EXHIBIT 5

PROFESSIONAL INSTALLATION SPECIFICATION

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PROFESSIONAL INSTALLATION
SPECIFICATION
FCC ID: MS8-CellTrackIT-1

EXHIBIT 5

ws/ramarcel

PRIVATE AND CONFIDENTIAL

RAMAR
TECHNOLOGY LIMITED

Equipment Authorization Division,
Office of Engineering and Technology,
Federal Communications Commission,
7435 Oakland Mills Road,
Columbia,
Maryland,
United States of America 21046

File Ref: JM/LET/JULY99
WP Ref: FCC16_7.doc

Date: 16th July 1999

Dear Sirs,

RAMAR Technology Ltd. CellTrackIT product - FCC approval

Please find enclosed a submission by RAMAR Technology Ltd. for FCC approval of its CellTrackIT product.

We are seeking approval under the Professional Installation category for which three qualifying criteria must be met – marketing, professional installation and application. I have attached to this letter some additional notes which address these three specific requirements in support of the submission. Should you have any enquiries, please contact me at the earliest possible opportunity.

Yours faithfully,

Jon Melmoth
General Manager

PRIVATE AND CONFIDENTIAL

Professional Installation

Professional Installation requires demonstration that the equipment cannot simply be purchased and installed by the average technically inclined person according to the following three qualifying criteria.

1. Marketing

The device cannot be sold retail to the general public or by mail order. It must be sold to dealers.

RAMAR only sells all of its products via distribution partners. RAMAR neither sells to the general public or end users directly, and RAMAR products are only available from the specialist catalogues supplied by partner distributors.

A formal trading Agreement is in place with each partner. The complete set is therefore limited. The partners deal only with other business organisations which are mainly professional utility and service organisations.

2. Requires professional installation

Installation must be controlled, installed by licensed professionals, and installation requires special training.

CellTrackIT is one element of a low range cellular radio system designed to offer meter reading facilities. Meters are equipped with RAMAR Transponders that are also FCC compliant, and these communicate with CellTrackIT which are firmware configurable to operate either in a repeat mode (to pass through radio messages) or data collection for interface with an PC. The repeat mode is triggered by operational Transponders, the data collection mode requires configuration at the PC by a skilled operator using custom software for which training is necessary.

The meter reading system uses a protocol proprietary to RAMAR. Because of its proprietary nature, CellTrackIT will only operate with RAMAR Transponders which are distributed via a defined set of partners as in 1 above. The Transponders are dispatched to Partners in an off state in order to comply with freight regulations. They cannot transmit until they have been configured by a skilled operator who requires a bespoke item of hardware, custom software, and training in the configuration process. The process requires specialist skills and training because of the parameters that need to be set and the options that are available to make the Transponder operational.

RAMAR conduct training courses for all staff who will be involved in the installation of a CellTrackIT system. These staff will be certified accordingly.

In summary:-

a) CellTrackIT cannot transmit unless there are configured RAMAR Transponders within close proximity of the unit, or it is configured to do so by a certified installer at the PC.
b) Transponders are shipped to the distributor in an off state, and specialist skills and equipment is necessary to configure them to transmit.
c) CellTrackIT will only transmit in response to RAMAR's proprietary protocol.

3. Application

The intended use is not for the general public. It is for industrial and commercial use.

RAMAR's CellTrackIT product is designed specifically for automatic meter reading. The protocol used by the system is tailored for this purpose. It uses short transmissions that make it inappropriate for other applications. The system can only operate with RAMAR products because of the proprietary nature of the protocol. It is sold via partners who deal exclusively with other business organisations involved in metering and utility services. RAMAR products are not available to the general public.

EXHIBIT 6

INSTALLATION AND OPERATING INSTRUCTIONS

INSTALLATION AND OPEATING INSTRUCTIONS

INSTALLATION & OPERATING
INSTRUCTIONS
FCC ID: MS8-CellTrackIT-1

EXHIBIT 6

RAMAR

TECHNOLOGY LIMITED

CellTrackIT

Installation and operating instructions
Version 0.5 (draft)

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Contents

Introduction.

The CellTrackIT Manual is designed to provide both the "Trainer" and the "Installer" a basis from which a CellTrackIT system can be effectively and efficiently planned and installed. It is assumed that the end user has limited to no knowledge of radio frequency application. The Manual covers all the essential and basic procedures that a system designer/installer must follow to design an efficient system. It also provides the basis from which the installer can implement the design plan. In most cases, the individual designing the network will also install the system at the submetering site.

CellTrackIT System Concept.

RAMAR Technology's product entry into the submetering market consists of the CellTrackIT system. With this new technology RAMAR plans to capitalize on the growing need within the utilities market to submeter apartment complexes.

The CellTrackIT is a cost effective entry product designed to operate as a cell network with up to 500 TransPondIT meter interface units (MIUs). It consists of three types of functional components: the transponders, repeaters, and node receiver unit connected to a Personal Computer (figure 1).

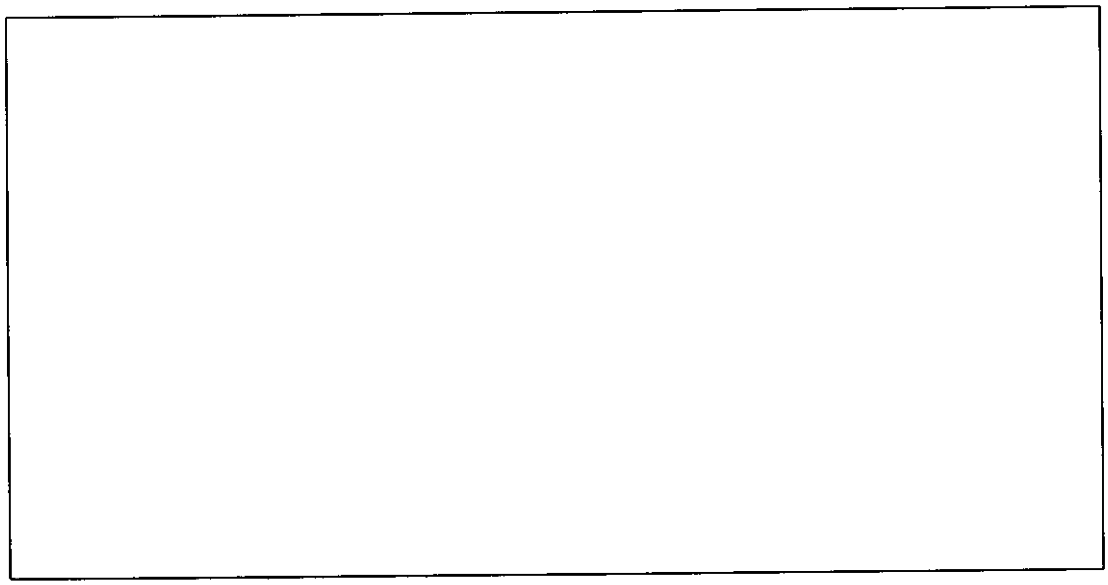

Figure 1. CellTrackIT Cell Network

Operation. The complete system is modeled as a self-contained cell network adaptable to a variety of submetering applications. The number of units and the terrain makeup of area covered determine the size of the network.

The CellTrackIT is a two tier, one way radio system based on an improved transponder technology and Spread Spectrum methodology for radio wave propagation. The two-tier approach offers flexibility and robustness while ensuring data integrity from the MIUs to the data collection computer within the network. With the two-tier approach the range of the transponders is also increased allowing for large site coverage. The system uses an open architecture approach for data integration with existing billing systems.

The first tier comprises of transponders transmitting to a repeater. Each repeater receives the transponder's signals and then retransmits them to the Node Receiver-computer combination. This back link from repeater to computer is the second tier of the network. The data is transmitted using a spread spectrum transmission scheme. The Node Receiver converts the signals to ASCII data and sends it via a COMM cable to the Personal Computer.

The CellTrackIT unit can be set up as repeater or a node receiver unit. In the node receiver mode, the unit configures itself as a node whenever it is connected to a PC running CellTrackIT software, via an RS232 cable. The node receiver function is automatic upon the CellTrackIT unit sensing the connection and doesn't require any further action on the part of the installer.

The data that resides within the PC can be accessed by telephone line for remote management or locally through the on screen program.

All CellTrackIT systems have a minimum of one repeater. This allows for flexibility in placing the receiver unit and the data collection computer. In smaller apartment complexes a CellTrackIT with one repeater should be sufficient to cover the area. In larger apartment properties the network will contain more repeaters.

Radio Frequency Propagation.

Radio Frequency Propagation is the transmitting of a radio signal through a possible hostile radio environment so as to reach the intended receiver. The straight-line direction to the intended receiver is often termed *Line of Sight*. In a CellTrackIT system, the Line of Sight is essentially a straight-line path of the radio wave from the transponder antenna to the repeater antenna and from the repeater antenna to the node receiver antenna. Any obstacle directly in the Line of Sight will impede the ability of the radio signal to reach the intended receiver. Propagation will also encompass those obstacles.

How to resolve the obstacles and improve propagation issues is what network design is all about. The designer has to be able to overcome the many influences that impact the signal as it travels from the transponder to the repeater and then to the node receiver. When planning the network the designer must consider the distance the radio signal must travel (maximum

range of signal) and the medium (building walls, trees, rain, etc.) through which it must penetrate to reach its destination.

Range. The range of radio AMR systems varies according to the type of installation. The radio signal must propagate from within steel pits, office buildings, or, as in the case of submetering, multi-housing dwellings.

The impact on the radio wave caused by the different environmental obstacles is called the *signal path loss.* As the radio wave passes through these obstacles, the wave is weakened or *attenuated* by *reflection*, *diffraction*, or *scattering*. The end resulting signal that is received is a combination of the signal that has been reflected, diffracted, and scattered. Depending on the obstacles between transmitter and receiver, range can be dramatically different.

In-building. In an in-building installation, the range issue is more complex. Reflections off walls and interior furniture can hinder a radio signal from reaching the intended receiver. The construction of the interior walls both attenuates the radio signal depending on whether the walls are concrete, sheet rock, or basic paneling and reflects the signal into what is referred to as "multipath signals.". Multipath signals add to the "noise" level at the receiver end. When large metal objects, such as walk-in safes, elevator shafts, or metal furnaces are located in a building, the potential for "nulls" exists. Nulls are areas where the signal is completely blocked or eliminated by conflicting reflected radio signals.

Regulatory Notice.

Federal Communications Commission (FCC) notice

The following notice is valid for CellTrackIT unit when operated as a node receiver.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

WARNINGS!

- Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

- The equipment is only authorized for use with the antenna and special accessories specified in Appendix 3 of this User Manual.

- The equipment must be professionally installed. The equipment is only authorized for use provided it is installed by qualified installers that have received the RAMAR certified training in the design and installation of the system.

- The CellTrackIT is solely industrial and commercial in nature, therefore it can not be sold to the general public.

Label Requirements. RAMAR complies with FCC and Underwriters Laboratory (UL) requirements. The label attached to the CellTrackIT unit specifies this compliance. *If the label is missing, please contact RAMAR before installing the system.*

Safety Warning. The CellTrackIT unit is a self-contained product with no serviceable user parts within. For safety reasons do not open or modify the unit from its original usage. If the unit is defective please refer to the warranty for disposition or call RAMAR customer service. Under no circumstances should the unit be opened for inspection or troubleshooting. The power cord receptacle is designed for standard AC power of 110-125 VAC at 10 amps. It is strongly recommended that the power source outlet be protected against overloads, short circuits, or surges in accordance with local and national wiring code regulations.

Warranty. Opening the CellTrackIT voids the warranty and may result in the user paying for all costs normally covered under warranty.

Planning the CellTrackIT Site.

The CellTrackIT system installation consists of two phases: *Planning* where the network is conceptualized and designed and the *Installation* phase where the plan is applied to the location. Both parts are essential in ensuring proper installation of the RAMAR system.

Making the connection radio-wise from the transponders to the Node Receiver will require some plotting on the site map. This planning determines the scope of the installation prior to an actual site visit or CellTrackIT installation. Planning is important in that it sets the parameters, assumptions, and basic layout of the installation. Planning is essential not only in determining where to effectively place the node and repeaters, but also when factoring cost per points. By planning the site, the cost per point can be reduced.

The planning aspect of the installation is geared towards determining the economical viability of the cost per point projection. It is also a tool for visually assessing how the network will look once the system is physically placed at the location. Finally, the planning documentation becomes the blue print for the installers whenever the project is approved for implementation.

- **Planning Procedure Overview.** Planning encompasses certain procedures which are critical for implementing the design concept. The following outlines the process:
    - Gathering Data
    - Define Site Type under Consideration
    - Define the RF Range for First and Second Tiers
    - Place Node Receiver and Repeaters
    - Optimize for Network Efficiency
    - Calculate Costs per Point

Gathering Information.

The most critical aspect of installing a CellTrackIT system is the gathering of pertinent data to properly design the system at a submetering location. Without the correct information, the whole design process is compromised and the installation of the CellTrackIT will be less efficient. Poor efficiency translates to an increase to overhead costs that inflate the cost per points projection. The goal of an efficient installation is to minimize the number of repeaters per system while maximizing the reception of each transponder signal. Data gathering then is a crucial step towards that goal. The following chart is a tool for assisting in gathering information, which will be used later for determining site type and component locations.

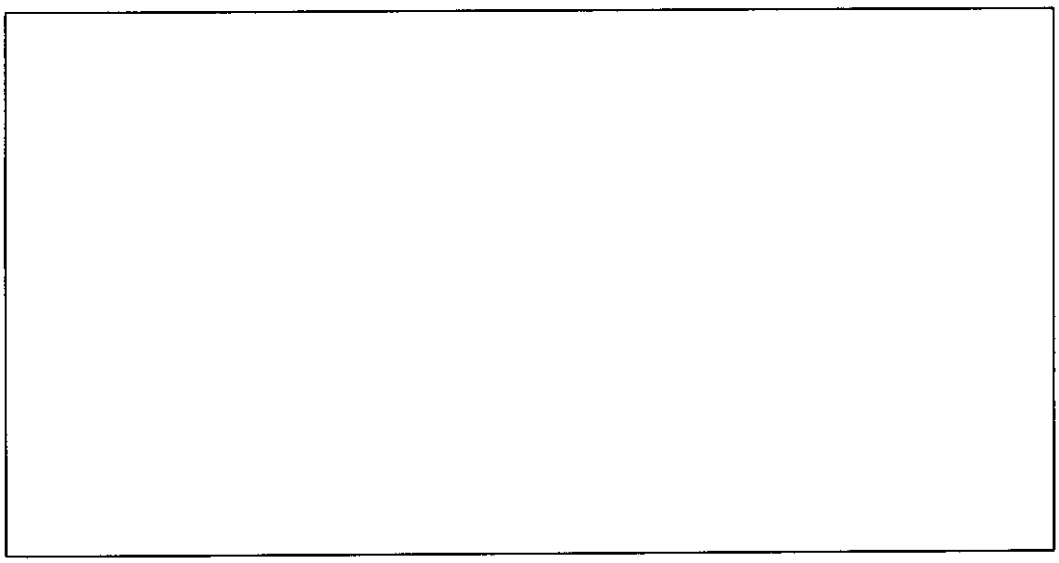

Figure 2. Data Gathering Input Form

Site Map. The data collection effort starts with the site map. The site map shows location of the buildings and trees plus the dimensions of the property. The length and height of each building, the length and width of the property, and type of landscaping terrain should be noted on the site map. Using the site map and any other background information on the location is helpful in determining the type of site the CellTrackIT system will be installed in.

Building Construction. Building types have to be considered when determining the range of the installed transponders. The type of construction will determine, among other things, how much attenuation the signal will receive. The increased attenuation of the transponder signal due to heavy construction leads to a reduced range. Building construction falls into various categories: reinforced concrete, concrete, wood, particleboard or vinyl. Identify the construction type of the site buildings as part of the information gathering process.

Landscaping. Trees and shrubs cause scattering of radio signals and therefore must be included when planning the network. The terrain plays an important part in determining how many repeaters are needed. A dense vegetation coupled with ridges and valleys results in a reduced RF range therefore an increase in ratio of repeaters to transponders.

RF Environment. Any external radio signals operating at the same or near same frequency as the CellTrackIT system will create interference that will reduce the transponder range and must be compensated for. Identifying potential RF interference is simply a matter of identifying radio towers, antennas, tall buildings, trees, or other AMR systems that are located in and around the site. Most radio systems operate at peak output during the

daylight hours with diminished signal trafficking during the night. Planning must take into account the operational hours of these various radio systems to ensure that the system is designed for maximum efficiency with the minimum number of repeaters.

Two simple ways to ascertain heavy radio traffic within the area is by: (1) conducting a site RF survey as outlined in Appendix 4 or (2) planning for max reception when the interference is at its lowest (usually after 11 PM and before 7 AM). If the CellTrackIT system functions perfectly during the noon and afternoon hours then interference is not an issue. When installing the CellTrackIT it is best measured for initial functionality and efficiency during the early morning hours instead of later during the day.

In some cases, the RF interference may require an independent assessment. Sites that are located in cities, high rise buildings, or near large commercial activities (airports, military bases, communication centers) may also need a RF interference study. Paging systems within buildings or other radio systems do impact on the functionality of the CellTrackIT. When analyzing the site for a CellTrackIT, identify the buildings in the area that have radio systems. If the area does have these systems, then do a RF interference survey as described in Appendix 4.

Planning Factors.

Certain factors influence the design of the CellTrackIT. These factors are key in the successful implementation of the system within a site.

Distance. Height and distance play an important part in determining the transponder signal strength being received at the repeater antenna. Distance in particular impacts on how strong the signal will be received. The closer the transponder is to the repeater, the stronger the received signal becomes. This is because distance contributes to signal loss by attenuating the radio signal. The range from transponder to repeater is entirely dependent on environmental factors.

Height. The location of the antenna determines how well the antenna is capable of receiving the Transponder signals. When doing radio links consider the height of the receiving antenna as a factor for determining line of sight and range. Normally, the higher the antenna the further the distance allowed. If, after placing the repeater within the recommended planning range, the repeater still can't pick up transponder signals then implement one of the two choices: (1) raise the antenna height or (2) move the repeater closer.

Line of Sight. Any obstacle between the transponders and the repeater antenna will result in an attenuated signal. Besides the obvious obstacle of the inner and outer building walls, there will be trees and shrubs associated with the site that will block the radio signal. A site with lots of trees and shrubs will require that the repeater to transponder distances be reduced to compensate for signal loss.

Node Receiver Location. The best possible central location where the CellTrackIT PC will be installed needs to be identified on the map. If the CellTrackIT PC has to be located other than at a central location (such as in the clubhouse or main office) then care must be taken when designing the network to ensure all repeaters are within the radio range of the node receiver. The PC location determines where the node receiver will physically be within the network.

Repeater Location. The repeaters are designed for internal attic or roof space installation only.

Controlled Environment. The CellTrackIT PC needs to be placed in an office environment where the ambient temperatures are within the 32 to 104 degrees Fahrenheit. When possible, try locating the CellTrackIT PC in a central location within the site map.

AC Power. The power requirement for each CellTrackIT is the standard 110 - 125 VAC. Each repeater will require a power conduit with the AC voltage at its location in the attic or inner roof area. The ability to meet this requirement must be considered when placing repeaters on the site map. A 110 –125 VAC power source will also be needed for the PC and node receiver.

Telephone. Each site will require at least one dedicated telephone line. Once the location of the CellTrackIT PC has been determined and approved then the system designer needs to notify the proper person(s) to ensure that the line is installed. Make absolutely sure that the telephone installer understands that the line is a dedicated line for the CellTrackIT System use only. A party line or an extension will not meet the requirement.

Aesthetics. This is one factor that may require some negotiating with the apartment owner or supervisor. In most cases the placing of antennas on roofs or under eaves will not be an issue. However, it pays to first ask or to explain the extent of change to the outward appearance of the building(s). The supervisor or owner will definitely appreciate the consideration.

Designing the Network.

Determining Type of Site. Once the information has been gathered and a site map obtained then the next process is qualifying the site as to type. There are basically three types of sites based on building types and site layout: Apartment Complex, Apartment Courtyard, and Apartment High-rise. We will map only the first two type apartment formats with the Apartment High-rise being considered in future revisions of this manual.

SITE TYPE	DESCRIPTION
Apartment Complex	Buildings spread throughout site, typically 2 to 3 stories, buildings linked by private roads & parking lot spaces.
Apartment Courtyard	Buildings have windows/doors facing a courtyard, typically apartments surround the center pool/yard.
Apartment Highrise	Buildings exceed 3 stories in height, normally one building with multiple levels.

Figure 3. Site Types

Apartment Complex. The Apartment Complex is identified by multi-buildings spread over an area that is linked by connecting roads and parking lot spaces. The buildings may be one story, but are typically two levels or more in height. There is normally a clubhouse that may also function as the main office.
The range determination of the combined first and second tiers for Apartment Complexes is categorized by the type of construction materials and the layout of the landscape within the site.

- Determine the RF range for the first tier. The first tier, which consists of the transponder to repeater link, has a transponder signal path that must travel through the building construction material of both inner and outer walls. Those units that are in the lower furthermost apartments must also transmit their signals through the various floors. These obstacles attenuate the radio wave and therefore reduce the range of the transponders. The following chart provides estimated ranges of signals that have been attenuated by the construction material of the buildings. The normal ranges are based on standard wood frame buildings with either wood, particleboard or vinyl siding exteriors.

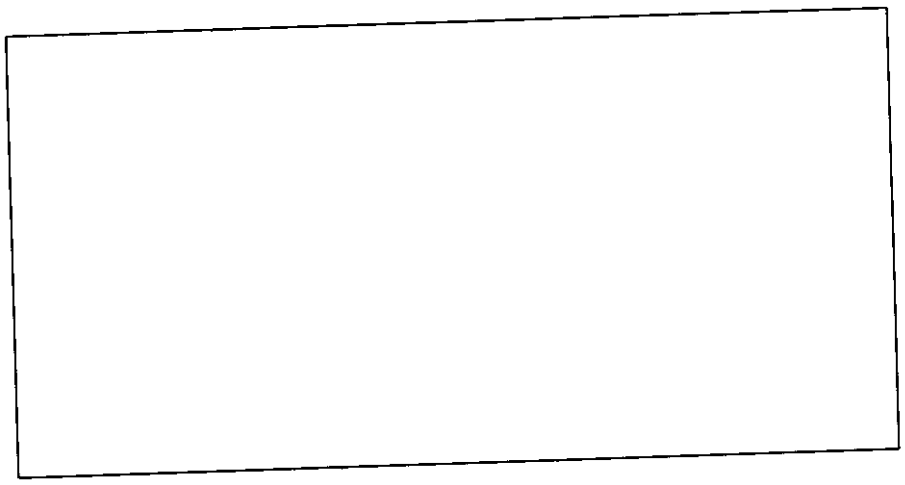

Figure 3. Transponder to Repeater Ranges

- Determining the RF Range for the Second Tier. The second tier ranges, which consists of repeater to node receiver link, are influenced more by landscape than by construction materials. Obstacles such as trees, tall buildings, and terrain contours contribute to the signal path loss experienced by each retransmitted transponder signal. The following charts delineates ranges based on line of sight obstructions.

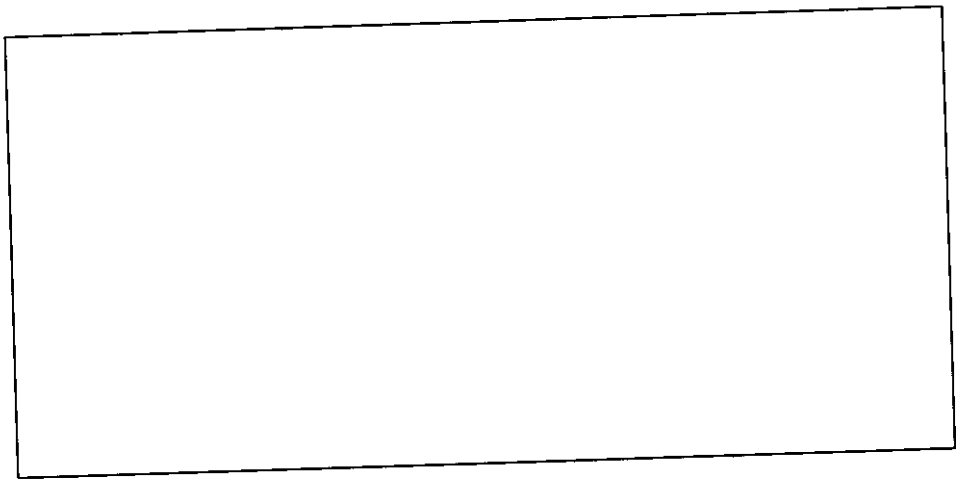

Figure 5. Repeater to Node Receiver Ranges

- **Node Location.** Network designing on the site map requires that the designer first identify the node receiver location. Ideally, the node receiver will be centrally placed on the site. This would allow for more site area coverage which will ensure more transponders will be within range. However, in some cases placing the node receiver in a central location may not be feasible. Additionally, the only location available may be the clubhouse or the main office of which neither may be centrally located. The designer then must be flexible whenever placing the node receiver. Regardless of choice, the node receiver possible locations needs to be

identified first. When placing the node receiver consider where the Personal Computer will be located since it is attached directly to the node receiver.

- **Repeater Location.** The repeater location(s) will be largely determined by the location of the transponders and the method used to group them. When determining range requirements use the chart in Figure 5.

- **Transponder Location.** The transponder placement will be determined by the location of the water meter. Where metal obstacles obstruct the line of sight it may be necessary to remote the transponders.

NOTE: The total ranges for the transponders consist of the combination of tier one and tier two distances.

- **Repeater Location Plotting.**

There are many methodologies for determining radio links. Each site will require that the systems designer use the method that best produces an efficient network. The following is a suggested method that can be adapted to all Apartment Complex type sites.

Furthermost Point. In this approach, the furthermost apartments from the proposed CellTrackIT node receiver antenna location are mapped first. A straight line representing "line of sight" is draw between each furthermost point and the CellTrackIT Node Receiver antenna location. Each furthermost point represents a transponder that has the greatest distance from the CellTrackIT PC (a location for the PC would have to be done first for this to work). Use the distances from the charts in Figure 4 and 5 to determine the range from transponder to repeater and from repeater to node receiver. Bear in mind that ranges vary depending on the environment per the chart.

- With a site map determine the furthermost points from the designated receiver unit location. The furthermost point is that apartment that has the greatest distance from the CellTrackIT receiver antenna location. Determine the furthermost points in all directions from the node receiver antenna location. Measure the distances and plot on the map (see Figure 6).

- Draw a line from the furthermost point to the node receiver antenna. Then measure, from the furthermost point towards the node receiver, the approximate distance or range of each transponder as determined by the chart. Placed an "X" further in toward the transponder point to ensure that the furthermost point is inside the RF circle which later will be drawn around the repeater (keep in mind that the range chart expresses the *maximum* range of each radio). The "X" represents a possible repeater location. Do

this for all the other points. Measure from each "X" back to the node receiver antenna. The distance should not exceed those specified by the tier two range limitations chart in Figure 5.

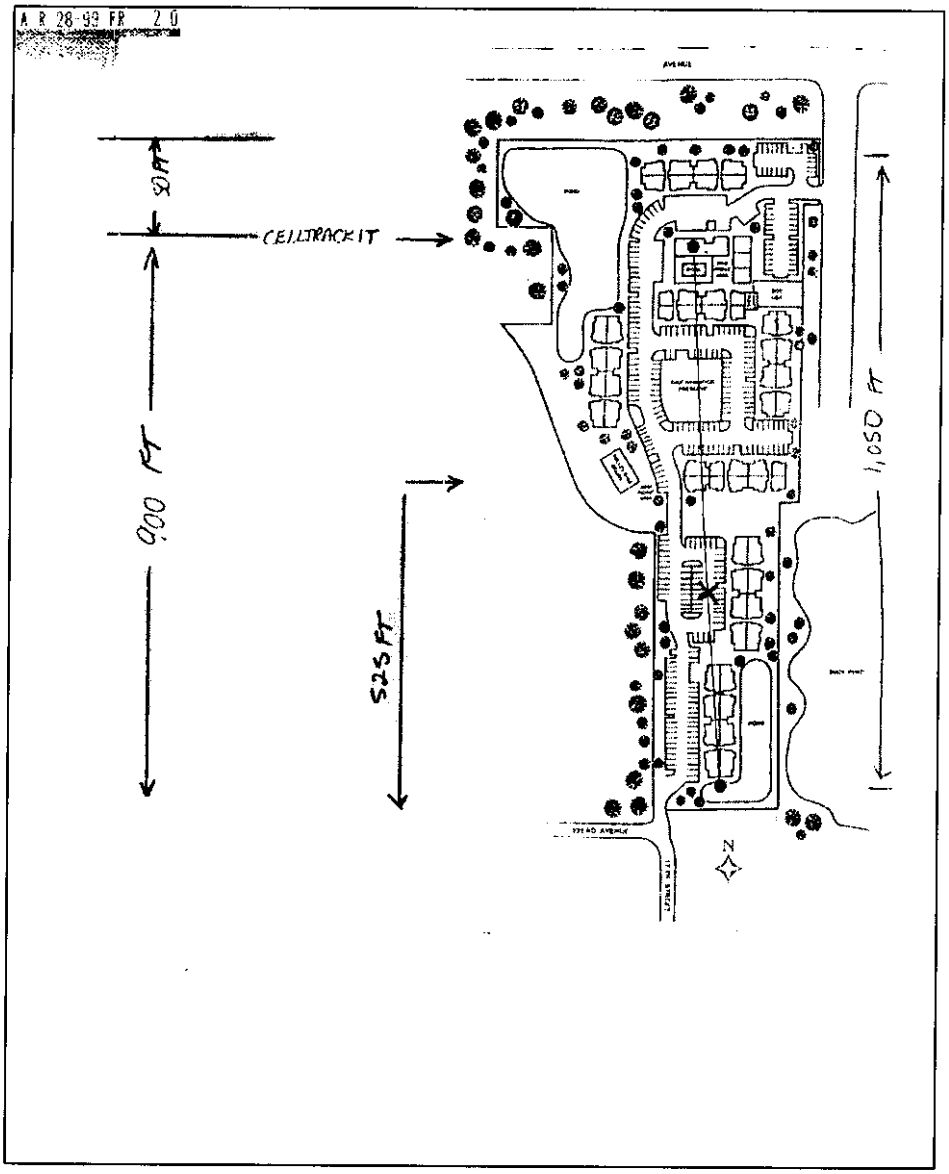

Figure 6. Determine Furthermost Points

- Draw a circle with each "X" as center point (see Figure 7). The radius should equal the transponder range as stated in the range chart. The repeater at center point will service all the apartment buildings within the circle. Repeat the process for all the furthermost points until all the apartment buildings have been designated a repeater.

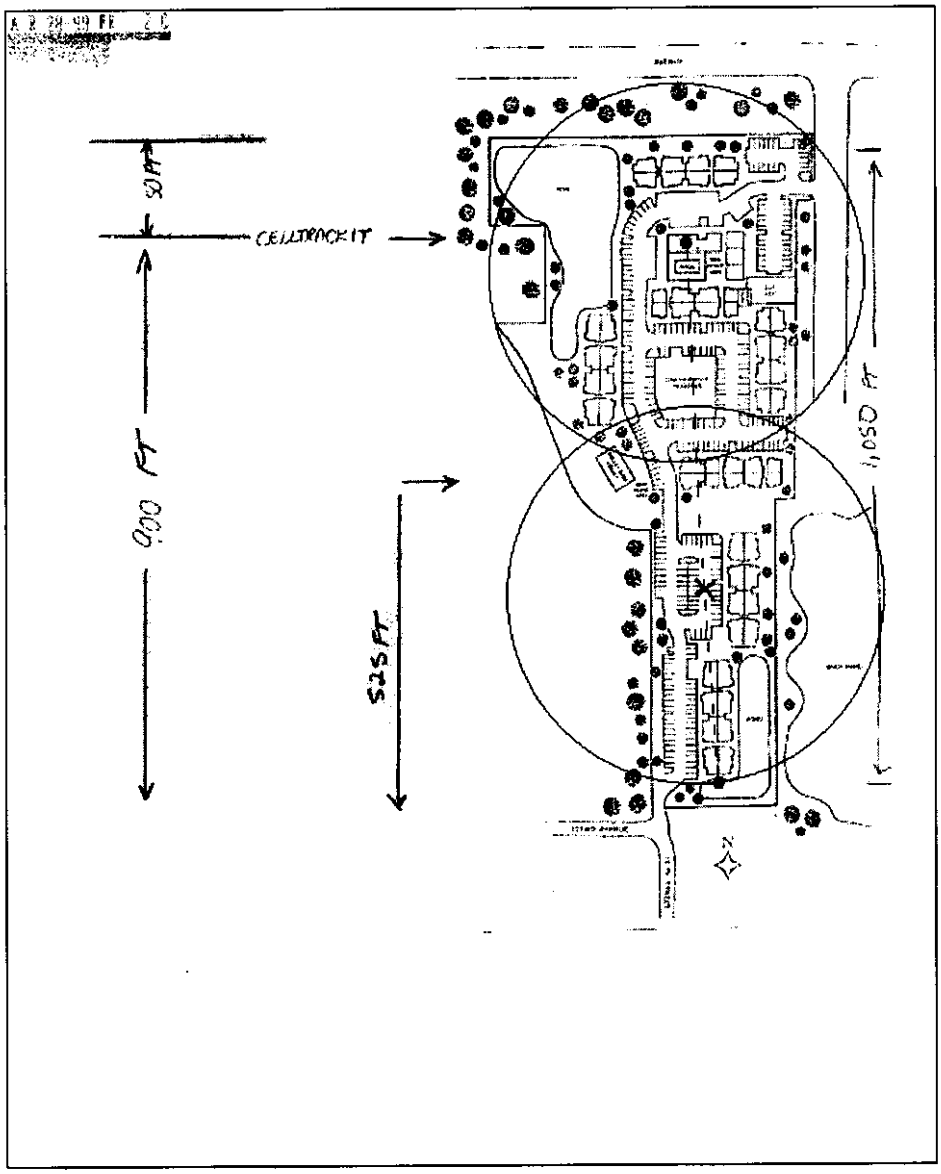

Figure 7. Draw Circles Designating RF Range

- When making the above drawing, keep in mind that each repeater will need 110 - 125 Volts AC power, that "line-of-sight" is important (no obstacles between the repeater and transponders or repeater and the receiving unit), and that different building types affect the radio signal of each transponder.

- As seen in Figure 7, the site requires approximately two repeater units to effectively cover the area. Since the basic CellTrackIT must include a repeater to function correctly, the repeater was placed where it would cover the remaining transponders around the clubhouse.

Cluster. The cluster approach is similar to the furthermost point except that the designer focuses on groups of transponders. Each group is given a repeater and the process is continued until all the transponders belong to a repeater unit. The CellTrackIT PC is then located so that all the repeaters fall within its RF range (second tier). The same measurement as the Furthermost Point method applies. Figure 8 shows a site with a clustering approach.

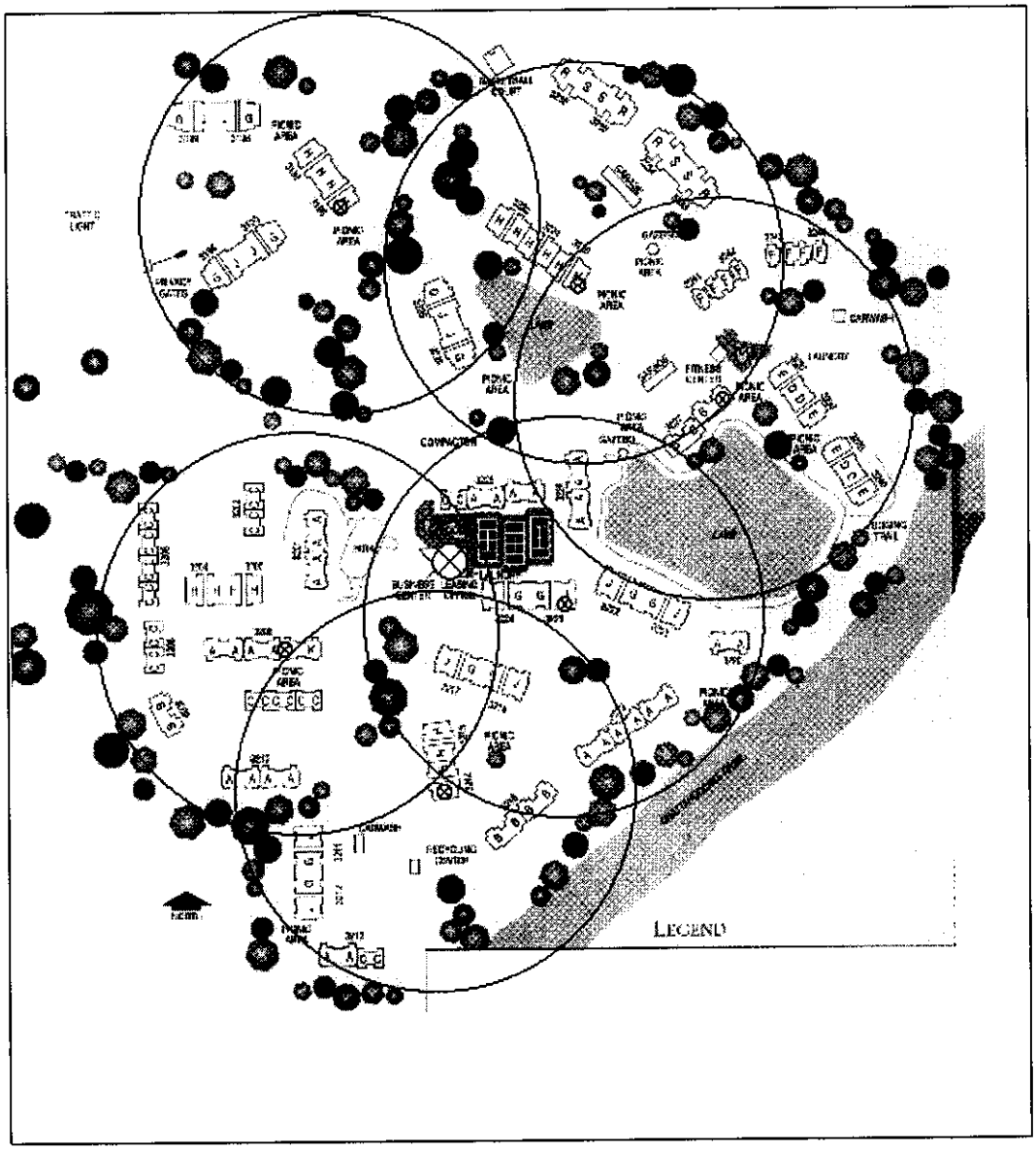

Figure 8. Site Map with a Cluster Approach.

NOTE: In any design approach a transponder signal may repeated by several repeaters without diminishing the efficiency of the network. The system is designed to handle simultaneous reads.

Optimizing the Apartment Complex Site. The final stage of the planning phase is to review the site map drawing and reposition the repeaters with the intent of eliminating excessive overlapping. Use a clear plastic document protector and reposition the repeater circles by drawing them on the plastic surface. When repositioning ensure that the buildings are still maintained within the RF circle of each repeater. When doing the RF circles take the liberty to reposition the repeaters to cover areas more efficiently. In some cases, by moving two repeaters slightly, a third repeater can be eliminated. Minimizing repeaters through repositioning on paper will become easier with experience.

NOTE: The idea is to eliminate repeaters while maintaining adequate coverage of the transponder points.

Apartment Courtyard. The Apartment Courtyard is easily identified for its enclosed inner court with the apartments facing inwards. Courtyards may also have more than 2 stories. The property may be square shaped, rectangular, or be a combination of courtyard buildings. Additionally, the construction material is normally concrete which limits the RF signals to propagating through windows and doors. In this type site the repeater must have line of sight to the windows and doors in order to pick up the transponder signals.

- Determine the RF range for the first tier. The first tier ranges in a courtyard scenario differs in that the repeaters are normally placed on opposite sides of the inner court. In a courtyard scenario, the signals permeate from windows and doors toward the center court. By placing the repeaters on opposite diagnally locations all the windows will be in the line of sight requirement. In this case, there will be two repeaters per court area. The type of construction of the buildings will greatly influence the ability of the transponder signal to reach the repeaters.

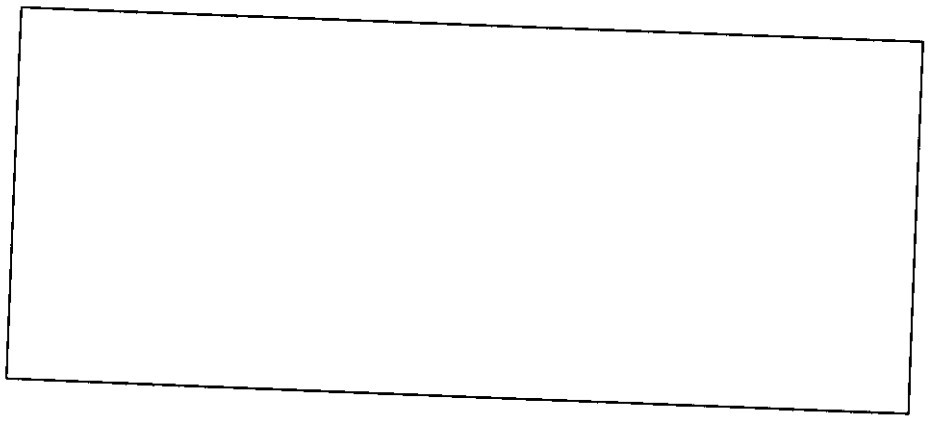

Figure 9. Transponder to Repeater Ranges

- Determine the RF range of the second tier. The second tier range should be basically a line of sight signal path. In most courtyard sites the buildings will be of equal height with the node receiver being within close distance. When multiple courtyard type buildings co-exist it may be necessary to centrally locate the node receiver.

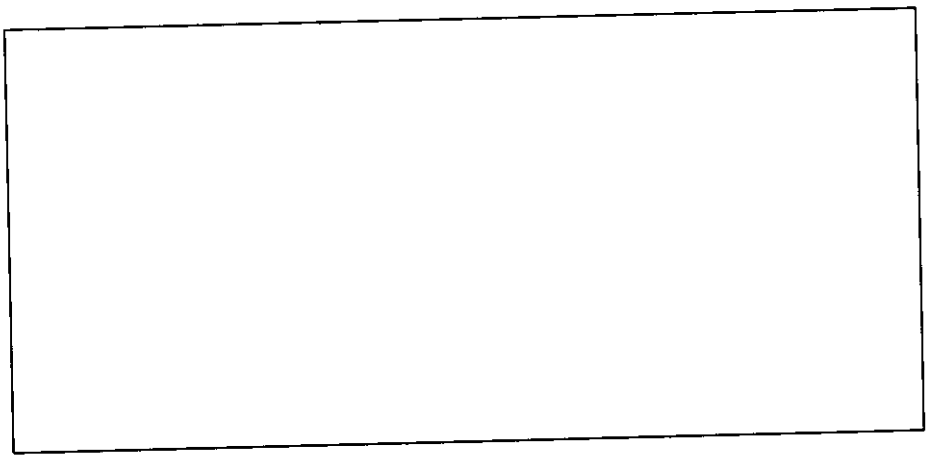

Figure 10. Repeater to Node Receiver Ranges

- **Node Location.** The node receiver should be ideally centrally located on the site property. When designing courtyard type sites it may not be possible to meet this requirement. When a central location is not an option, ensure that the selected placement meets the range requirements for the repeater to node receiver link.

- **Repeater Location.** In a square building with a center courtyard, the repeaters will normally be placed opposite to each other. The same applies to multiple buildings that encase a center area and that have windows facing the enclosed area. The CellTrackIT network designer needs to plan for two repeaters per courtyard.

- **Transponder Location.** As in the other apartment formats, the transponder placement will be determined by the location of the water meter. Where metal obstacles obstruct the line of sight it may be necessary to remote the transponders.

NOTE: The total range for the transponders to node receiver consists of the combination of tier one and two distances.

- **Location Plotting.**

Courtyard location plotting takes a simplier approach due to the way the buildings are arranged. Once the node receiver location has been identified

the repeaters can then be plotted on the site map. Each courtyard is viewed as a two repeater cluster or group that links to the node receiver.

- With the site map identify the number of courtyard enclosures on the property. On one of the enclosures locate two opposite ends diagonally across each other. This will put the repeater antenna in the corner where the two parts of the building intersect.

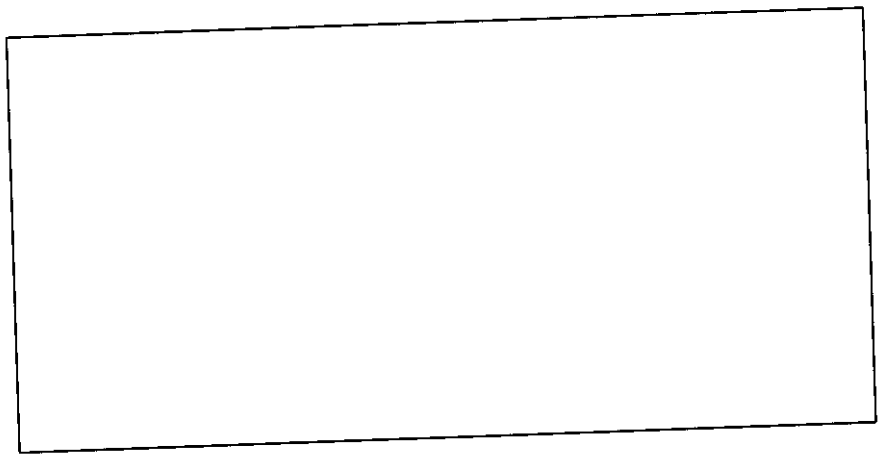

Figure 11. Placing the Repeater in a Courtyard

- Measure the distance from the repeaters to the node receiver and the repeaters to the transponders using the range charts previously discussed. The distances must comform to the ranges listed in the charts.

- Repeat the process for all other courtyard enclosures found on the site.

Location Survey. A location survey is necessary whenever the area around the site is suspected of having a high RF traffic that could interfere dramatically with the CellTrackIT performance. Appendix 4 at the back of this manual provides procedures for doing a site survey.

Determining Cost Analysis.

The cost of the CellTrackIT system can be determined once the placement of the repeaters is completed on the site map. Our sample in Figure 7 shows that two repeaters were needed for the entire system to function properly. Figuring total cost per point is a matter of identifying the various costs associated with a CellTrackIT System installation.

CellTrackIT System Cost. The total CellTrackIT System cost is directly tied to the number of repeaters used within the site. When designing the network it becomes important that the number of CellTrackIT units be minimized.

The CellTrackIT unit antennas will need a bracket or possibly a metal pipe for its installation. Depending on how each repeater is installed, the antennas may also need brackets or metal pipe for setup. The cost of coaxial cable and connectors needs to be determined also.

Power surge protectors should be added to each power outlet as normally done with standard computer equipment. This will protect the equipment from unnecessary abuse due to surges or lightning. The antennas also should be wired against lightning strikes, which would require grounding wire.

Electrical Costs. The cost of installing power conduit in attics or along walls per repeater has to be factored into the cost per point determination. In Figure 7 on page _____, the two separate repeaters need a power source of 110 - 125VAC. In both cases, the installation of the AC power must comply with standard building codes. Normally, a licensed electrician will be required to install the electrical wiring. If the CellTrackIT PC is being located in a secluded place then a power source will be needed for both the PC and the node receiver.

Telephone Costs. For each CellTrackIT PC a dedicated telephone line will be required. The cost of installing the line and the various hookup charges need to be considered. The monthly cost of renting the telephone line needs to be included in the operating costs of the site and not in determining installation cost per point.

Man-Hour Costs. The man-hours to include connecting and configuring the Transponders are part of the cost of installation. Included in this is the hours spent in planning and coordinating the site or any additional hours associated with the installation process.

Miscellaneous Costs. Any travel or outside consultant, such as a RAMAR Technical Support individual, adds to the total cost of the installation. While RAMAR desires to support each site installation, the cost of sending a Technical Support individual can be expensive and will be incurred by the requesting partner. Eliminate potential problems with the site installation by calling Technical Support during the planning phase on RF issues that can't be resolved.

Figuring Costs. Figuring cost per points is as simple as adding the costs and dividing by the number of apartment units at the site location. Once the cost per point is determined then a decision to proceed with the installation can be made.

Installing the CellTrackIT System.

Site Preparation. Site preparation is a critical element of the CellTrackIT installation procedures. There are many tasks that must be accomplished prior to installing any component at the apartment site. Logistic planning encompassing the ordering or procurement of all parts and labor needs to be done. A check list covering those items to be ordered and tasks to be accomplished is found in Appendix _____.

- The installer needs to procure all parts not included in the CellTrackIT system purchase. This means that a certain amount of lead time is needed to ensure that parts arrive prior to the actual on site installation. Note that transponders, while being essential to the system, are considered as a separate purchase item external to the CellTrackIT.

- External subcontract work such as the AC power conduit installation for the repeaters and the telephone line installation for the PC needs to be scheduled and completed.

- Proper tools need to be identified so that there will not be on site delays due to improper or missing tools. In particular, determine how the repeaters and the antennas will be installed on/in the apartment roofs. In some cases, special ladders will be needed that can reach more then two stories.

- When installing the water meters with attached transponders track serial numbers to apartment address or account numbers to minimize confusion later on. It is very easy to mistake a read from one apartment when it belongs to another due to wrong record keeping.

Installing the Repeater. The CellTrackIT unit is designed to be installed in lofts or roof spaces and *not for external installation*. When installing the repeater write down the 10 digit serial number and building it is associated with. This information will later be used for configuring the network.

A 110 – 125 VAC-power source must be wired to the unit for it to operate correctly. The AC power should include ground for proper repeater operation. Install a UL approved surge protector to minimize or prevent damage to the repeater from power outages or load conditions. **When installing the power source, ensure that applicable building codes are adhered to.**

The repeater comes with 10 feet of coaxial cable for antenna installation. The antenna should be installed just under the roof eaves using the recommended antenna-mounting bracket (see Appendix 2). As in the Node Receiver antenna, the repeater antenna can't be substituted for a different

kind. When placing the antenna, make sure that it is located on the side of the building closest to the transponders it is servicing.

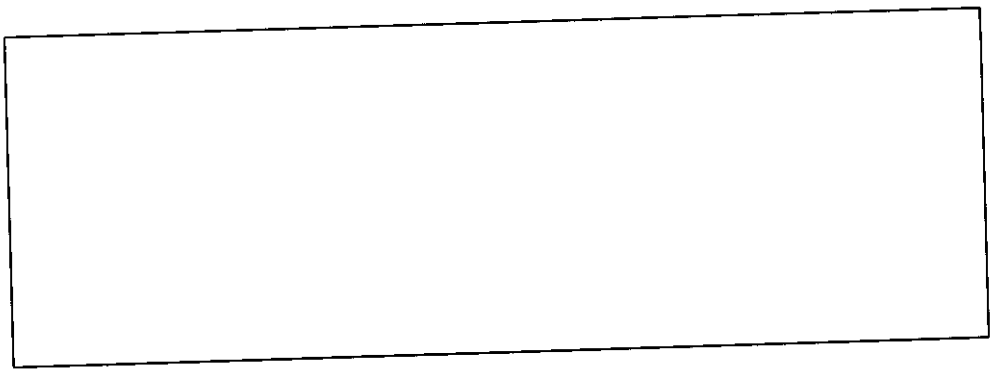

Figure 15. Proper Mounting of CellTrackIT Repeater.

Plug in the power cord and attach the antenna coaxial cable with the male TNC connector end to the RX/TX TNC hookup. The other end of the cable should have a male N Type connector that screws to the antenna (Appendix 2).

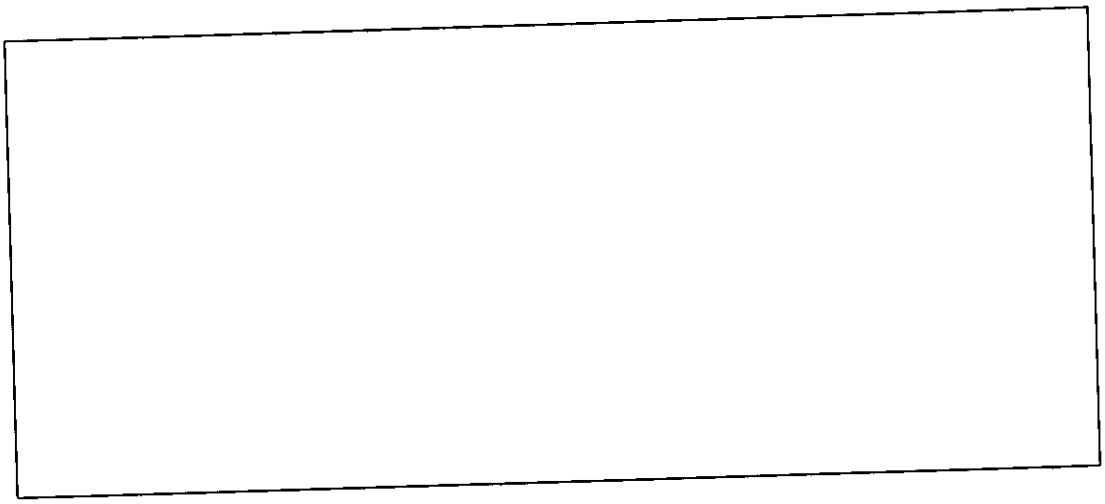

Figure 16. CellTrackIT Repeater Connections.

Both the Node Receiver and repeater antenna connections at the N Type end should be wrapped in water proof tape to prevent corrosion due to water seepage (ACE Rubber Splicing Tape --ACE 30986).

- **Verifying Repeater Operation.** Once the repeater is installed in the attic and the connections are completed check the two red LEDs for activity. The POWER LED should be on while the DATA LED will be flickering in an on-off mode. If either malfunctions check the AC power source for the POWER LED and the antenna for the DATA LED. The best

approach would be to replace the repeater with another. If that doesn't solve the problem then check the power source by simply plugging in any AC device (plugin light or power drill) and checking operation. The antenna check will require attaching the HandTrackIT to determine if transponder transmissions are being received.

Installing the Node Receiver. Installing the Node Receiver consist of plugging a CellTrackIT unit to a 110- 125 VAC power outlet and connecting the RS232 cable between the COMMS Port of the CellTrackIT unit and the PC. The Com1 on the PC is normally where the cable is connected. Once this is done, then the antenna with the associated coaxial wiring is installed.

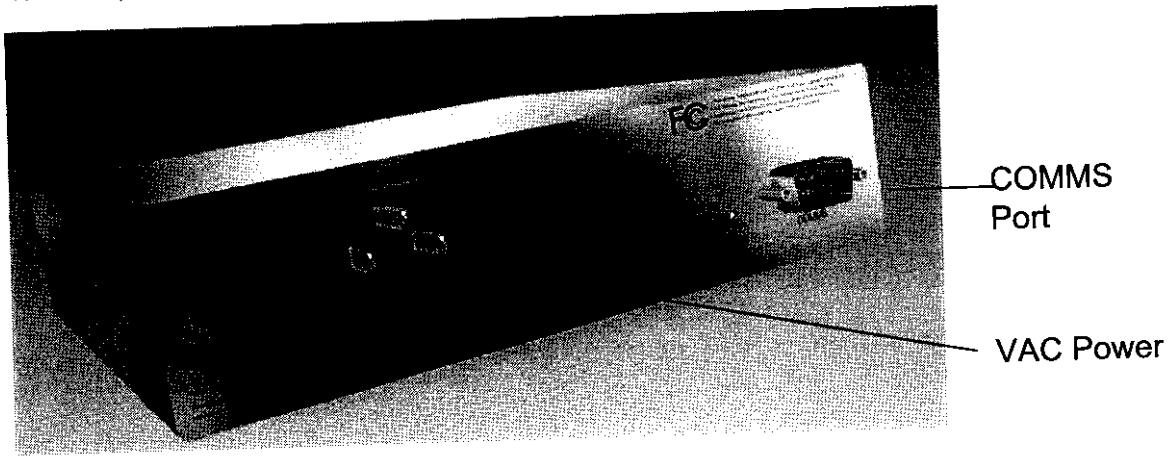

Figure 12. Node Receiver Connections.

Installing the Node Receiver Antenna. The coaxial cable that connects the antenna to the Node Receiver is RG58 type cable. One end of the cable requires an N type Male connector that is then screwed on the antenna. The other end requires a male TNC connector that attaches to the RX connection on the CellTrackIT unit. Appendix 2 covers in detail the cable assembly and antenna mounting procedures.

The Node Receiver antenna should be installed so that it clears the roof and isn't obstructed by any part of the building. The antenna should be at least 6 inches away from any metal object along its length and tip. The standard practice is to attach a 1-inch x 10 feet conduit pipe (normally found at home improvement stores) to the roof element. If the antenna pole needs to be longer, use a thicker pipe to compensate for wind velocity or add guide wires to secure the pole (Check local ordinances for compliance requirements). The antenna with its attachment bracket is then connected to the pole. Most CB radio and electronics stores have mounting brackets for mounting antennas and antenna poles. Run the coaxial cable down the inside of the pipe if possible.

The coaxial cable that comes out from the end of the antenna pole will need to be placed in conduit (PVC pipe) or attached to the wall. *Avoid damaging*

the coaxial cable when attaching it to the wall. Make sure that the attachment nails do not puncture the black plastic covering or any portion of the cable. The antenna that is provided with the Node Receiver has been FCC compliance certified and approved and can't be replaced with any other antenna. Contact RAMAR Technical Support if the antenna needs replacing or is not available at the time of installation.

- **Verifying Node Receiver Operation.** Once the node receiver is installed and the connections are completed check the two red LEDs for activity. The POWER LED should be on while the DATA LED will be flickering in an on-off mode. If either malfunctions check the AC power source for the POWER LED and the antenna for the DATA LED. The best approach would be to replace the CellTrackIT unit with another. If that doesn't solve the problem then check the power source by simply turning the PC on and checking operation. The antenna check will require attaching the HandTrackIT to determine if transponder transmissions are being received.

Configuring the Node Receiver. The CellTrackIT unit will automatically configure itself to function in a receiver capacity whenever an RS232 cable is connected to it. The node receiver will be ready for use when the power cord is plugged into an AC source and the RS232 cable is attached between the receiver and the PC. The installer will, however, have to provide aliases for each repeater for identifying the repeaters during maintenance. The aliases concept is described in depth in the CellTrackIT Software section.

Configuring the CellTrackIT PC.

- **Hardware.** Once the PC has power, plug in the telephone line into the LINE in jack on the modem card. The system should already have Windows software installed. Test the phone line by having someone dial in from their computer once the CellTrackIT system has been installed and is operational.

  The connection between the PC and the CellTrackIT unit will require an RS232 cable with 9 pin male connector on one end and a 9 pin female connector on the other.

- **Software.** The software that comes with the CellTrackIT was designed to operate within Windows 95 or 98. After the PC is turned on and running, insert the diskettes into the drive and install the CellTrackIT software using the install setup program. Make sure that the node receiver is on and connected to the PC. Turn the computer OFF then ON once the software has been installed.

The computer must be cold started by turning the power OFF then turning the power ON in order for the CellTrackIT software to become operational. Do not soft start the computer (cntrl- alt- delete) or push the manual reset button on the computer for startup.

- Once the computer is operational the **CellTrackIT Console** Screen will appear. Select **File** and **Login** menu options. At the **Log In** Screen enter the password for the level authorized. Then select **Status** for a report on which repeaters and transponders are below signal margin. These marginal components will have to be evaluated and reinstalled or replaced as necessary.

- Identify each repeater. From the **CellTrackIT Console** Screen select **Repeaters** then **Edit**. The **Repeater details** Screen appears. At the top of the screen is a number representing the number of repeaters whose signal had been received by the system. In the **Name** input enter an alias name or use the default 10 digit repeater serial number. Identify where the repeater is located or what building it is associated with in the **Info** input section. Use the down arrow to scroll down each repeater. Confirm that each serial number matches the ones installed.

- Identify each transponder. From the **CellTrackIT Console** Screen select **Transponders** then **Edit**. The **Transponder details** Screen appears. At the top of the screen is a number representing the number of transponders whose signal had been received by the system. Input the apartment address or related register serial number in the **Info** input section. Up to 79 characters can be entered in the **Info** input section. Use the down arrow to scroll down each transponder.

- **Data Management.** The last functional test to be conducted is the downloading and managing of data files from the PC into a remote system.

TROUBLESHOOTING

Repeater Not Received	Check CellTrackIT unit LED lights. The repeater will not transmit if it doesn't receive any signals from the transponders or if power isn't applied to it. The POWER LED should be on while the DATA LED will be flickering in an on-off mode. If either malfunctions check the AC power source for the POWER LED and the antenna for the DATA LED. The best approach would be to replace the unit with another. If that doesn't solve the problem then check the power source by simply plugging in any AC device (plug in light or power drill) and checking operation. The antenna check will require attaching the HandTrackIT to determine if transponder transmissions are being received.
Repeater Link Marginal	The link may be marginal for several reasons. The primary one would be a range issue. Check the distance between the repeater antenna and the node receiver antenna. Make sure that it is within the range specified for that particular site type. The other reason would be jamming by another radio system that is close by the repeater. If this is the case, allow the node receiver to qualify the repeater link over a period of 24 hours before taking corrective action. Corrective action would be to move the repeater to another location or, as last resort, move the repeater antenna by remoting it further away. One last possible reason would be an obstacle in the line of sight. This may occur as a young tree becomes bigger or a building is erected in the line of sight path. If this occurs the only corrective action is the one mentioned previously.
Transponder Not Received	Whenever a transponder is not received first confirm that the repeater to which the transponder is linked is operating properly and that all the other transponders in that group are received. Then use a HandTrackIT and verify that the

	transponder is turned on. Use the ConFigIT to turn the transponder on if the unit was off. If the transponder is transmitting, then check the link to the repeater that is servicing it. Look for range requirements and line of sight obstacles. If that is not the problem, go back to the transponder and walk away until the signal fades and can't be read by the handheld. Measure the distance and make a note of the time of day. Before removing the transponder allow a 24 hour period for the node receiver to qualify the link. If the system qualifies the transponder link by receiving the signal later in the night then annotate a comment to this transponder to include the distance and time of day recorded earlier or replace it with another. If after the 24 hour period the transponder is still not being received replace it.
Transponder Link Marginal	There can be a few reasons for the transponder signal being marginal. First check to see if other transponders within the group are also marginal. If that is the case suspect the repeater unit. Assuming that all other transponders within the cluster are functioning correctly, check to see if the transponder has been moved or dismounted from the wall. Secondly, look for line of sight obstacles and that range requirements are met. Lastly if all else is correct, replace the transponder.

INSTALLATION CHECK LIST

Appendix 1

Proper Installation of the CellTrackIT System is essential for compliance with FCC 15 requirements. To ensure compliance please follow the list and check when completed.

Training Conducted

- FCC Compliance Requirements Discussed
- CellTrackIT System Concept
- Radio Frequency & Site RF Interference
- Site Map Planning & Cost Analysis
- Installation of the CellTrackIT System
  - Installing the Transponder
  - Installing the Node Receiver & PC
  - Installing the Repeater
  - Installing the Repeater & Node Receiver Antennas
- Operation of the CellTrackIT System
- Software Application & Usage
- FAQs

Site Plotting Completed

- Repeater Location Plotted
- Node Receiver Location Plotted
- PC Location

Logistic Planning

PARTS:

- Antenex Antennas Ordered & Received
- Antenna Mounting Brackets Purchased (Repeaters)
- Antenna Pole Mounting Bracket Purchased
- Antenna Pole Purchased
- Coaxial Cable Conduit Purchased
- Lightening Copper Wire & Rod Purchased
- Coaxial Cables Manufactured
- PARTS:
  - N type Male Connectors
  - TNC Male Connectors
  - RG58/U Coaxial Cable
- TOOLS:
  - RG58 Connector Crimper
  - Soldering Iron w/ solder
  - Self Fusing Rubber Splicing Tape
  - Wire Stripper

Transponders Ordered & Received
Water Meters Ordered & Received
Power Surge Protectors for Repeaters Purchased
Uninterrupted Power Supply (UPS) for PC Purchased
CellTrackIT System w/ Repeaters Ordered & Received
CellTrackIT PC Ordered & Received

Installation Planning

PLANNING:

Property Owner Contacted For Authorization & Apartment Access
Site Installation Project Supervisor Assigned
Telephone Company Contacted For Line Installation
Electric Company Contacted For Power Conduit Installation
All Components Inventory For Correct Type & Amount

TASKS:

All Transponders Attached to Registers & Configured/TX On
Telephone Line Installed & Tested
Power Conduits Installed & Tested
Water Meters Installed
CellTrackIT System Installed & Tested

CellTrackIT Functional Tests

Verifying Antenna Operation

Initializing Procedures for CellTrackIT

Verifying Null Modem Connection/Terminal Emulation

Verifying Installed CellTrackIT Software

Verifying CSV File Generation

Verifying Power Shutdown and Startup

Verifying Telephone Connection & File Downloading

APPENDIX 2 Repeater & Node Receiver Antenna Mounting

Recommended Parts List & Suppliers

Appendix 3

The following parts (with asterisk) have been determined to comply with the necessary FCC 15 Rule and have been approved by RAMAR for use in the CellTrackIT system. Use of any other component may result in an FCC violation and could result in the CellTrackIT system being permanently disconnected or its operation temporarily suspended. Using components other then those specified by RAMAR voids the system warranty.

PART	PART NO.	REMARKS
Antenna*	B8965C	Antenex 1-800-323-3757
Antenna Base*	MBC800	Antenex 1-800-323-3757
Antenna Mount		Right angle iron appr. 11" X 8.5" X 1"
Antenna Pole		1.5" X 10" Conduit Pipe
Antenna Pole Mount		Check local electronics store for kit
RG58/U*	Belden 9310	12.8dB loss per 100ft @ 900MHZ
N Type Male		RG58 solder or crimp type connector
TNC Male		RG58 solder or crimp type connector
UPS		Uninterrupted Power Supply rated @
Surge Protector		UL certified. Rated @
Copper wire		Standard lightning arresting wire
Copper rod		Standard lightning rod
Personal Computer		Systems Requirements:

RF Interference Survey Methodology

Appendix 4

When gathering information about the site it is important to ascertain possible radio interference within the area and its impact on the operation of the CellTrackIT system.

What to look for:

- Antenna towers and antennas
- High rise office buildings
- Communications Centers w/ microwave antennas
- Airports, military air bases, and aircraft facilities
- Heavy or dense landscaping with trees and shrubs
- In-building wireless systems (ATMs, Pagers, Cell phones, wireless LANs)
- Automated Meter Reading systems

What is needed:

The primary focus of doing an interference survey is ensuring that the transponders are received by the repeaters and node receiver. A few transponders and the RAMAR HandTrackIT will be sufficient to determine whether interference will impact on the CellTrackIT system.

You will need the following equipment:

- Site Map with pre-plotted repeater and node receiver locations.
- HandTrackIT Receiver with two 10 dB Attenuators
- Handheld or laptop computer
- HandTrackIT to Handheld or Laptop Cable
- Six transponders (TT915/F-01-02)
- RAMAR ConFigIT unit with cable, software, and AA batteries

What to do:

- Get the site map and pick a repeater with its group of transponders.
- Make sure the six transponders are turned on using the ConFigIT unit.

INSIDE APARTMENT:

- Select the furthermost apartments in the group and install the transponders inside each apartment where the water meter is located.

- After installing the transponders, go to the proposed repeater location and do a read for each installed transponder. This will require access to the roof since that is where the repeater antenna will be placed. Note the ones that are read. While a read normally appears in

sequence with the TX intervals, in a heavy RF environment there may be longer delays. Excessive delays in signal reception can mean that there is no line of sight and the signal being received is a reflected or refracted radio wave or the distance is too great. If this is the case, check for line of sight obstacles or move the antenna to compensate for obstacles or range.

- Identify those transponders that are not being read. Are they within range of another repeater? Will moving the repeater antenna (closer) solve the reception problem?
- Repeat the process for other repeaters and groups of transponders. Pay particular attention to furthermost points that can extend the area coverage of the system.

OUTSIDE APARTMENT:

- If access to apartments is not an option then use the 10dB attenuators to simulate the signal passing through building walls. For medium to heavy construction use the two 10 dB attenuators together. For light construction use only the 10dB attenuator.
- Place a few of the transponders at the proposed location of the repeater antenna. This should be a roof top or eaves location. Go to the furthermost apartments within the repeater group and do a read of the transponders. When locating at the apartment, try maintaining a direct line of sight reading.
- If the transponder signals are not being received at the location, remove the attenuator(s) and do a read. If, after removing the attenuator(s), the signals are received then the repeater may need to be placed closer to the apartment(s). If the signals still are not being received after removing the attenuator(s) then the repeater is completely out of range and needs to be located closer to the apartment(s).
- Repeat the process for other repeaters and groups of transponders. Pay particular attention to furthermost points that can extend the area coverage of the system.

What Factors to Consider:

- Determine the hours of peak RF Interference at the site. As the clock moves towards the noon hour more radio systems will become operational resulting in an increase in radio traffic. Transponder signal reception may therefore take longer in this type of increasing RF environment.
- Determine frequency hopping systems. This may require special scanners or test equipment. A simple approach would be to place the HandTrackIT in an unfiltered mode and see how often the same signal appears.

Lesson Plan For CellTrackIT Installation Training

Appendix 5