qualitative Figure of Merit scores were given. Further tests were performed where varying combinations of Base Stations were used on a system basis, with repeated drive and walking tests on established routes, and handoff, audio quality, and 2GHz propagation characteristics and their effect on Omnipoint's spread spectrum system were studied.

Base Station Locations - Manhattan

Three configurations, each consisting of 10 cell sites, were utilized for different drive and walk routes, and were selected for their environmental diversity and location relative to all other cell sites for large scale coverage and analysis of an N=3 re-use pattern. The locations of the Base Stations for Configurations 1, 2 and 3 are summarized in Tables 4-1, 4-2 and 4-3 and Figures 1-1, 1-2, and 1-3, respectively. All Base Stations function with the following parameters:

Transmit Power	0.1 W (20 dBm)
Radiation Center:	50 - 100' AGL, side mounted
Antenna:	3 dBd omnidirectional
Effective Radiated Power (ERP):	0.2 W (23 dBm)

Table 4-1

Base Station Configuration No. 1

	Manhattan Sites	Center Frequency (MHz)
1.	47th St and Lexington Ave.	1970
2.	52nd St. and Madison Ave.	1910
3.	55th St. and 5th Ave.	1925
4.	55th St and Broadway	1970
5.	52nd St. and Eighth Ave.	1925
6.	56th St. and Seventh Ave.	1910
7.	56th St. and Park Ave.	1970
8.	51st St. and Park Ave.	1925
9.	42nd St. and Madison Ave.	1925
10.	53rd St. and Fifth Ave.	1970

Table 4-2:

Base Station Configuration No. 2

	Manhattan Sites	Center Frequency (MHz)
1.	47th St and Lexington Ave.	1910
2.	52nd St. and Madison Ave.	1925
3.	55th St. and 5th Ave.	1910
4.	55th St and Broadway	1970
5.	52nd St. and Eighth Ave.	1910
6.	56th St. and Seventh Ave.	1925
7.	56th St. and Park Ave.	1970
9.	42nd St. and Madison Ave.	1970
10.	53rd St. and Fifth Ave.	1970
11	51st St. and Lexington Ave.	1925

Table 4-3:

Base Station Configuration No. 3

	Manhattan Sites	Center Frequency (MHz)
1.	47th St and Lexington Ave.	1970
2.	52nd St. and Madison Ave.	1910
3.	55th St. and 5th Ave.	1925
4.	55th St and Broadway	1970
5.	52nd St. and Eighth Ave.	1925
6.	56th St. and Seventh Ave.	1910
7.	56th St. and Park Ave.	1970
8.	51st St. and Park Ave.	1925
10.	53rd St. and Fifth Ave.	1970
12.	44th St. and Lexington Ave.	1925

It is seen from Figures 1-1, 1-2, and 1-3 that the three cell frequency re-use pattern discussed above in section 3 is employed several times through the three configurations.

4.3 Manhattan Test Descriptions and Results

Signal Strength Tests

As part of Omnipoint's initial cell site planning efforts, extensive signal strength measurements at each site were performed in conjunction with LCC. The attached RSS and Fade Margin Plots detail the results for each cell site, as well as the composite coverage of all cell sites.

Individual Site Tests

Base Stations installed at each site were tested individually for signal quality, and antenna placements determined as a function of the particular mounting choices available at each location. The testing conducted included subjective signal quality as a function of both LOS and NLOS distance from the Base site where Figure of Merit (FOM) scores were awarded based on a scale of four levels, and coverage plots were generated from a single cell site with handoff disabled. These FOM scores were then used to graphically display the relationship between each test point and the Base site:

Table 4-4
Qualitative Figure of Merit Scores

Level	Plot Color	Rating
1	Red	Excellent: Clear audio/voice, no noise
2	Blue	Good: Minor muting or even a single audible "pop"
3	Green	Marginal: More muting, still intelligible voice
4	Violet	Poor: unacceptable voice, but link intact

Typical of the coverage plots for Base sites are Figures 1-9 and 1-8. Site 1, located at 47th St. and Lexington Ave., is a typical East/West corridor installation, with Excellent to Good coverage from 1st Ave to Eighth, a distance of almost 6000 feet. With antennas installed on an

East/West orientation on 47th Street, Excellent to Good coverage is also provided North/South in NLOS from 54th to almost 42nd Streets, a distance of approximately 2900 feet.

Similarly, Figure 1-8 shows performance of a typical North/South corridor installation. At this site, Excellent to Good coverage is available for almost 7500' North and South on Madison Avenue, from 38th past 66th Streets.

Table 4-5 summarizes the maximum linear range achieved for each installation on it's primary North/South or East/West corridor. Wider North/South avenues typically allowed for greater distances than narrower East/West streets, but adequate coverage was achieved on all of these primary corridors with a Base Station ERP of approximately 200mW. As discussed, rapid signal fades on the order of 20-30dB typically occur when turning the corner from primary coverage corridors.

Figure 1-18 shows the composite coverage plot for configuration 1 for the total area served effectively.

TABLE 4-5

System Coverage, Configuration No. 1

FOM <= 3

NUMBER	SITE	STREET	DIRECTION	DISTANCE (ft)
1.	47th & Lexington	47th	E	1,708
			W	4,204
2.	52nd & Madison	Madison	N	3,600
			S	3,873
3.	55th & 5th	55th	E	1,971
			W	3,153
4.	55th & Broadway	55th	E	2,890
			W	2,760
5.	52nd & 8th	8th	N	2,233*
			S	3,022
6.	56th & 7th	56th	E	3,547
			W	3,679
7.	56th & Park	56th	E	2,102
			W	4,073
8.	50th & Park	Park	N	3,600*
9.	42nd & Madison	Madison	N	2,836
			S	2,727
10.	6th & 55th	6th	N	1,200**
			S	3,600
11.	50th & Lexington	Lexington	N	2,509
			S	2,073
			Average****	3,049

* Stopped at Central Park

** Antennas configured for coverage N of Park only

***Excludes No. 8, South, and No. 5, North

Manhattan System Tests

Once Base hardware for each configuration was installed, mobile units were driven and walked throughout the covered areas. All hardware employed in this test fully supports two-way calling. Operational characteristics (multipath mitigation, range, signal quality, hand-off, etc.) at varying speeds were measured. Two drive paths ("Long" and "Short") were chosen to determine signal quality and coverage over the many environments present in the area covered by the Base Stations of the three configurations, restricted by street directions, traffic patterns and density, etc. [illegible] handsets in order [illegible] same series [illegible] planned for [illegible] ically different environment [illegible] therefore, Omnipoint [illegible] and

"LONG" route - The long path (approximately 2.8 miles) offers a variety of environments to study signal quality and handoff capabilities. This route starts at 47th St and First Ave, and proceeds west to Madison Ave (North), 55th St. (West), and Eighth Ave (North), to Columbus Circle. The path follows Columbus Circle to Broadway (South), and to 56th St (East), and then proceeds to Park Ave (South), and ends by turning left at 50th St and stopping at the southeast corner of 50th and Park. This path travels through a wide (two lanes, two way plus center island) & deep (30 to 70 floor buildings flanking the avenue) "canyon" (Park Avenue), medium (3 lanes, one way) & deep canyons (Madison, Eighth & Broadway), narrow (one to two lanes, on way) & shallow (5 to 30 floor buildings) "crevasses" (55th and 56th), and a moderately open section around Columbus Circle, and presents a variety of traffic situations.

Different handoff situations are present, from quick hand-off events as the vehicle or pedestrian turns a corner and experiences a 20-30dB near instantaneous building shadow fade, to a same-street hand-off where excessive deep fading or vehicular shadowing could cause hand-off from the source to the destination Base Station to access anywhere over a 100 to 300 foot handoff "zone".

"SHORT" route - The short path (approximately 0.9 miles) experiences a less diverse set of environments, but does allow for faster collection of data for analyses hand-off events and a close N=3 reuse pattern. The Short path begins at the intersection of 47th St and First Ave, proceeding West to Madison (North) to 56th (East) to Park Ave (South), and back to 47th (West). Transportation of the mobile through this route allows for quick hand-offs at each right turn due to building shadowing, allowing for a detailed study of rapidly changing RF environments.

Mobile System Link Quality Test Results

Over a period of several days, 31 runs were made on the long route, and 11 runs on the short route. During the tests, the traffic conditions affected the test environment, which changed significantly from test to test, providing each run its own unique parameters. Tests were conducted at all times of the day and night, with run times varying from less than 6 minutes at 3:00am on the short route to as long as 1½ hour runs during rush hour. As tedious as some of the longer runs may have been, the contrast in run times allowed for testing at very different speeds; from stopped for several long minutes during gridlocked rush hour, to walking when Madison Avenue was closed for a day during the test period for a street fair, to relatively high speed runs in the early morning hours. While a walk through Manhattan at 3:00am may be an educational experience itself, all night tests, regardless of traffic conditions, were performed from a vehicle for continuity and safety reasons. As a result of this extensive testing, Omnipoint field engineers came away with abundant technical test results.

For each test, a standard Omnipoint 2GHz PCS Handset was utilized as the mobile unit, and was powered through an adapter by the battery of the vehicle or employed a standard pocket phone 700mAh battery. As the mobile progressed through each route, Figure of Merit scores were given to the link quality, and handoff events marked on a map. These individual runs were then compiled to generate a composite picture of system performance through FOM scores and to establish handoff zones throughout the route.

Long route composite summary - From the 31 runs on the long route of approximately 2.8 miles, an accurate picture of coverage provided by the Base installations was derived over a wide variety of operating conditions.

Beginning at the intersection of First Avenue and 47th Street, the test vehicle would proceed westbound on 47th to Madison Avenue. During this stretch of the route, traffic is typically dense, and this 5 block section can take 30 seconds to 30 minutes, depending on traffic conditions. Regardless of the speed with which this section was negotiated, coverage for the entire 5 blocks was consistently excellent, or rated as a "1" on the FOM scale. Upon turning right at Madison, heading north, the signal would encounter very rapid shadowing, at which time the first handoff in the route would occur. This handoff event occurred without exception by mid-block between 47th and 48th Streets, usually without audible defects due to the large structural shadowing right at the northeast corner of the intersection creating a 30 - 40dB disparity between the signals from the two base stations placed at approximately equivalent distance from the handoff zone, but on orthogonal streets. In the center of the intersection of 47th and Madison, the handset sees similar signal quality from both Base Stations, but maintains its link to the original Base as there exists no reason for a handoff. When the Handset passes around the corner from 47th to Madison the 47th signal experiences a rapid drop, and handoff to the higher quality (and in this case, much higher level) signal occurs. This handoff typically happens in 12 - 18 milliseconds, and may or may not be accompanied by a barely audible instantaneous muting.

The next section of the route is on Madison Avenue between 47th and 55th Streets, and is a wider street than 47th, with 3 lanes of traffic in one direction (north). Proceeding north on Madison, signal quality remains excellent for most of the section, with the exception of a small area near 53rd Street where signal quality on the order of FOM2 exists, meaning slight packet muting. On 10% of the runs, this area also experienced short sub 1 second periods of FOM3 levels, but no severe muting was noted. The left turn onto 55th Street caused another handoff, where all handoff events occurred within a half block of Madison, and again were very rapid (on the order of 18 - 20 milliseconds). The handoff is the same experienced at 47th and Madison, with rapid shadowing and significant signal quality disparity between Base Station signals dominating the decision.

Section 3 of the long route is 55th Street (narrow) between Madison and Eighth Avenues. Signal quality remained excellent from handoff at Madison to just before 6th Ave, where a localized region of mostly FOM1 but some 2 scores were present. This area contains a varied mixture of high rises and smaller buildings where different multipath characteristics are present than those of the first two sections. Signal quality returned to excellent shortly after passing though the Sixth Ave intersection, then entered another small area of mostly FOM1 and 2 scores, with an occasional FOM3 at Seventh Ave. At this point, environmental factors began to play a larger role as the handset transferred to another Base. This handoff region is larger than the first two and could occur anywhere over approximately one city block, a half block east and west of Seventh. As the handset entered this zone, differences in signal quality, due mostly to fast fading or truck shadowing rather than average signal strength reduction triggered a handoff from the Origin Base to the Destination Base. Depending on traffic conditions, handoff in this zone occurred as early as Sixth Ave, but more typically occurred on the west side of Seventh. In this area, one could experience audible noise in an FOM2 or 3 environment for 250 milliseconds to 750 milliseconds just before handoff, and then excellent quality would again return to the link upon handoff to the Destination Base.

The route continued for just a short distance to Eighth Ave, with excellent (FOM1) signal quality from the handoff zone until the handset disappeared from LOS on 55th to Eighth Ave north, where a handoff similar to that conducted at 47th & Madison and Madison & 55th, that is, minimal audio detection of the handoff in a fast shadow fading environment.

The remainder of the route was a repeat of one of these two types of scenarios: A) Solid link with virtually no audible detection of handoff due to significant differences in Received Signal Strength (RSS) levels and Frame Error Rates (FER's) between the original and destination Base Stations, or B) Solid link with a 250 - 800 millisecond period during which intermittent packet muting occurred just before a handoff.

In order to further test how Omnipoint's handoff algorithms function in such a dynamic environment (very rapid shadow and multipath fading with wide disparity in simultaneous RSS), the short route was designed to provide a tightly coupled series of required handoffs with a close proximity frequency re-use pattern in the presence of large, rapid shadow fading that is common in an urban canyon environment such as Manhattan.

During the 11 runs of the short route, many of which consisted of more than one loop per run, close to 60 handoff events were initiated. Handoffs universally occur within a half block of each intersection, verifying the algorithm's ability to supply extremely fast handoff in a fast shadowing and multipath environment with minimal audible detection of the handoff function.

NOTE: To put these Omnipoint tests in perspective, repeated attempts were made with an 800MHz cellular phone to traverse the "Long Route" . Not one of the runs was completed without dropping the call. Moreover, the noise level was significant over many areas and frequently other user's conversations were suddenly picked up.

5 Colorado Springs Tests

5.1 Incumbent OFS Coordination

Omnipoint has in the past reported its work in the OFS band in Colorado Springs under its Experimental License, which permits simultaneous operation of up to three Base Stations and 24 Handsets. Work in Colorado Springs has continued under the authority of this License, but has been limited by its operational parameters. While this has provided adequate flexibility and freedom for the tests conducted to date, future test plans include simultaneous operation of up to 70 Base Stations and 200 Handsets in order to perform the same series of tests planned for Manhattan, but in a radically different environment. Therefore, Omnipoint petitioned and received from the FCC a second Special Temporary Authority for the Colorado Springs area.

Omnipoint has undertaken all efforts to assure that its tests pose no interference to incumbent OFS links. As part of this effort, Omnipoint has employed LCC to determine open channels available for test, as well as the locations of co-channel and adjacent channel links in the vicinity of the Colorado Springs test bed.

Using the same criteria detailed in Section 4.1, LCC determined that the 1885, 1915, and 1965MHz channels (OFS Bandwidth = 10MHz) can be considered clear, with the closest user 46 miles away and blocked by a large mountain range.

5.2 Colorado Springs Site Identification and Description

Several sites have been tested in the Colorado Springs area based on the available terrain, the proximity to Omnipoint, and the availability of cell sites. Each network was configured with three to four Base Stations, and less than 24 handsets.

<u>Colorado Springs Configurations</u>

As part of Omnipoint's continuing efforts to conduct technical trials of its developmental efforts in a variety of environments and applications, extensive testing has been undertaken in the semi-urban and suburban environment of Colorado Springs to complement those tests performed in New York. As part of this effort, 5 types of tests were established, each to meet a different objective:

1. Large, single cell, high speed mobility
2. Large, two cell with handoff, high speed mobility
3. Large, three cell with handoff, high speed mobility
4. Large, three cell, medium to high speed loop, with handoff
5. Large, four cell, medium to high speed loop and complete low speed residential coverage, with handoff

Rather than conduct tests in an artificially unchallenging RF propagation environment such as flat or gently sloped test area with Base Station transmitters placed high for easy RF signal access to mobile units, Omnipoint's objectives of this series of tests were to test in as near to real world environments as possible, with incumbent real-world logistical, regulatory, cost, technical and especially zoning hurdles. This would allow for proof of the Omnipoint concept of very low cost infrastructure for a PCS service. In order to meet these rigorous goals, reasonably characteristic, variable terrain test zones were selected. In light of the hardware restrictions mandated under the original Experimental License, logistical concerns for selecting sites in close proximity to the Omnipoint labs were also taken into account.

1. Large cell, high speed tests - In order to demonstrate the Omnipoint system's ability to provide large cell architecture ("large" at 1.9GHz consists of cells in excess of 1 mile radii), complete with high speed mobility and handoff, a multi-cell configuration was established along the Interstate 25 adjacent to the Omnipoint facility. The particular area selected includes significant elevation changes as well as serpentine turns, and includes bridges and buildings along the route, adding to the complexity of the project. Three sites (Configurations summarized in Table 5-1) were chosen with -85dBm average RSS test handoff operations:

a) Omnipoint lab facilities ("Omnipoint Site") - The first cell site is installed in the three floor facility housing the Omnipoint Corporate Headquarters at the intersection of I-25 and Woodmen Avenue, and is representative of a typical multistory, mid-sized office facility. The structure is a five year old, three story Class A multiple tenant office building with interior walls consisting of typical drywall-on-steel-stud office construction. Besides the structural steel framework, the exterior is covered with glass all around, with a pre-cast aggregate facie between windows. The building is separated into two wings of approximately 24,000 square feet each with a common area linking them. The Base Station of this cell is installed in mechanical penthouse of the facility, with antenna mounts at a height of approximately 40 feet AGL on the penthouse roof. The antenna configuration employs universal mounts, which allow for a wide variety of antenna options (See Table 5-3).

b) Intersection of Nevada & I-25 ("Nevada Site") - The second site, approximately 1.5 miles south of and non-LOS to the Omnipoint Site, is located near the on-ramp of Nevada Avenue to I-25, and consists of a Base Station and two 3dBd antennas mounted at 25' AGL (standard telephone pole height), separated in the horizontal plane by approximately 48 inches. A large dirt berm separates this site from line of sight to the Omnipoint antennas, and the support pole is installed in the parking lot of a small industrial park.

c) Point of the Pines Blvd. - ("Sunbird Site") - The third site is located approximately 1.1 miles southwest of the Nevada Site atop a 50 foot bluff adjacent to I-25. The Base Station and 3dBd antennas are mounted on a custom antenna stand at approximately 6 feet AGL.

Table 5-1
High Speed, Multi-Cell Base Station Configuration

	Site	F_c (MHz)
1.	Omnipoint	1915
2.	Nevada	1885
3.	South	1965

2. Large Cell, Medium and Low Speed Tests - The Omnipoint Site, and all Base Stations used in these tests, provide a cell with a maximum TDD structure of 1.7 miles in radius. (This is being expanded to 9.2 miles or larger in the next version.) In order to focus on an area for detailed testing, the northeast quadrant was selected, and limited specifically to that area bounded by Academy Blvd. on the East, Woodmen Road on the South, and I-25 on the west and north, a service area which contains a residential area of 168 homes, 4 hotels, 22 businesses of varying sizes, and two shopping centers. The neighborhood adjacent to Omnipoint within this sector supplies the requisite real-world target coverage area, as well as being convenient.

<u>It should be noted that the terrain within this area is highly variable and rises and falls above and below the antenna heights at the cells sites.</u> There is approximately one hundred feet of elevation difference between the Omnipoint Site and the high point of the neighborhood, with zones of rise and fall in between. In addition, the neighborhood is very well established; and therefore is filled with large man-made obstacles to accompany the already dense foliage from the native trees. For example, the residence on Reed Street (Site of the Reed/Woodmen Base Station installation) has been isolated from traffic noise on Woodmen Road by construction of a large dirt berm, which, in conjunction with the large native trees creates a difficult RF propagation environment. This site is not an isolated incidence of blockage for the neighborhood. All areas are bordered by housing structures, hills, and trees of varying sizes, surpassing the Omnipoint Site in height, and many houses are almost totally blocked by the trees and terrain that make up the streets.

Three Base Station sites were initially chosen based on propagation tests performed by LCC. Note: The coverage plots shown are for 3 Base Stations,(See Figures 2-1, 2-2, and 2-3). However, after a series of tests were performed , a fourth micro Base Station was added later to fill a particularly difficult coverage area in the neighborhood. For these four sites, installations consist of a Base Station and antennas mounted at a maximum of 30' AGL (due to local CC&R restrictions), and separated in the horizontal plane by approximately 48 inches. Composite analysis was performed on four base locations based on drive and walk routes. The summary of the four sites for the residential area is defined in Table 5-2.

Table 5-2

Low/Medium Speed, Multi-cell Neighborhood Base Station Configuration

	Site	F_c (MHz)
1.	Omnipoint	1915
2.	Cragin & Academy	1965
3.	Reed & Woodmen	1885
4.	Murdoch & Collins	1965

Base Station Configurations

All of the Base Stations employed in the Colorado Springs tests are operated with the following parameters:

Table 5-3

Colorado Springs Base Station Configurations

Transmit Power	0.1 W (20dBm)
Radiation Center	25', pole mounted
Antennas (except Omnipoint)	8dBd Omnidirectional
Antennas (Omnipoint)	0dBd, 3dBd, 8dBd, 15dBd
Effective Radiated Power(ERP):	0.1 W to 3.2 W

5.3 Test Description & Results

Signal Strength Tests

Extensive signal strength measurements at each site were performed in conjunction with LCC. See attached RSS maps for north Colorado Springs. Cell sites were chosen to provide average RSS coverage of -85dbm to -95dbm.

Link Quality Tests

Five separate series of tests (Three "Freeway", two "Neighborhood") have been conducted, each with unique objectives. The Freeway tests included subjective drives where

Figure of Merit scores were given as a function of location, and included handoff, propagation characteristic, and limited Frame Error Rate testing for calibration of numerical comparisons to perceived signal quality.

In the Neighborhood series, tests were repeatedly performed at each site to obtain Figure of Merit scores as a function of location in a stand-alone configuration as well as in a multi-cell architecture on a system basis, where routes were traversed in vehicles as well as on foot, testing audio quality, handoff, and propagation characteristics.

Test Series No. 1: Large Single Cell, High Speed Mobility

The objective of the first test is to determine system performance at high speeds in fast Rayleigh fading conditions within a single cell, without the use of equalizers or combining diversity. For these tests, only the Omnipoint Site used an active Base Station.

For this test, the mobile was transported to the furthest public access point on the Air Force Academy grounds to the north of the Omnipoint Site at the entrance to I-25. Calls were placed from the Handset to the Base Station, and vice-versa with FOM, and Frame Error Rate tests. As the vehicle accelerated from the starting point and onto I-25 to 65mph, a full duplex link was maintained and real-time FER data taken. The test vehicle made its way south on I-25 until it entered a deep dip in the highway (at approximately 2.6 miles) where the multi-cell configuration would normally hand-off, and the signal was lost. At this point, the FER test was terminated, and data accumulated. The test vehicle would then repeat this process, starting from the south and heading north on I-25. FER data was accumulated over the entire distance of the test and, averaged over test series, resulted in a 1.09% average Frame Error Rate, again without the use of equalization or combining diversity techniques (combining diversity will be implemented in future tests). FOM data shown in Figure 2-4 also shows coverage for Base 1. It can be seen that excellent link quality is provided over almost the entire run with no discernible audio degradation at this FER. (Note: FOM scores in Figure 2-4 are common to all three Freeway tests, relative to the size of the area covered.)

Test Series No. 2: Two Large Cells w/ Handoff, High Speed Mobility

For the two cell test series, data on the effect of handoff functions on the link quality was to be determined. The test configuration of Test Series No. 1 was repeated, except that a second Base at the Nevada Site was functional.

The test process from Test Series No. 1 was repeated for Series No. 2, with the exception that the test vehicle proceeded further south, through a handoff to the Nevada Site installation, until the outer boundary of the second cell was reached, at which time the FER test was terminated. For this series of tests, average FER for each entire run, including handoff events, was 1.44% over a run of 3.8 miles. Figure of Merit scores are shown graphically in Figure 2-4, again demonstrate that excellent signal quality is present over the entire test path, with only slight signal degradation in the handoff zone between the systems at the Omnipoint and Nevada sites.

Test Series No. 3 - Three Large Cells w/ Handoff, High Speed Mobility

The objective of this test was to prove that high speed handoff and reliable link quality are present in a system that utilizes multiple cells and multiple frequencies. Test procedures used for Series Nos. 1 & 2 were employed in this series, but FER data was not taken as FOM scores indicated virtually identical performance to the other large cells sites. The FOM data was, and is reflected in Figure 2-5, which shows signal quality through the entire three cell distance of approximately 6 miles, again with only slight quality degradations in the two hand-off zones just prior to handoff.

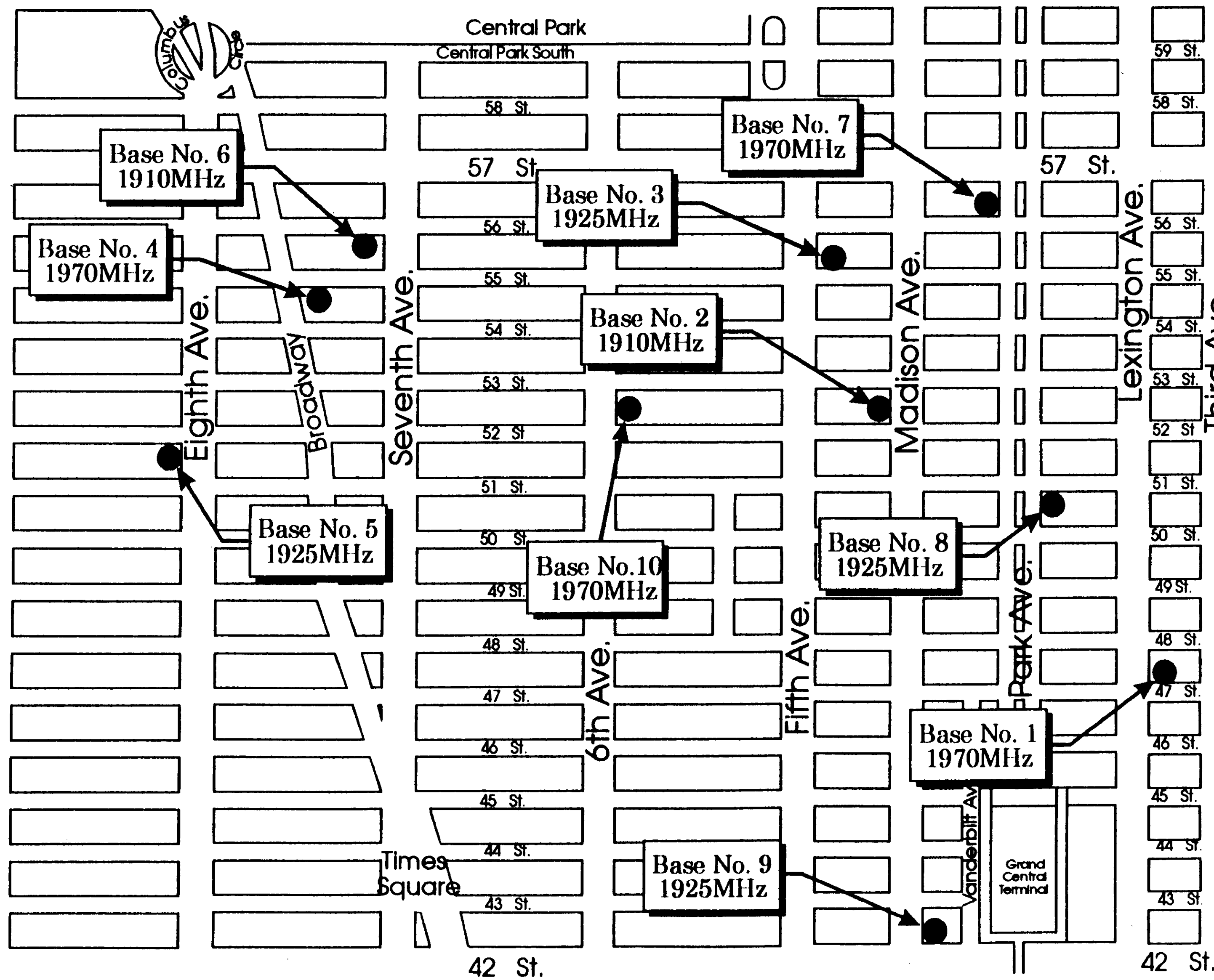
During all Freeway tests, every handoff that was attempted was completed within 100 milliseconds, and subjective signal quality scores remained consistent throughout.

Test Series No. 4 - Large Cell, Medium to High Speed Loop

Upon successful demonstration of high speed qualitative and hand-off capabilities, and in order to test system design parameters under differing mobile conditions (for example, simultaneous low and high speeds on the same hardware), a test was designed to show hardware capabilities under dramatically varying rates. Focusing again on the Northeast Residential Quadrant, it was determined that varying rates do not effect the signal quality to any noticeable degree. In covering the loop, speeds ranging from 10mph to 45mph were reached and then abruptly reduced to zero to accommodate stop lights and signs. In addition, speeds of 65mph were reached on the freeway during the same run with no degradation. These trends can be seen in Figure 2-6. While there were some areas at the fringe of the bases that show some degradation, the bulk of the test which contained all of the varying parameters was clean.

Test Series No. 5 - Four Cell Medium to High Speed Loop, Complete Low Speed Residential Coverage

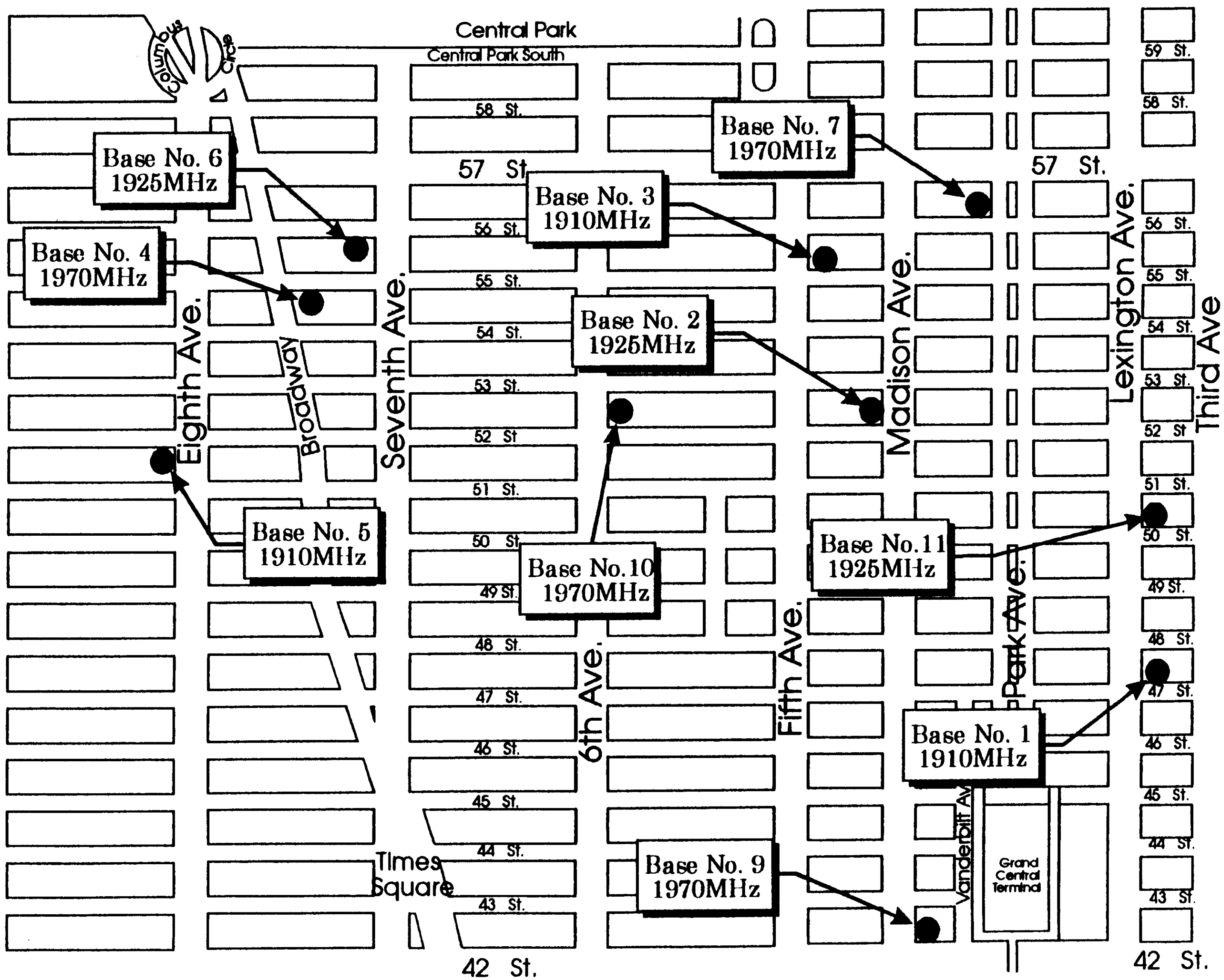
The last test in the series had the objective of showing how an entire neighborhood could be covered. Figure 2-7 shows the coverage from just the three perimeter installations. The test shows the high quality performance of slow speed communications under heavy shadowing conditions. Under these conditions, fades do not happen as quickly, but they are far deeper. This again points to the fact that average signal strength measurements do not give a complete description of signal quality.



Manhattan Test Base Station Locations
Configuration No. 1

mdtnbs04.cd

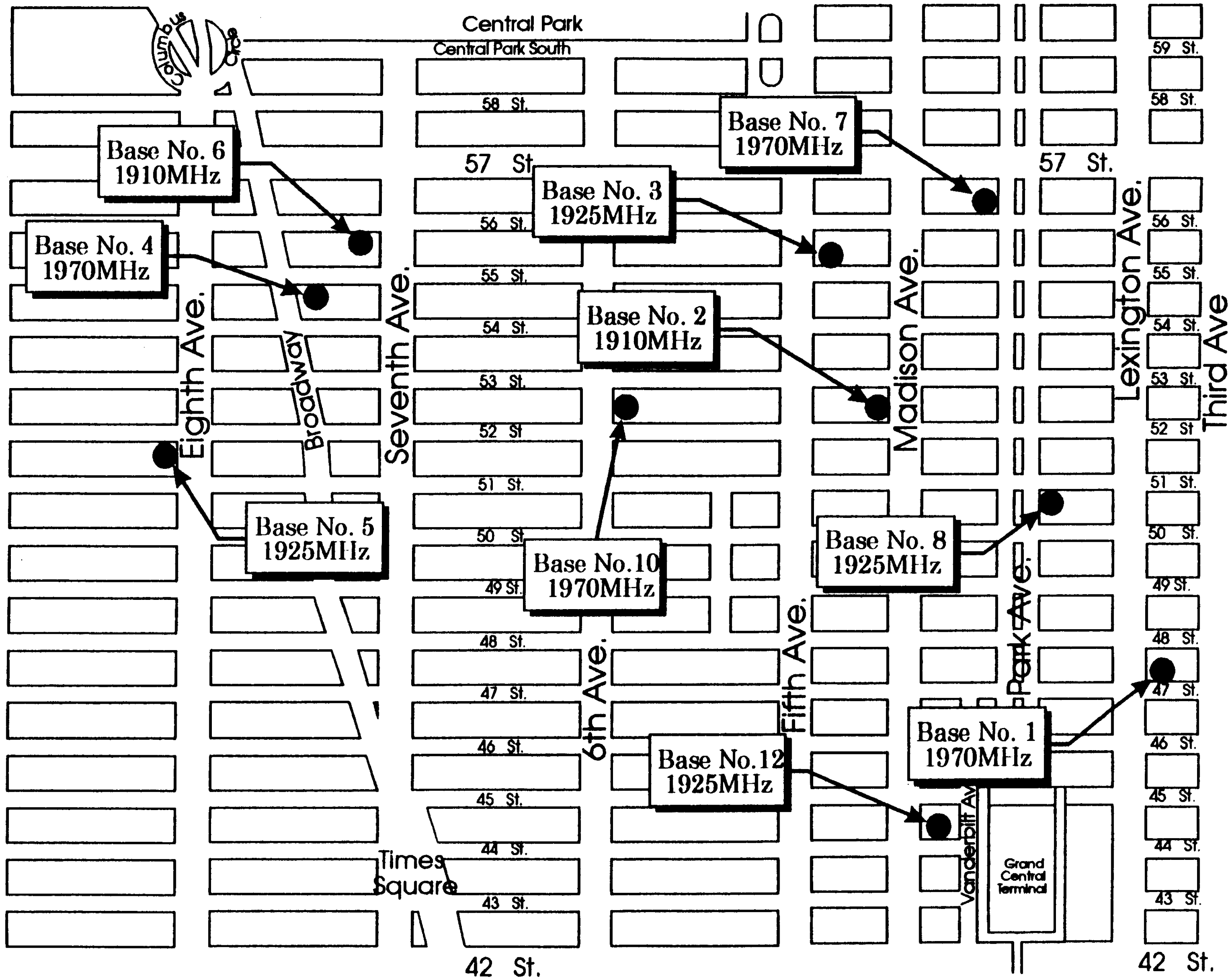
Figure 1-1



Manhattan Test Base Station Locations
Configuration No. 2

mdtnbs05.cdr

Figure 1-2



Manhattan Test Base Station Locations
Configuration No. 3

mdtnbs06.cdr

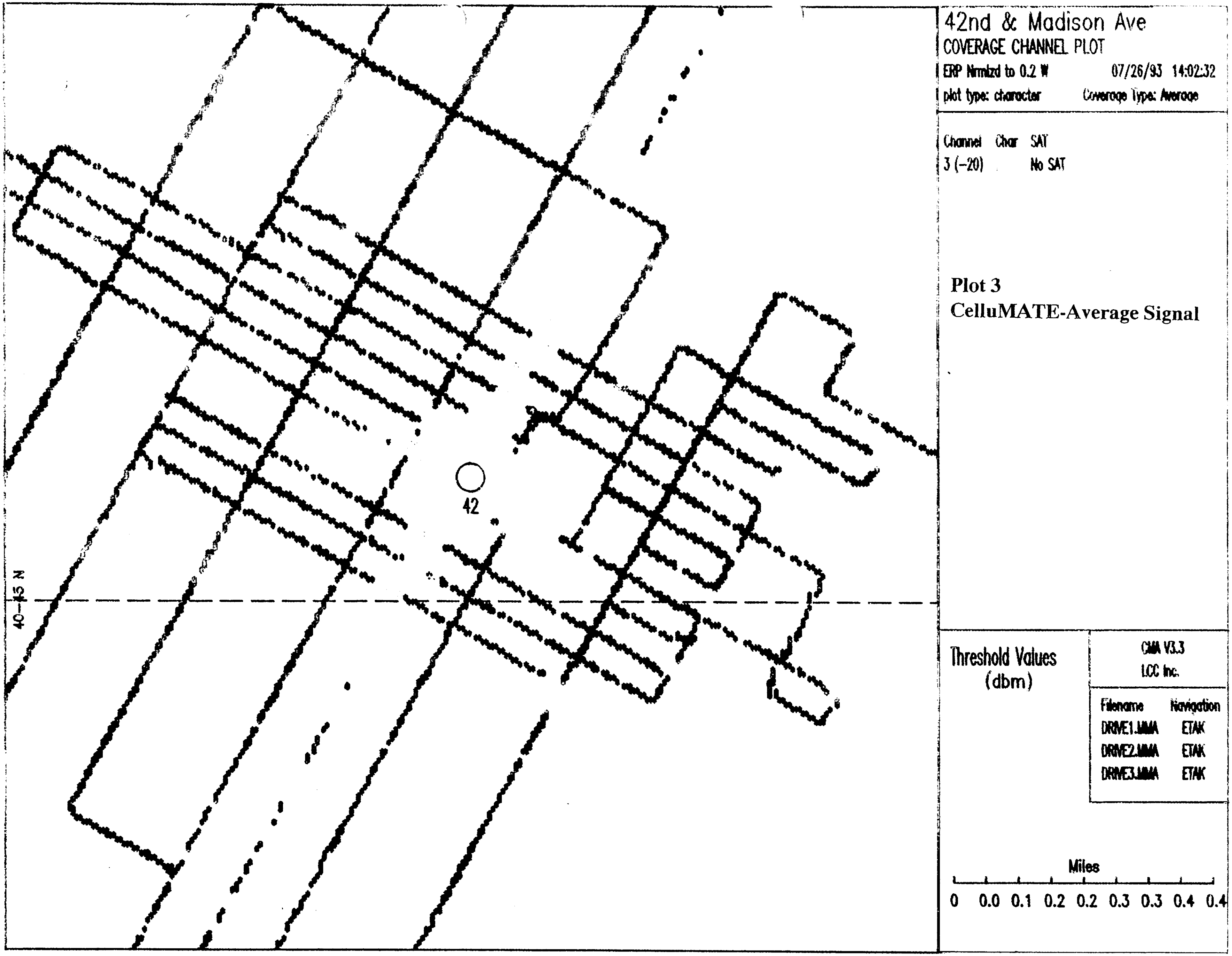

42nd & Madison Ave
COVERAGE CHANNEL PLOT
ERP Nrmlzd to 0.2 W
07/26/93 14:02:32
plot type: character
Coverage Type: Average
Channel Char SAT
3 (-20) No SAT
Plot 3
CelluMATE-Average Signal
Threshold Values
(dbm)
CMA V3.3
LCC Inc.
Filename Navigation
DRIVE1.MMA ETAK
DRIVE2.MMA ETAK
DRIVE3.MMA ETAK
Miles
0 0.0 0.1 0.2 0.2 0.3 0.3 0.4 0.4
42
40-45 N

Figure 1-4

2120 Hollowbrook Drive, Cc rado Springs, CO 80910

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
SPECIAL TEMPORARY AUTHORIZATION

EXPERIMENTAL
(Nature of Service)

K K 2 X C V
(Call Sign)

XD FX & MO
(Class of station)

S-1200-EX-93
(File number)

NAME OMNIPOINT CORPORATION

Vicinity of New York, NY
(Location of station)

Special Temporary Authority is hereby granted to operate the radio transmitting apparatus described below:

Frequency MHz	Authorized Power (watts)	Emission Designator
1850-2200	5 (ERP)	1

1. Licensee is authorized to use various modes of modulation, bandwidth, and data rates. None of these modes of transmission shall extend beyond the band band limits set forth above.

This special temporary authorization is granted upon the express condition that it may be terminated by the Commission at any time without advance notice or hearing if in its discretion the need for such action arises. Nothing contained herein shall be construed as a finding by the Commission that the authority herein granted is or will be in the public interest beyond the express terms hereof.

This special temporary authorization shall not vest in the grantee any right to operate the station nor any right in the use of the frequencies designated in the authorization beyond the term hereof, nor in any other manner than authorized herein. Neither the authorization nor the right granted hereunder shall be assigned or otherwise transferred in violation of the Communications Act of 1934. This authorization is subject to the right of use of control by the Government of the United States conferred by Section 706 of the Communications Act of 1934.

This authorization effective August 3, 1993 and
will expire 3:00 A.M. EST. December 31, 1993

FEDERAL
COMMUNICATIONS
COMMISSION

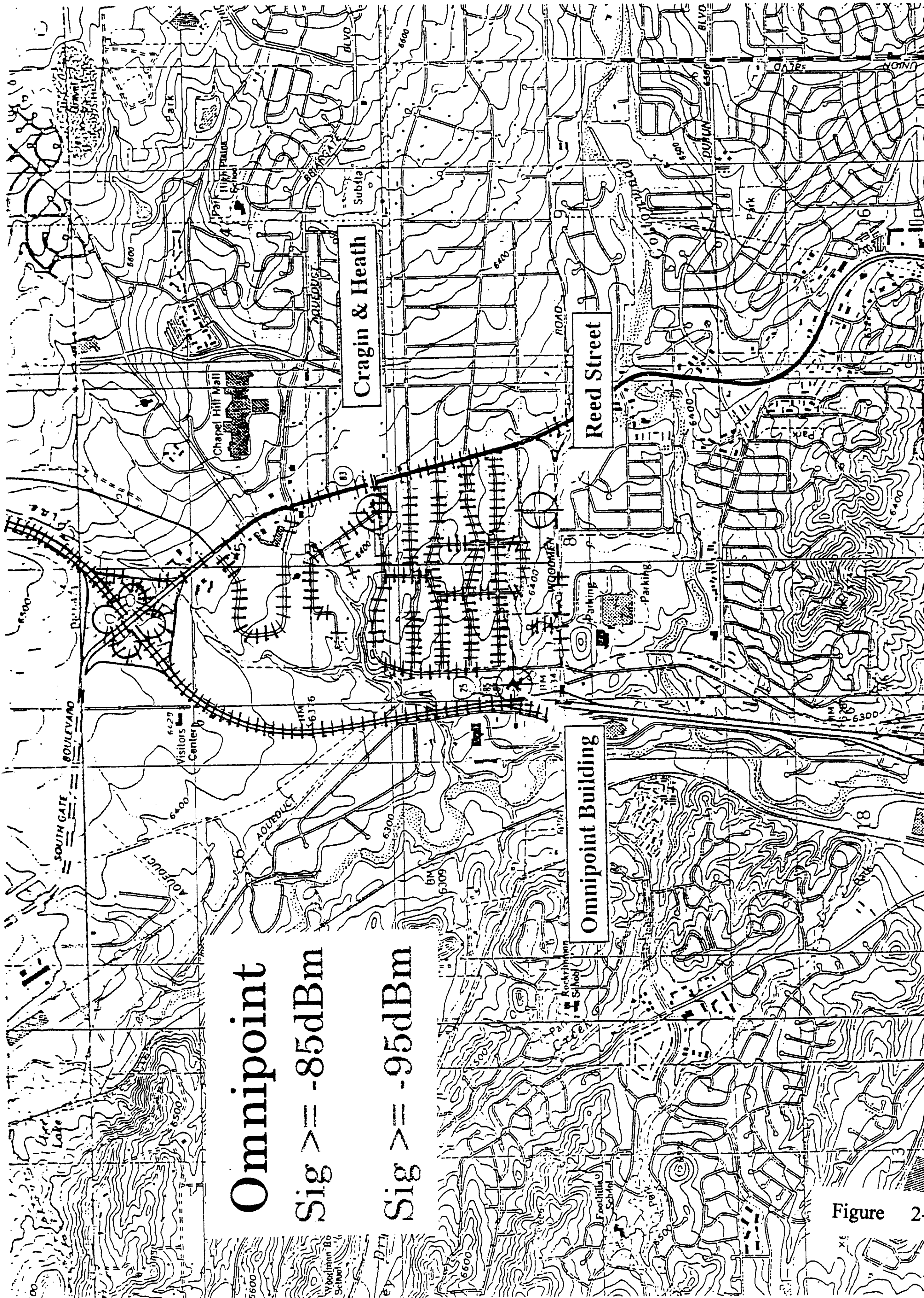

Omnipoint
Sig >= -85dBm
Sig >= -95dBm
Cragin & Heath
Reed Street
Omnipoint Building
Chapel Hill Mall
Visitors Center
SOUTH GATE
BOULEVARD
AQUEDUCT
WOODMEN
ROAD
Parking

Figure 2-1

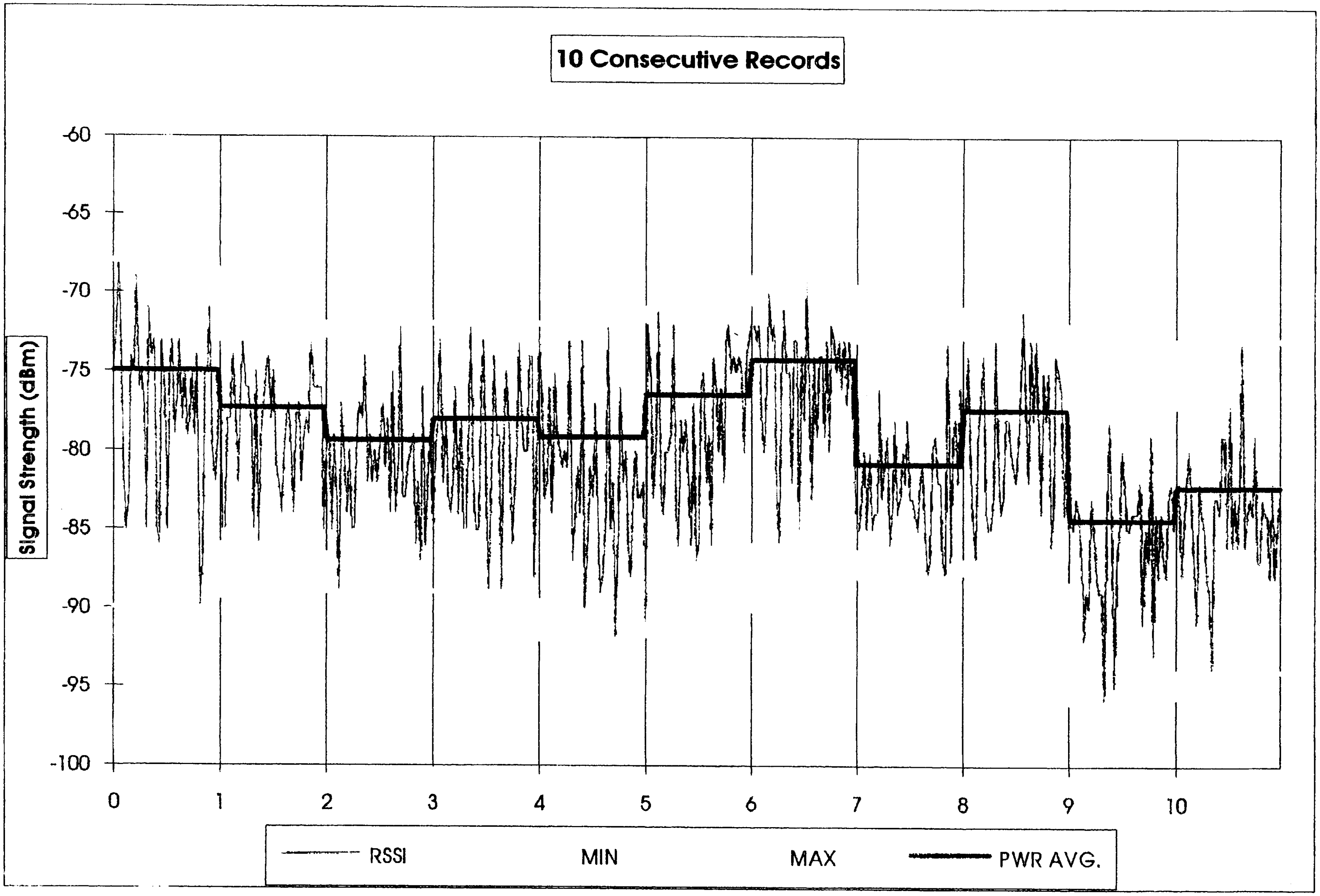

10 Consecutive Records
Signal Strength (dBm)
-60
-65
-70
-75
-80
-85
-90
-95
-100
0
1
2
3
4
5
6
7
8
9
10
RSSI
MIN
MAX
PWR AVG.

Figure 2-9

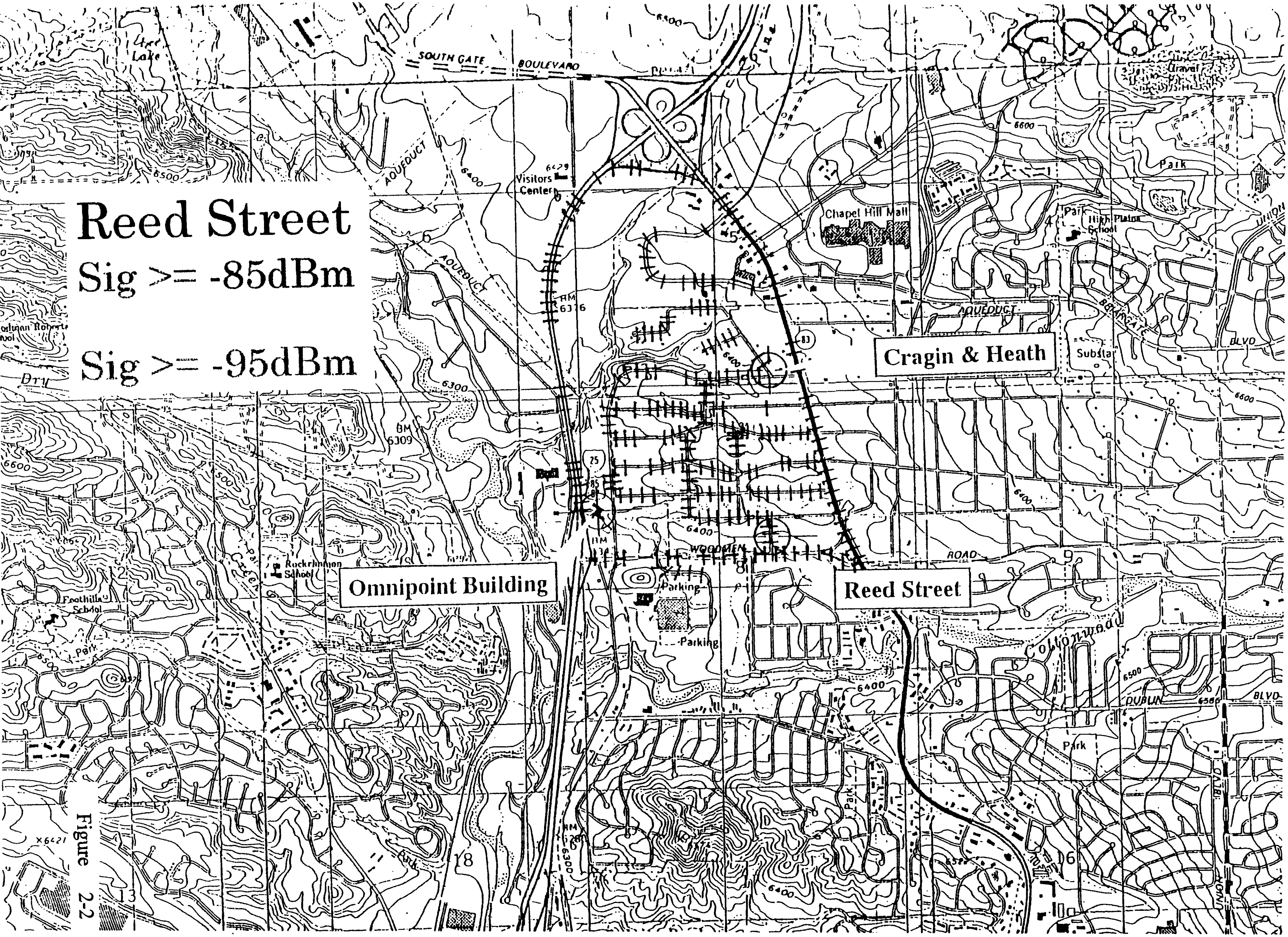

Reed Street
Sig >= -85dBm
Sig >= -95dBm
Cragin & Heath
Omnipoint Building
Reed Street
SOUTH GATE
BOULEVARD
AQUEDUCT
Visitors Center
Chapel Hill Mall
High Plains School
Park
Substa
WOODMEN
ROAD
Parking
Rockrimmon School
Foothills School
Cottonwood
DUBLIN
BLVD
Gravel

Figure 2-2

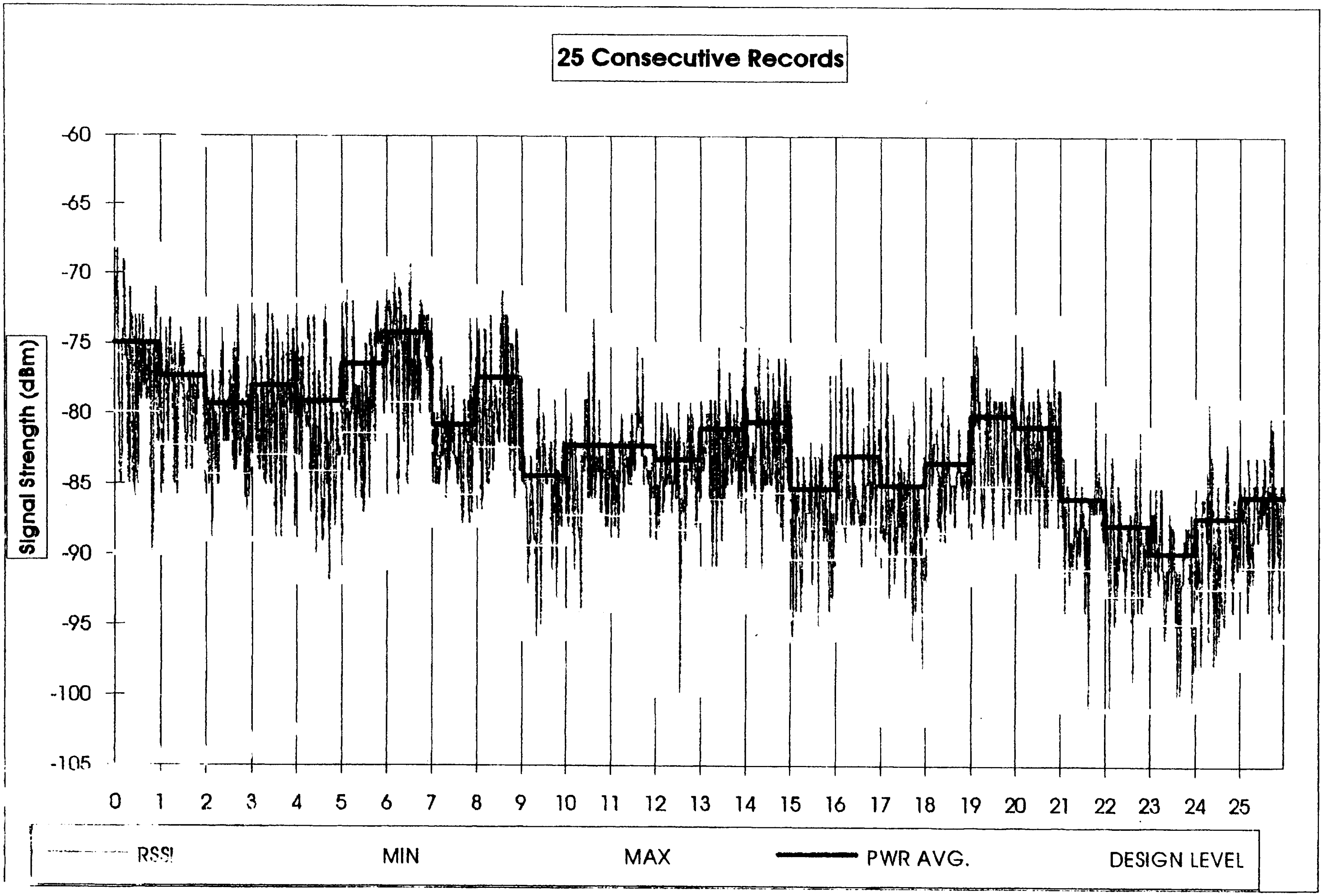

25 Consecutive Records
Signal Strength (dBm)
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
RSSI
MIN
MAX
PWR AVG.
DESIGN LEVEL

Figure 2-10

7150 Campus Drive, Suite 155, Colorado Springs, CO 80920

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
SPECIAL TEMPORARY AUTHORIZATION

EXPERIMENTAL
(Nature of Service)

K K 2 X C V
(Call Sign)

XD FX & MO
(Class of station)

S-1223-EX-93
(File number)

NAME OMNIPOINT CORPORATION

Vicinity of Colorado Spring, CO
(Location of station)

Special Temporary Authority is hereby granted to operate the radio transmitting apparatus described below:

Frequency MHz	Authorized Power (watts)	Emission Designator
1850-2200	5 (ERP)	1

1. Licensee is authorized to use various modes of modulation, bandwidth, and data rates. None of these modes of transmission shall extend beyond the band band limits set forth above.

This special temporary authorization is granted upon the express condition that it may be terminated by the Commission at any time without advance notice or hearing if in its discretion the need for such action arises. Nothing contained herein shall be construed as a finding by the Commission that the authority herein granted is or will be in the public interest beyond the express terms hereof.

This special temporary authorization shall not vest in the grantee any right to operate the station nor any right in the use of the frequencies designated in the authorization beyond the term hereof, nor in any other manner than authorized herein. Neither the authorization nor the right granted hereunder shall be assigned or otherwise transferred in violation of the Communications Act of 1934. This authorization is subject to the right of use of control by the Government of the United States conferred by Section 706 of the Communications Act of 1934.

This authorization effective August 5, 1993 and will expire 3:00 A.M. EST. December 31, 1993

FEDERAL
COMMUNICATIONS
COMMISSION

Wider Bandwidth Direct Sequence Spread Spectrum Signal Format Exhibits More Stable Propagation Characteristics In the Face of Multipath

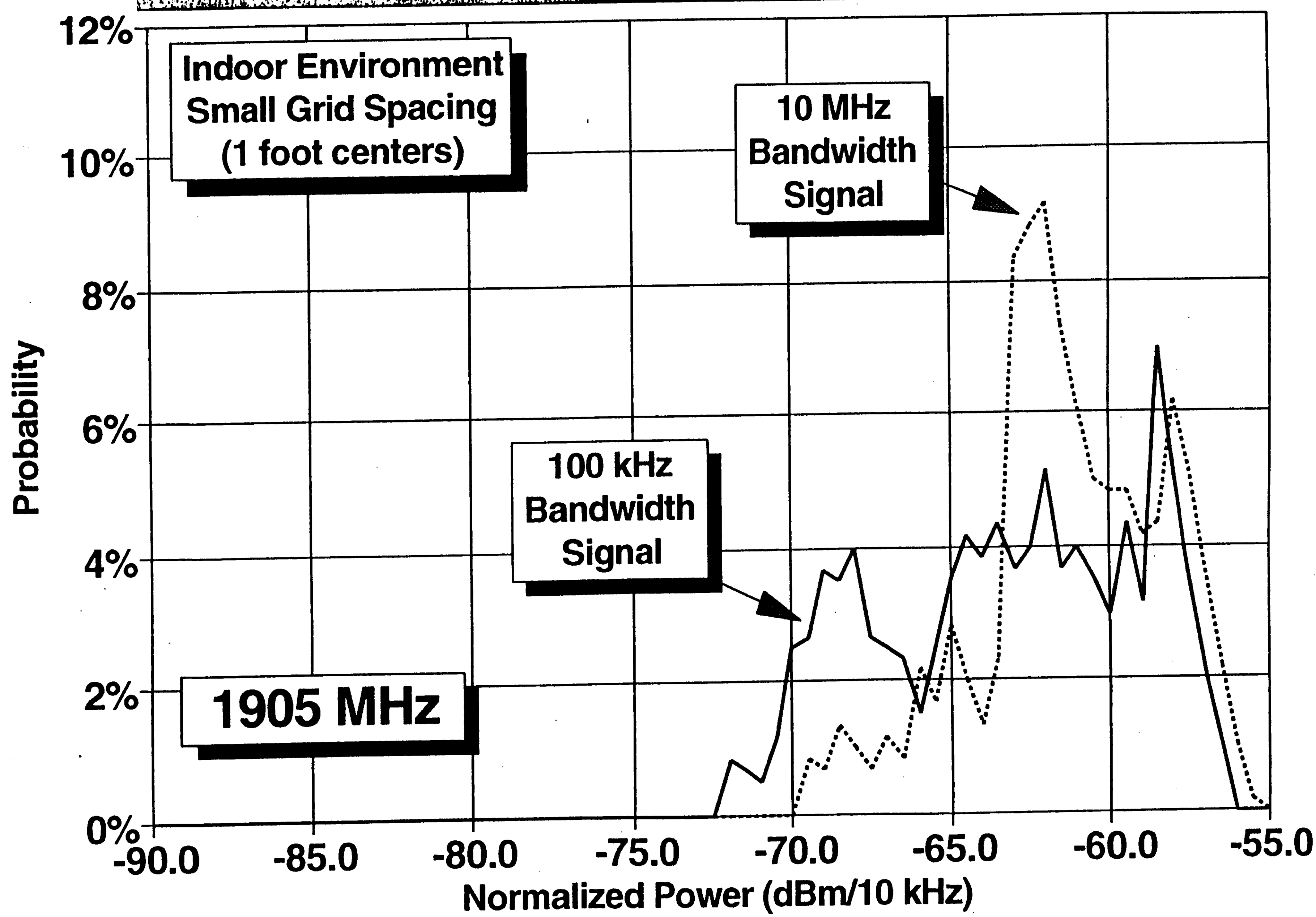


Figure 3-1

Wider Bandwidth Direct Sequence Spread Spectrum Signal Format Exhibits More Stable Propagation Characteristics In the Face of Multipath

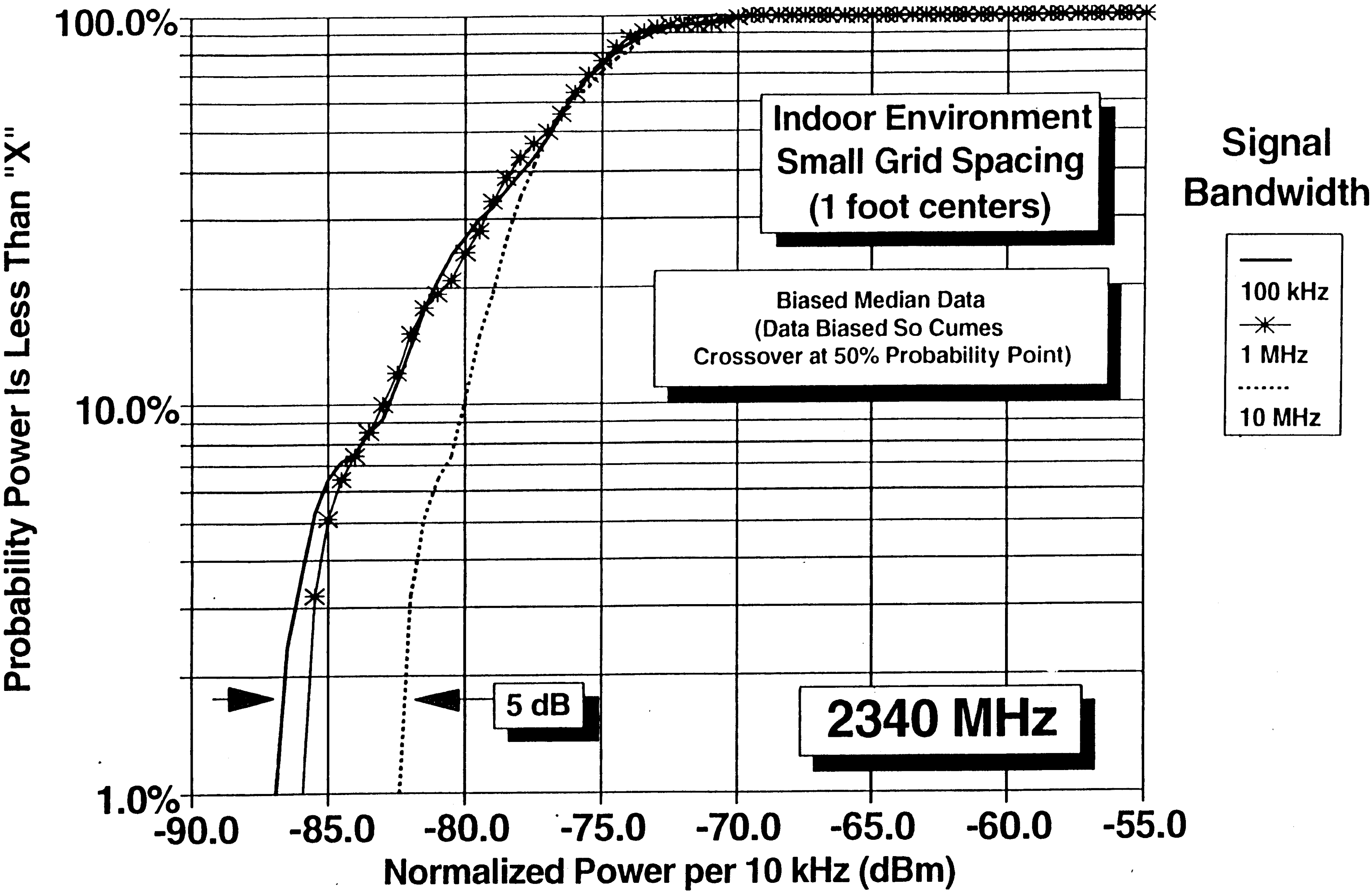
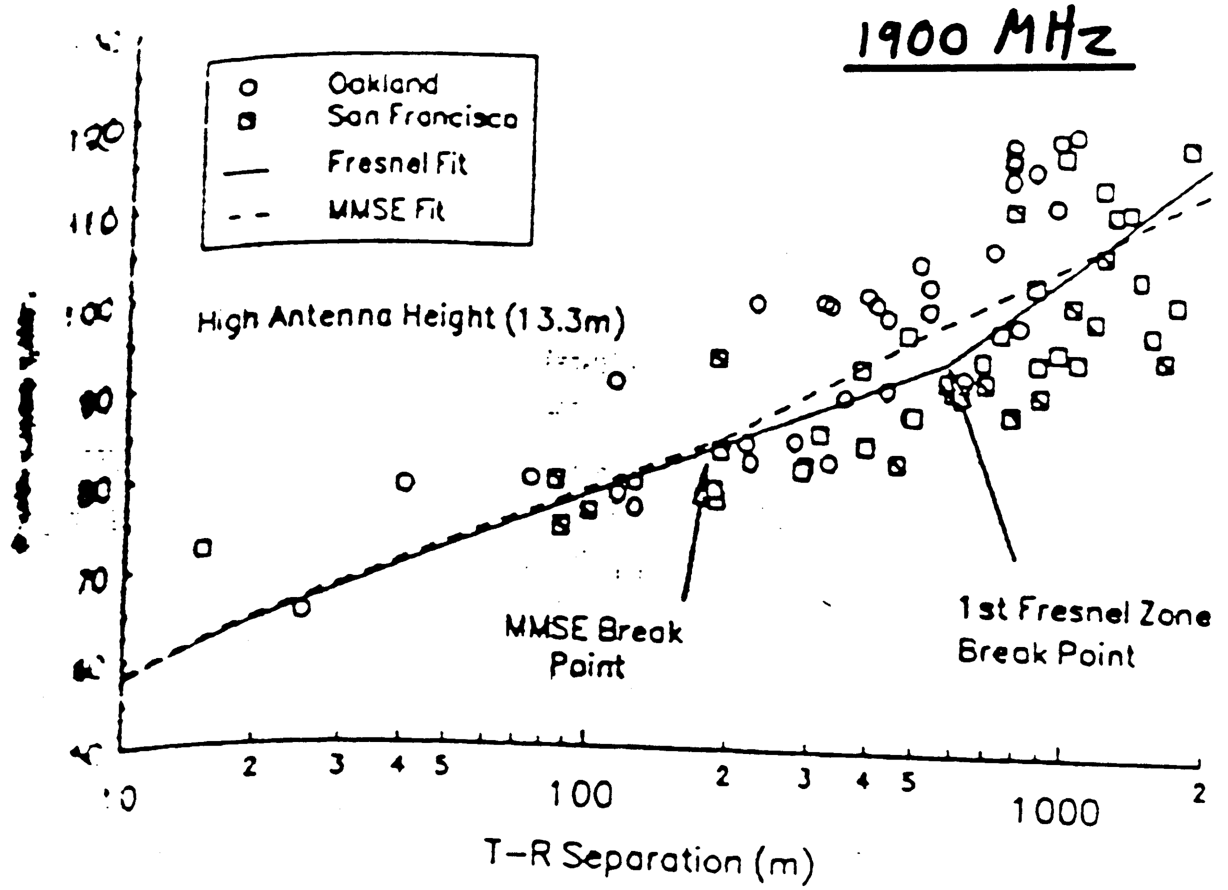


Figure 3-2



Path loss vs. T-R separation for high antenna height.

	Fresnel Best-Fit				MMSE Best-Fit				
	n_1	n_2	σ (dB)	d_f (m)	n_1	n_2	σ (dB)	d_b (m)	h_b (m)
Low	2.18	3.29	8.76	159	2.20	9.36	8.64	884	3.7
Med	2.17	3.36	7.88	366	2.14	6.87	7.23	884	8.5
High	2.07	4.16	8.77	573	2.03	2.79	8.34	190	13.3

Table 1: Path loss exponents, standard deviations, and break points for 1st Fresnel zone and MMSE break point curve fits for each antenna height.

5. Blackard et. al., *Path Loss & Delay Spread Models as a Function of Antenna Height for Microcell System Design*, IEEE 1992 Vehicular Technology Conference Proceedings.

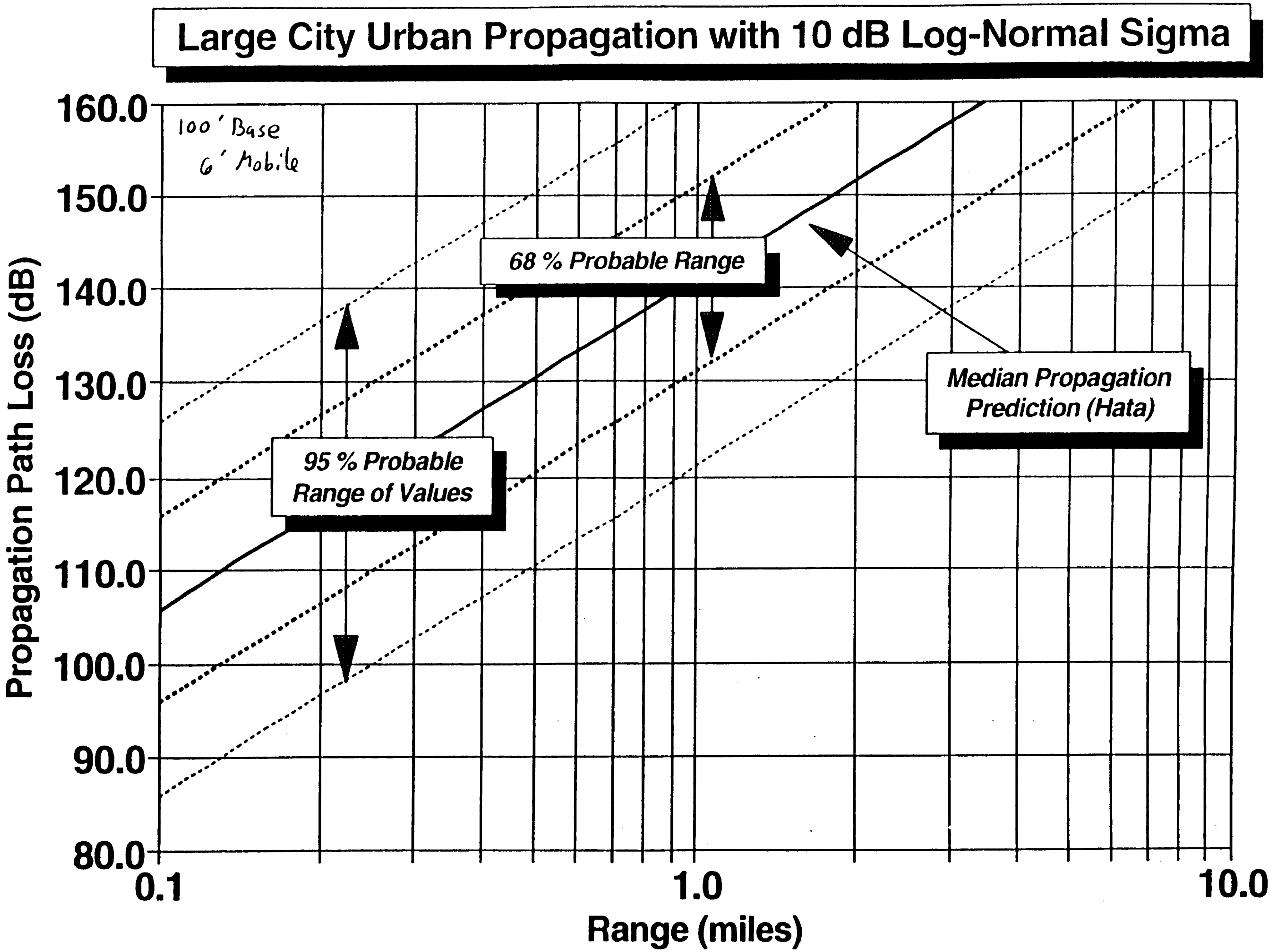

Large City Urban Propagation with 10 dB Log-Normal Sigma
100' Base
6' Mobile
68 % Probable Range
95 % Probable
Range of Values
Median Propagation
Prediction (Hata)
Propagation Path Loss (dB)
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
0.1
1.0
10.0
Range (miles)

Figure 3-4

PCS Cell Radius Will Be Much Smaller Because of Differences In Propagation and Expected Lower Handset Transmit Power

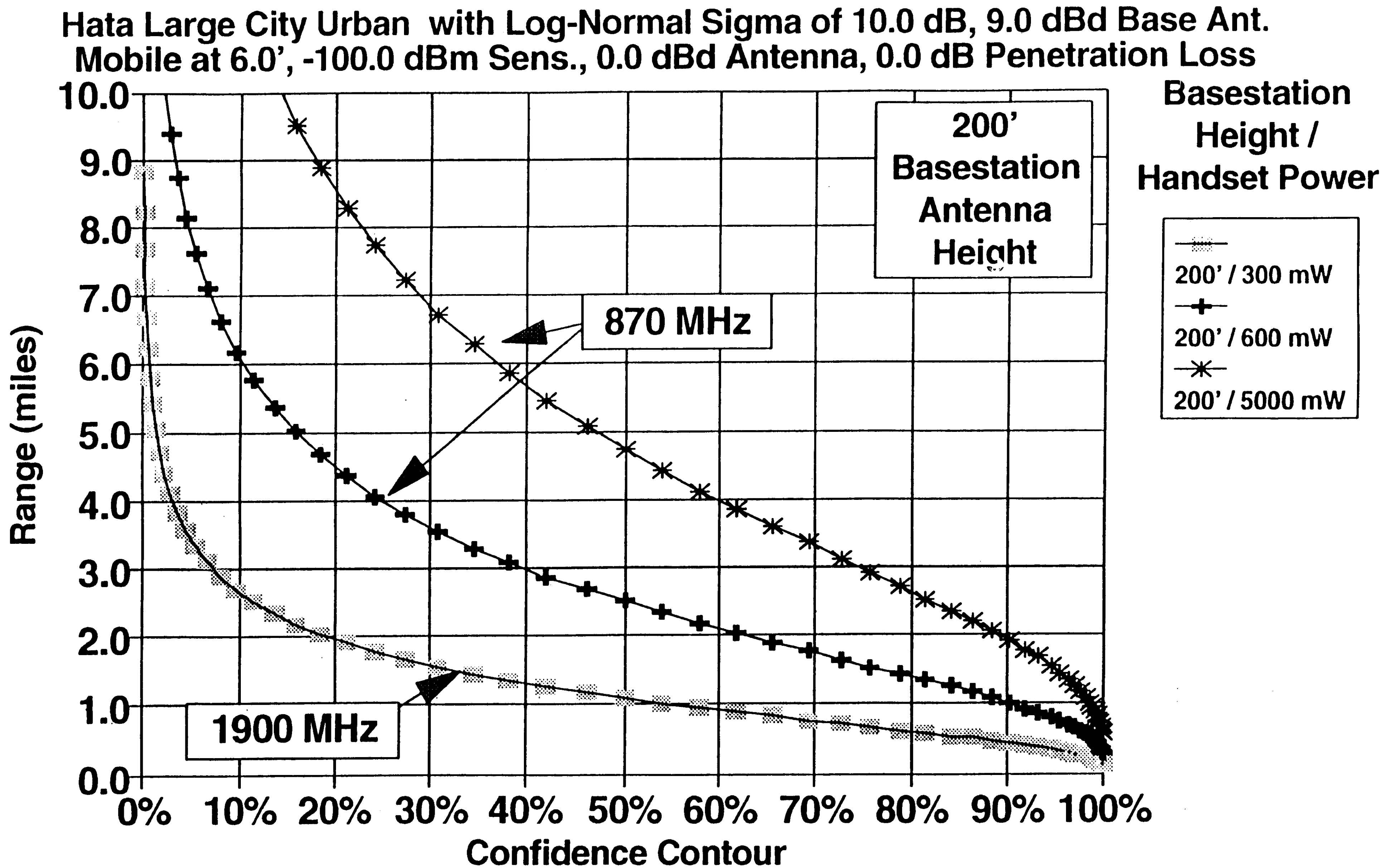


Figure 3-5

PCS Cell Radius Will Be Much Smaller Because of Differences In Propagation and Expected Lower Handset Transmit Power

Hata Large City Urban with Log-Normal Sigma of 10.0 dB, 9.0 dBd Base Ant. Mobile at 6.0', -100.0 dBm Sens., 0.0 dBd Antenna, 0.0 dB Penetration Loss

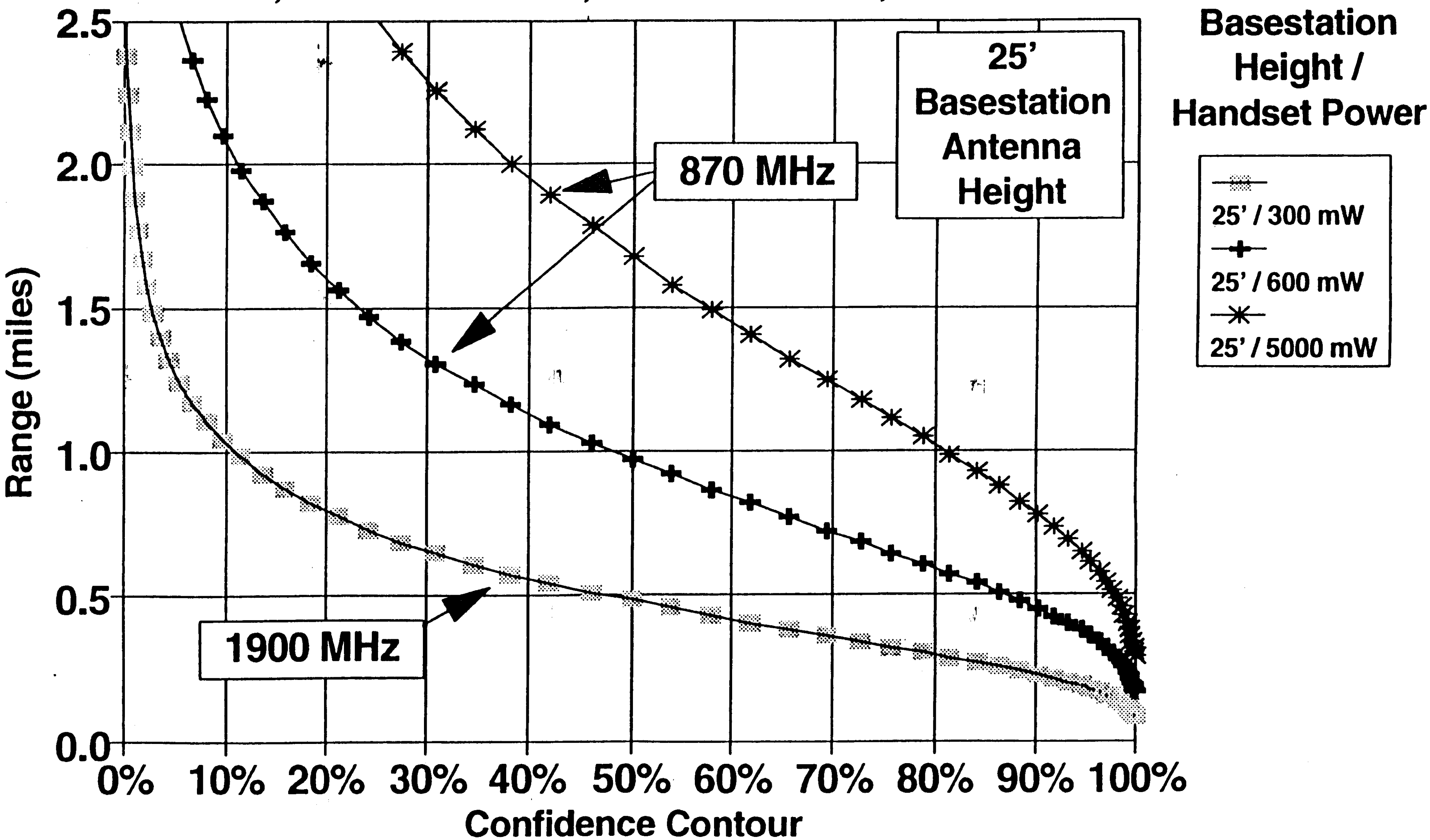
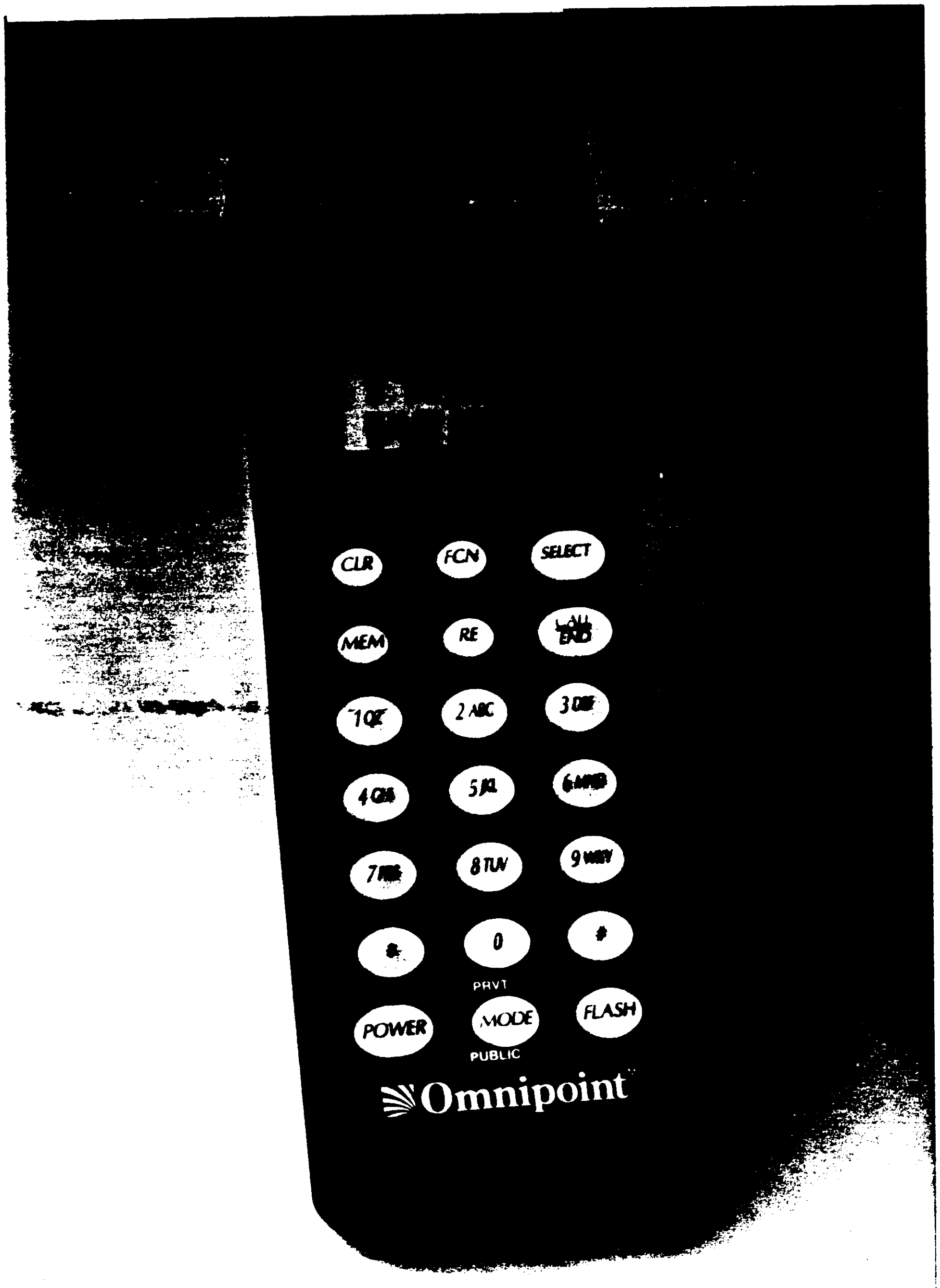
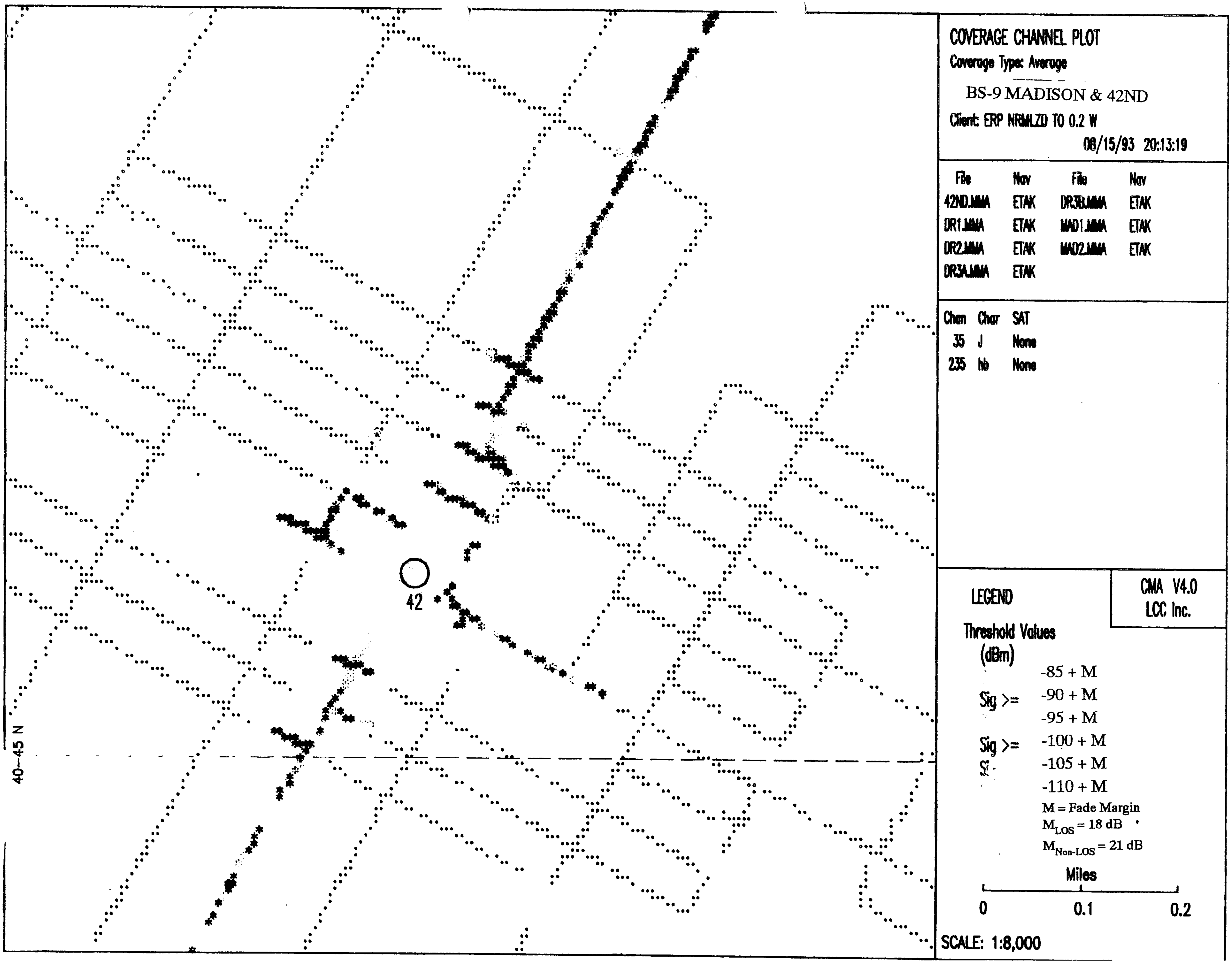


Figure 3-6


CLR
FCN
SELECT
MEM
RE
0
PRVT
POWER
MODE
PUBLIC
FLASH
Omnipoint


Omnipoint
CUSTOM
DISPLAY
Power
Master
Sync
Sync Cable


Omnipoint
blic Microcell



COVERAGE CHANNEL PLOT
Coverage Type: Average
BS-9 MADISON & 42ND
Client: ERP NRMLZD TO 0.2 W
08/15/93 20:13:19
File Nav File Nav
42ND.MMA ETAK DR3B.MMA ETAK
DR1.MMA ETAK MAD1.MMA ETAK
DR2.MMA ETAK MAD2.MMA ETAK
DR3A.MMA ETAK
Chan Char SAT
35 J None
235 hb None
LEGEND
CMA V4.0
LCC Inc.
Threshold Values
(dBm)
-85 + M
Sig >=
-90 + M
-95 + M
Sig >=
-100 + M
-105 + M
-110 + M
M = Fade Margin
M_{LOS} = 18 dB
$M_{Non-LOS}$ = 21 dB
Miles
0
0.1
0.2
SCALE: 1:8,000
42
40-45 N

Figure 1-5

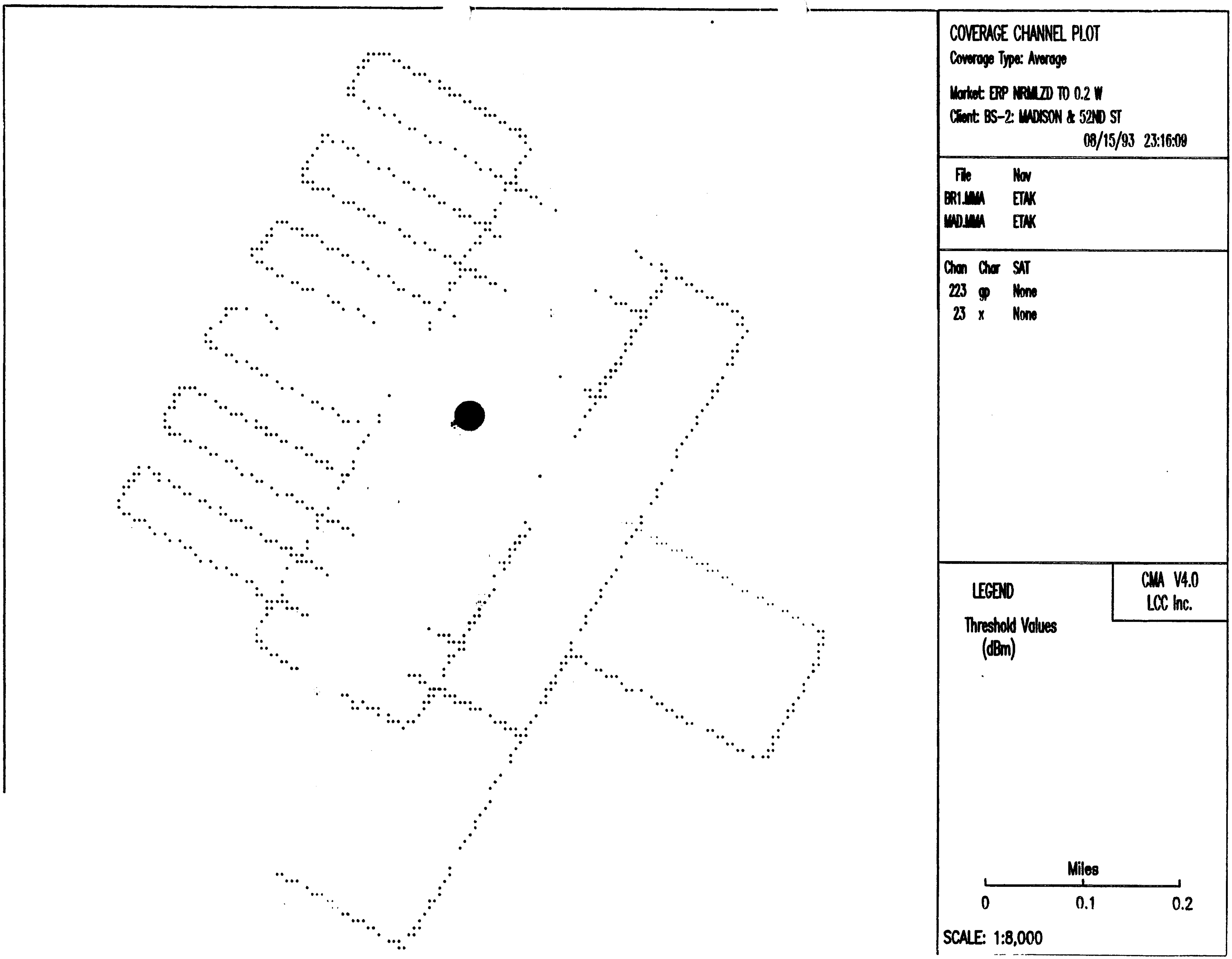
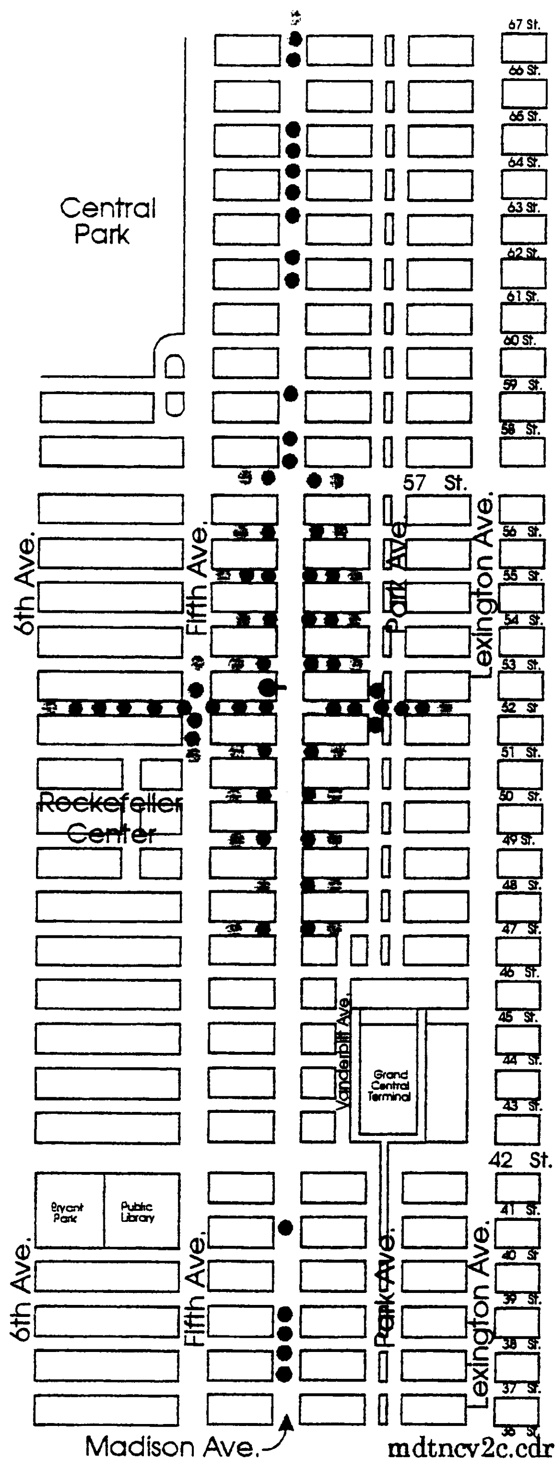

COVERAGE CHANNEL PLOT
Coverage Type: Average
Market: ERP NRMLZD TO 0.2 W
Client: BS-2: MADISON & 52ND ST
08/15/93 23:16:09
File Nav
BR1.MMA ETAK
MAD.MMA ETAK
Chan Char SAT
223 gp None
23 x None
LEGEND
Threshold Values
(dBm)
CMA V4.0
LCC Inc.
Miles
0 0.1 0.2
SCALE: 1:8,000

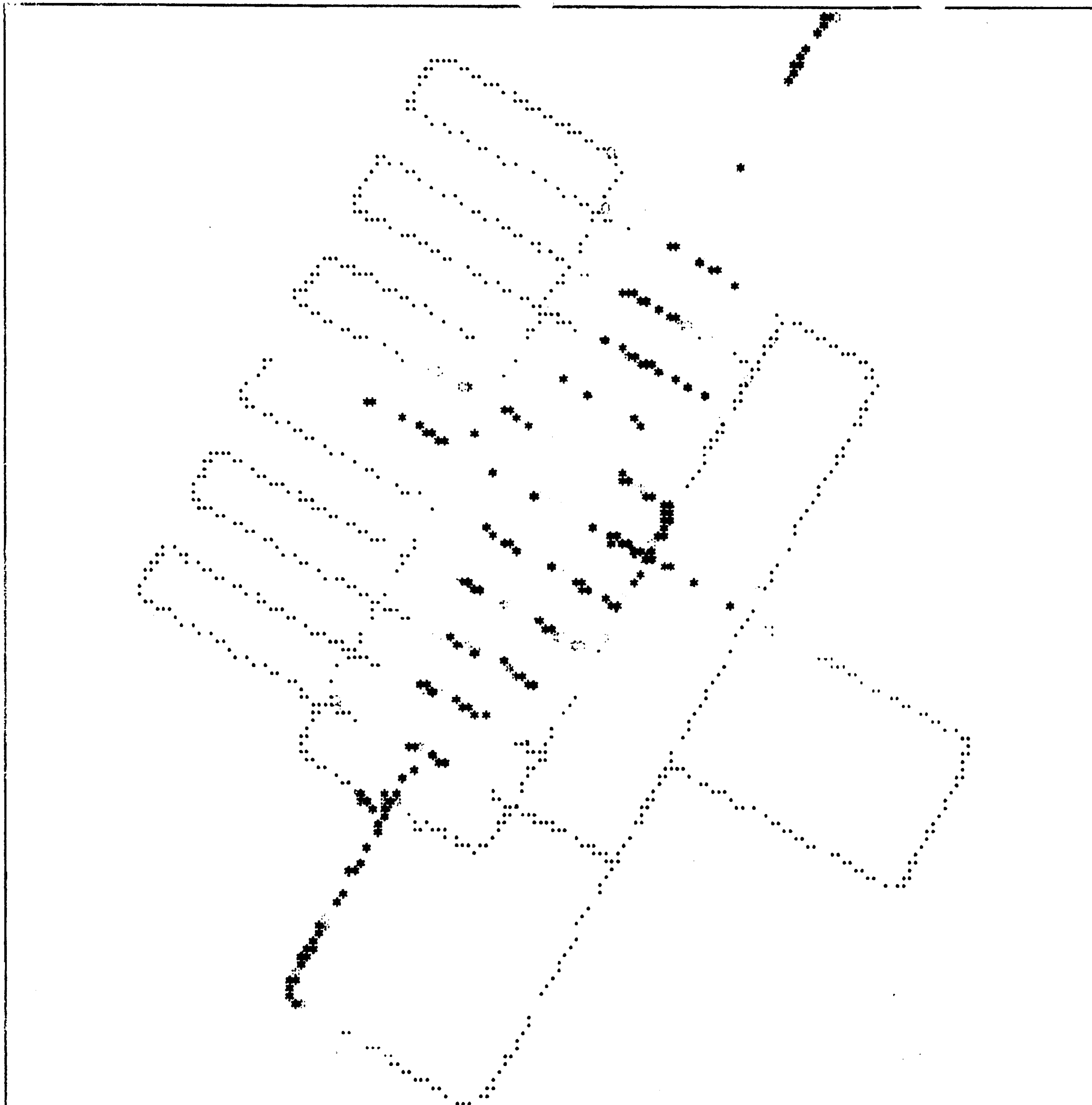
Figure 1-6

Omnipoint
CORPORATION



Coverage Plot: Base Site No. 2
52nd St. & Madison Ave.

Figure 1-7



COVERAGE CHANNEL PLOT
Coverage Type: Average

Market: ERP NRMLZD TO 0.2 W
' BS2 MADISON & 52
08/14/93 21:58:55

File	Nav
BR1.MMA	ETAK
MAD.MMA	ETAK

Chan	Char	SAT
223	gp	None
23	x	None

CMA V4.0
LCC Inc.

LEGEND

Threshold Values
(dBm)

-85 + M
Sig >= -90 + M
-95 + M
Sig >= -100 + M
-105 + M
-110 + M
M = Fade Margin
M_{LOS} = 18 dB
$M_{Non-LOS}$ = 21 dB

Miles
0 0.1 0.2

SCALE: 1:8,000

Figure 1-8