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Global Positioning System (GPS) Technology for Community Supervision: Lessons Learned

NOBLIS TECHNICAL REPORT
NTR-2007-012
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Center for Criminal Justice Technology

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Global Positioning System (GPS) Technology for Community Supervision: Lessons Learned

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Tracy M. L. Brown
Steven A. McCabe
Dr. Charles Wellford

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3150 Fairview Park Drive South, Falls Church, VA 22042

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PRACTITIONER'S SUMMARY

Introduction

Fueled by high-profile cases, jail and prison overcrowding, and facilitated by the rapid evolution of technology, the use of GPS has become more prevalent at every level of community supervision. Supervision programs using GPS vary widely with regard to scope, objectives, and processes. In many cases, agencies must implement GPS as a result of mandates. Whether a program is being implemented by a city, county, state, or federal agency, there is an expected learning curve and challenges to crafting a successful program.

In an effort to address this, Noblis and the National Institute of Justice (NIJ) designed a study to identify the kinds of success and challenges that supervision agencies face when using GPS to track clients. This report is the result of interviews with seven community supervision agencies about their experiences using GPS to manage clients. The study also researched GPS and other location-based tracking technologies as well as GPS standards and evaluations of GPS programs. It is the intention of this report to provide information to practitioners and other stakeholders at every jurisdictional level that will help them to better understand the use of GPS in community supervision.

Program Dimensions

There are a number of multi-dimensional factors for consideration when implementing a supervision program involving GPS. The following list, while not necessarily comprehensive for every conceivable circumstance, is illustrative of many of the dimensions that are involved and addressed in this report.

- Program Motivation
  - Legislative or Other Mandate
  - Victim Protection
  - Intensive Supervision
  - Jail/Prison Overcrowding
  - Behavioral Sanction
- GPS Type
  - Active
  - Passive
  - Hybrid
- GPS Hardware Components
  - Two-piece
  - One-piece
- GPS Vendor Selection
  - Geographic conditions
  - Equipment availability
  - Contracts
- Types of GPS Clients
  - Sex Offenders
  - Other Violent Offenders
  - Pretrial Defendants
  - Probationers
  - Parolees
- Geographic Factors
  - Urban
  - Rural
  - Inclement Weather
  - Cellular Coverage
  - Building Interference
- Monitoring Model
  - Vendor
  - Third-Party
  - Agency
- Other Supervision Program Tools/Treatments
  - Radio Frequency (RF) Home Detention
  - Secure Continuous Remote Alcohol Monitoring (SCRAM)
  - Counseling
  - Substance Abuse
  - Other Treatments
- Funding Model
  - Government Funded
  - Client Funded
  - Government/Client Funded

These many factors can complicate an agency's decision-making process; it is not always a simple matter of identifying a single item from each bullet and starting a program. For a given agency, multiple selections from some bullets may be appropriate, or circumstantial constraints (e.g., a legislative mandate) may force selections regardless of their efficacy. Each set of choices, as well as the juxtaposition of choices across dimensions carries a set of consequences. An

important goal of this report is to help make agencies and other stakeholders aware of some of those consequences based on the experiences and lessons of other agencies.

Study Methodology

The methodology used to conduct this study was also multi-dimensional. Several different types of information were gathered, each with a different focus and purpose.

- Seven relatively mature GPS supervision programs were identified for inclusion in the study. These were intentionally selected to represent a cross-section of geographic locations and jurisdictional levels, and covering as many of the program dimensions as possible. Applicable practitioners at the agencies were interviewed – using a standard interview guide – to gather their experiences and lessons from implementing, managing, and operating a GPS program. The practitioners interviewed included planners administrators, implementers/supervisors, officers, monitors, and technicians. The information gleaned from these interviews is the primary focus of Chapter 2 and the Agency Perspective section of Chapter 3. The purpose of this information is to highlight the real-life challenges and successes that these agencies have experienced. In addition, Chapter 6 summarizes the most salient Lessons Learned and Key Success Factors and Challenges cited by these practitioners.

- Several well-known vendors of GPS technology for community corrections were invited to respond to a survey questionnaire about their products and services. Not all invited vendors responded to the survey. The Vendor Perspective section of Chapter 3 summarizes much of the survey responses and Appendix C presents the unedited vendor responses.

- Independent research into public domain information was conducted in order to speculate about the future of GPS technology. The research encompassed general GPS infrastructure technology factors, as well as factors that are most pertinent to location-based tracking in the specific context of community supervision. In addition, information is presented about emerging technologies that may augment GPS capabilities and help overcome some inherent technological weaknesses; this is the primary focus of Chapter 4. The purpose of this information is to help make agency planners aware of alternatives and future possibilities that may bear on some of today's technology decisions.

- Chapter 5 looks at the way standards for GPS use in community supervision have been developed, the use of such standards in the operation of GPS, and the value they hold for improving program evaluations. The current status of electronic community supervision program evaluations is then considered and the relationship between standard setting and improved evaluations of effectiveness is demonstrated. Finally, the steps that can be undertaken to improve standard setting and program evaluations are considered.

Using This Document

The scope of this document is quite extensive; however, it is the authors' hope that the organizational structure of the document lends itself to readability and comprehension. It is anticipated that practitioners will gravitate toward specific chapters of interest. While this is encouraged and expected, in order to comprehend the full scope of the study, practitioners are also encouraged to read the entire document.

ACKNOWLEDGMENTS

This study could not have been possible without the assistance and participation of the following people and organizations. The CCJT gratefully acknowledge their time and assistance in conducting this study and developing and reviewing this report. The employment affiliations of individuals reflect their associations at the time of their assistance.

Advisory Group

Steve Bock
Program Manager
Michigan Department of Corrections

Gunnar Knutsen
Correctional Specialist II
Montgomery County, Maryland Department of Corrections and Rehabilitation

Joe Russo
Program Manager
Corrections, National Law Enforcement and Corrections Technology Center (NLECTC)

Carl Wicklund
Executive Director
American Probation and Parole Association

American Probation and Parole Association (APPA)

Ann Crowe
(Former) Senior Research Associate

Matthew DeMichele
Research Associate

National Institute of Justice (NIJ)

Marlene Beckman
Chief, Justice Systems Research Division,
Office of Research and Evaluation

William Ford
Program Manager
Office of Science and Technology

Gary MacLellan
(Former) Program Manager for Corrections
Office of Science and Technology

Michele Moses
System Planning Corporation
NIJ - Support Contractor
Office of Science and Technology

Participating Agencies

City and County of Denver, Colorado Electronic Monitoring Program
Marilyn Rosenberg, Director
EM Program Staff

Court Services and Offender Supervision Agency (CSOSA) for the District of Columbia (Washington, DC)
Tom Williams, Associate Director
CSOSA Staff

Marion County, Indiana Community Corrections
Brian Barton, Executive Director
Community Corrections Staff

New Mexico Corrections Department
George Drake, Deputy Director, Probation and Parole
Probation and Parole Staff

Oakland County, Michigan Community Corrections
Barb Hankey, Community Corrections Manager
Community Corrections Staff

Texas Department of Criminal Justice
Bryan Collier, Director Parole Division
Parole Division Staff

US Pretrial Services, Central District of California
George Walker, Chief US Pretrial Services Officer
Pretrial Services Staff

Vendors

Behavioral Interventions (BI)
iSECUREtrac Corporation
Omnilink Systems
Pro Tech Monitoring
STOP-LLC
StreeTime Technologies

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FOREWORD

Project Overview

This project was conceived by the Noblis Center for Criminal Justice Technology (CCJT), in collaboration with Dr. Charles Wellford, Director of the University of Maryland's Criminal Justice Research Center. Its scope was further refined in coordination with the National Institute of Justice (NIJ) and the American Probation and Parole Association (APPA). During the Winter 2006 APPA conference, members of the project team informally discussed the use of GPS in community supervision with various practitioners. This group of practitioners expressed a strong desire to know more about how GPS was being used by other agencies, and understand the lessons gained from agencies experienced in using GPS technology. Based on this interest, NIJ sponsored the CCJT's efforts to conduct a study of agency experiences with implementing and managing GPS as part of their supervision programs.

To ensure that the scope and objectives of the study remained consistent with the needs of the corrections practitioners, an Advisory Group was established. This group assisted with identifying agencies to solicit for participation, reviewing study materials and report drafts, and providing general guidance to the project team. See Appendix A: Project Methodology for details of Advisory Group participants and responsibilities.

The CCJT, NIJ, and the Advisory Group determined that it would be most beneficial to interview agencies that had been using GPS in community supervision programs for at least three years, as their experiences would better reflect the long-term challenges and successes of a program. Also taken into consideration were the agency type and size. A mix of local and state community supervision agencies were selected along with one federal agency. Additionally, the group determined that a mixture of agencies with pretrial, probation, and/or parole missions would most benefit practitioners in learning about GPS. Every effort was made to select agencies that were using different GPS vendors. The participating agencies included:

- **City and County of Denver, Colorado Electronic Monitoring Program**, which operates pretrial and post-conviction supervision programs.
- **Court Services and Offender Supervision Agency (CSOSA) for the District of Columbia (Washington, DC)**, which operates probation and parole supervision programs.
- **Marion County, Indiana Community Corrections**, which operates pretrial and post-conviction supervision programs.
- **New Mexico Corrections Department**, which probation and parole supervision programs.
- **Oakland County, Michigan Community Corrections**, which operates pretrial supervision programs.
- **Texas Department of Criminal Justice**, which operates parole supervision programs.
- **US Pretrial Services, Central District of California**, which operates Federal pretrial supervision programs.

A survey was distributed to GPS community supervision vendors in an effort to obtain information about the existing state of the GPS market, as well as potential future trends. The information was analyzed and is presented in this report along with a look at emerging location-based and GPS enhanced capabilities.

The existing state of GPS product and process standards was also investigated, along with the value they hold for improving supervision program evaluations. The current status of GPS community supervision program evaluations was also considered and the relationship between standard setting and improved evaluations of GPS program effectiveness was discussed. In addition, the steps that can be undertaken to improve standard setting and program evaluations are considered.

It is important to note that all of the information contained within this document reflects the state of each agency's program as it appeared during the summer of 2006 when the interviews were conducted (reference Table A-1 for specific interview dates). In addition, all technology research and references are

intended to reflect the state of the technology as of the date of the reference. Vendor surveys were also collected during the summer of 2006 and information obtained from those surveys is intended to be accurate as of that time. Neither the agency programs or GPS and location-based tracking technology are static and it is therefore anticipated that some information may be overcome by evolving program changes and technology innovations.

Document Objectives

The intent of this report is to identify the current practices of agencies that have been using GPS in their community supervision programs for a variety of client types and purposes. It is not intended to evaluate the effectiveness of GPS in modifying behavior, deterring crime, or protecting victims, but is a case study of how agencies have implemented GPS and the associated lessons learned. In addition, this report looks at the existing state of GPS products for community supervision, as well as emerging location-based technologies. A discussion of standards and evaluation criteria is also included. The report is intended to provide practitioners with a better understanding GPS technology and its potential impacts on an agency's supervision program.

Document Contents

The contents of this document include the following:

- Chapter 1 provides a background and description of the technological elements of GPS, and more specifically the GPS components used in community supervision.
- Chapter 2 describes the results of the agency interviews, including current practices and key considerations for GPS use in community supervision.
- Chapter 3 reviews the current state of GPS technology and products from both the agency and vendor perspectives.
- Chapter 4 identifies key considerations on the future of GPS while also looking at other location-based technologies.
- Chapter 5 discusses setting and using standards for GPS in community supervision.
- Chapter 6 summarizes the lessons learned throughout this study, including agency perspectives on key factors for success and challenges. Also included are agency suggestions for how GPS can be improved to better suit community supervision needs.
- Chapter 7 contains references for external materials cited in this document.
- Chapter 8 contains a glossary and acronyms list.
- Appendix A describes the project methodology.
- Appendix B provides an overview of interviewed agencies' use of GPS in their supervision programs.
- Appendix C provides an overview of the GPS vendors that participated in a survey for this study.
- Appendix D contains a listing of online resources that may be beneficial to practitioners along with a list of points of contact who participated in this study and indicated they would serve as a resource on the use of GPS.

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CHAPTER 1: GPS TECHNOLOGY AND COMMUNITY SUPERVISION

The intent of this chapter is to present an overview of GPS technology and how it is used to track the movements of clients[1] participating in community supervision programs.

1.1 Background/History

Electronic technology has long been used as a tool to assist community supervision agencies with client supervision. The American Probation and Parole Association's (APPA) *Offender Supervision with Electronic Monitoring* document outlines the evolution of electronic supervision from its first conceptual use in Massachusetts in 1964 to more commonly seen "curfew" or "house arrest" programs in federal, state, and local jurisdictions in the 1980s and 1990s (Crowe 2-3). These "curfew" or "house arrest" programs provided agencies with the ability to detect when a client violated the conditions of their home curfew by leaving their residence during prohibited times.

The rich history of using technology to assist in client supervision has evolved in the last ten years to include the use of Global Positioning System (GPS) technology. In the mid-to-late 1990s, agencies began learning about a new method for tracking clients electronically. This new method used telephonic communications and elements of Radio Frequency (RF) in conjunction with the Department of Defense's (DoD) GPS system to identify a client's location on a map and to design a schedule that went beyond merely establishing a curfew. GPS allowed agencies to begin to electronically supervise client's days as well as nights.

1.1.1 History of GPS

Most Americans have become familiar with GPS over the last few years as its commercial uses have continued to expand. GPS is now widely available in personal and commercial vehicles, personal devices such as personal digital assistants (PDAs), cellular phones, laptops, and even watches. However, the concept of GPS started in the early 1970s as a way for the United States military to accurately identify locations throughout the globe.

Between 1978 and 1985, the DoD launched the first generation of GPS satellites exclusively for military use. However, in 1983, President Ronald Reagan decided to permit civilian use of GPS technology once it became operational. The first civilian uses of GPS were primarily in the realm of aviation and surveying (Rand Corporation).

In 1995, the second generation of GPS satellites became fully operational and commercial civilian use began to be more fully explored, with the first instances of GPS technology specifically designed for tracking humans surfacing a few years later.

1.1.2 How GPS Works

According to The Aerospace Corporation and Trimble, GPS technology can be described in terms of three segments:

- **Space Segment**. Consists of twenty-four satellites orbiting 11,000 nautical miles above the earth.
- **Control Segment**. Consists of 5 ground stations around the globe that manage the operational health of the satellites by transmitting orbital corrections and clock updates.
- **User Segment**. Consists of various types of GPS receivers that can vary in complexity and sophistication. This segment is what most people are familiar with; examples include the navigation system in a car, or the GPS device in a cell phone.

GPS receivers are able to identify their location when three GPS satellites triangulate and measure the distance to the receiver and compare the measurements. A fourth satellite measures the time to the receiver. The information from all four satellites is compiled to determine the location. The sophistication of a GPS receiver impacts the reliability and accuracy of the GPS data received. For additional detailed information on how GPS works, see the references to Trimble and The Aerospace Corporation identified in the References section in Chapter 7.

[1]The term "client(s)" is used in this report to reference both pretrial defendants and convicted offenders. It is recognized that some agencies may consider the term inappropriate for use in discussing community supervision defendants and offenders, however, it is used in the interest of brevity.

Figure 1-1 depicts the three segments comprising GPS.

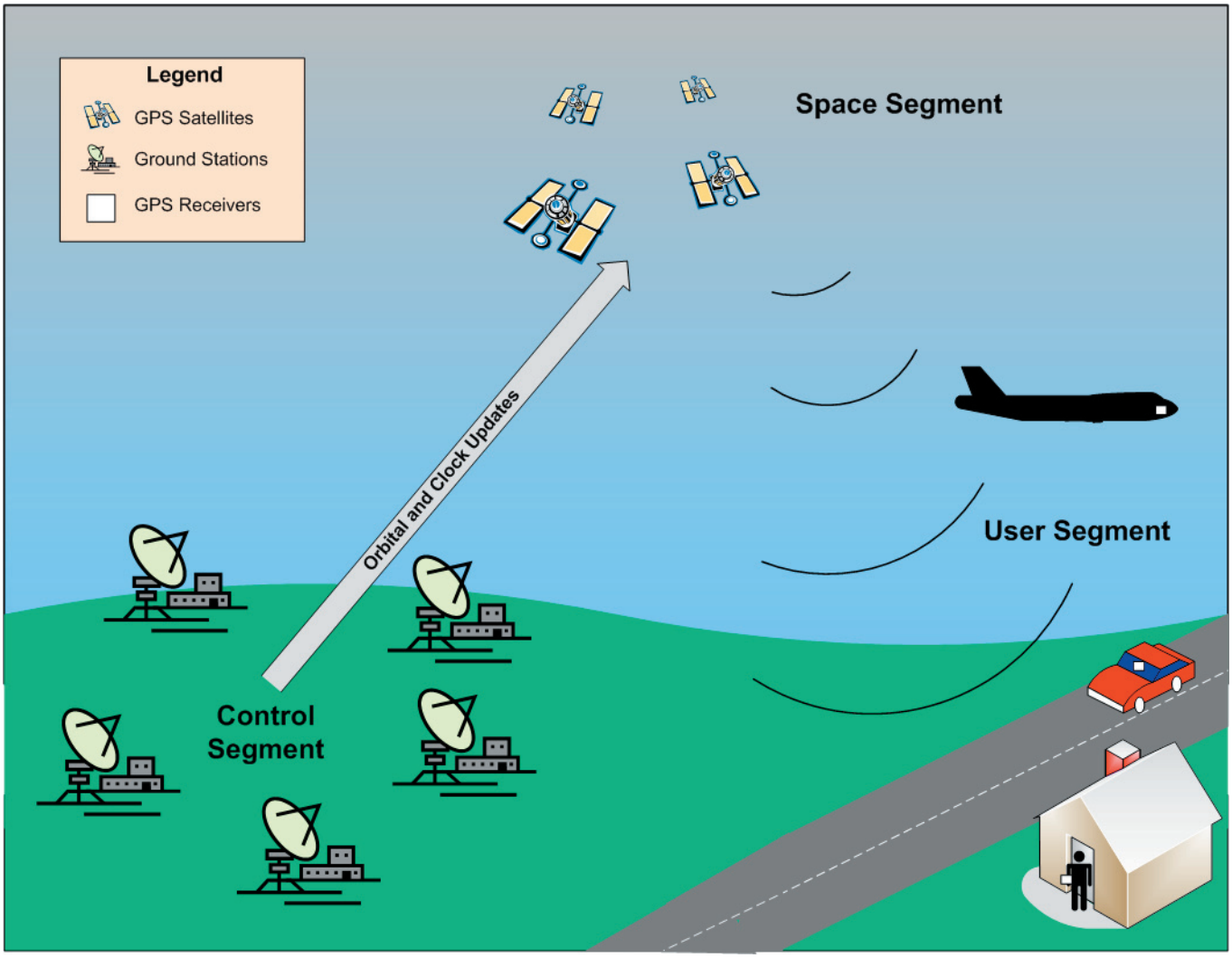


Figure 1-1. GPS Segments

1.2 Key Elements of GPS Technology in Community Supervision Programs

The use of GPS as a tool to help supervise community corrections clients has gained popularity over the last 10 years. Not only are more agencies at all jurisdictional levels using GPS, but the technology itself has improved, with reductions in equipment size and more features being offered such as voice communications. Chapter 3 discusses the current state of GPS for the community supervision market.

This section describes in detail how community supervision GPS technology operates using the following elements:

- Equipment
  - GPS Receiver
  - Tamper-Resistant Bracelet
  - GPS Charging Unit
- Communications
  - Active, Passive, and Hybrid GPS
  - RF
  - Land-Line Phone
  - Cellular Phone
  - Internet
- Vendor Software
  - Case Management
  - Mapping
- Monitoring Center

Figure 1-2 depicts how these various elements work together. The following sections describe each element in detail.

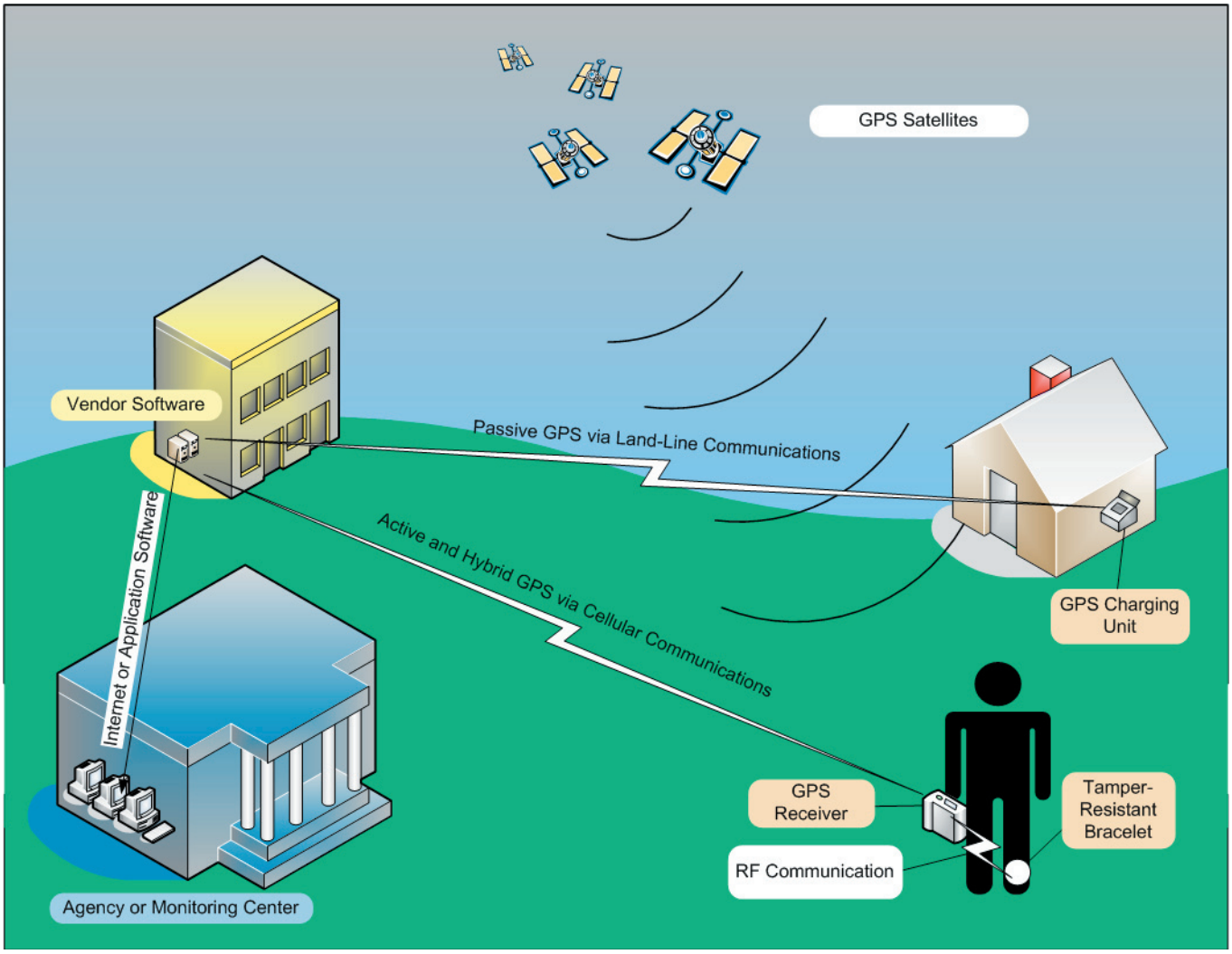


Figure 1-2. GPS Monitoring Components

1.2.1 Equipment

The key equipment components for using GPS in community supervision include:

- **GPS Receiver**. Each vendor refers to this piece of equipment by a different name. However, the basic technology consists of a GPS receiver for receiving location data points, memory for storing the points, a rechargeable battery, RF technology for ensuring proximity to the tamper-resistant bracelet, and for Active units, cellular phone technology for transmitting GPS data points near real-time. Some vendors also provide GPS receivers that have voice communication capability.

  The GPS receiver records the data points on a pre-defined time parameter, which is usually configurable by the agency. This could be as frequently as every second or as infrequently as every 10 minutes.

- **Tamper-Resistant Bracelet**. This piece of equipment is familiar to users of RF technology. It typically consists of a bracelet worn on the client's ankle. It contains a battery and utilizes RF technology to verify it's proximity to the GPS receiver. The bracelet will transmit an alert via the GPS receiver if tampering occurs.

- **GPS Charging Unit**. This equipment is usually located at the client's home and is used daily to recharge the GPS receiver. Some charging units are connected to a land-line phone, by which the daily GPS data points are transmitted to the vendor software (typically Passive GPS, see following sections).

1.2.2 Communications

1.2.2.1 Active, Passive, and Hybrid GPS

The basic concept of how GPS receivers acquire location data is described section 1.1.2.

Within the community supervision field, there are three basic concepts of how the collected GPS location data is transmitted to a vendor's software for processing, *Active*, *Passive*, and *Hybrid*. These can be described as follows:

- **Active**. In this case, cellular communications are used to transmit the collected GPS data points back to the vendor software for processing. This is done on a "near real-time" basis, such as every minute, every 5 minutes, etc. Many vendors allow the time parameter to be configurable based on the specific client.
- **Passive**. In Passive GPS situations, the GPS receiver collects the GPS data throughout the day. Once the client returns home, he/she is instructed to place the GPS receiver in the charging unit. When connected to the charger, the GPS receiver transmits the GPS data points from the day to the vendor's software for processing using the land-line phone connection.
- **Hybrid**. The term "Hybrid GPS" has recently emerged in the criminal justice GPS market and reflects various vendors' attempts to establish a third model for GPS tracking. The main difference with Hybrid GPS is the timeframe at which the GPS data is sent to the vendor and agency. With Active GPS, the location data is sent to the vendor software for processing in near-real time and then sent on to the agency immediately. With the new Hybrid concept, the data is sent to the vendor on a less regular basis (which is programmable - such as every few hours), but automatically switches to Active mode in the event of an alert. For Hybrid, the time parameter is usually much longer than with Active, but more frequently than once a day, as with Passive. For instance, the time parameter may be set so that data is transmitted every 4 hours. Hybrid GPS typically uses cellular technology to transmit the location data; however, since the device is not sending the data in near-real time, the cellular communications are less frequent.

1.2.2.2 Radio Frequency (RF)

Traditional "curfew" and "house arrest" programs utilize RF communications between a tamper-resistant bracelet and a stationary device to detect when the bracelet and stationary device exceed the established distance parameters during pre-determined timeframes. When this occurs, the stationary unit, using land-line or cellular telephone technology, automatically alerts the vendor software. For instance, the stationary device is placed in a client's home and the distance is set to 100 feet. If the client ventures more than 100 feet from the stationary device during the prohibited timeframe, while still wearing the bracelet, an alert will occur.

This type of RF technology has been extended for use in GPS solutions by configuring the RF signal to communicate between the tamper-resistant bracelet and the GPS receiver instead of the stationary device in the client's home. Most vendors utilize RF in this capacity; however, some vendors have eliminated the need for RF in this situation by designing a single device that is both a GPS unit and a tamper-resistant bracelet. However, since the prevailing technology still uses two-piece units the diagrams and examples discussed in this chapter use the concept of a separate GPS unit and bracelet. Chapter 3 provides analysis on the key differences between one and two-piece units and the associated pros and cons.

1.2.2.3 Land-Line Phone

Passive GPS tracking systems require that the charging station be connected to a land-line phone to allow the GPS location data collected throughout the day to be sent to the vendor software for processing into map points.

As described previously, all GPS receivers require daily charging. Therefore, it is important to note that when in the charging stand, most Active and Hybrid configured GPS units will revert to transmitting data via the land-line phone in lieu of cellular communications.

1.2.2.4 Cellular Phone

Active and Hybrid GPS systems utilize cellular communications technology to periodically send the GPS location data to the vendor software for processing.

1.2.2.5 Internet

Nearly all vendors offer accessibility of their software via the Internet. This allows agencies to access their client GPS data from any computer connected to the Internet using a Web browser.

1.2.3 Monitoring Software

Each vendor has unique software that processes the GPS data acquired from the receivers. However, there are key components of the software that virtually every vendor provides.

- **Case Management**. While not necessarily inclusive of traditional elements of a client's case management profile (such as tracking visits with the supervising officer, treatment notes, etc), the GPS case management portion of the software allows officers to set up a client's approved schedule, restrict their approved movements to various zones (exclusion and inclusion zones), and set alert parameters.
- **Mapping**. Provides a graphical display of a client's location data points over a period of time, such as a day or several hours. Each vendor's map displays vary in their complexity and details; however, most graphically depict the exclusion and inclusion zones and basic local points such as schools and parks.

As indicated previously, nearly all vendors provide supervision agencies with access to their software via the Internet.

1.2.4 Agency/Monitoring Centers

All vendor software is designed to be able to send alerts regarding client's adherence to pre-established parameters. The main difference among agencies comes in the form of who receives and reviews those alerts and the associated alert flow processes.

There are three basic options for receiving alerts; these are depicted in Figure 1-3.

- **Option 1**. In this option, the agency utilizes the vendor's monitoring center for all alert notifications. In this scenario, the vendor's service representatives review and analyze each alert and then contact the applicable agency personnel in the event of a legitimate client alert. Additionally, the vendor software may send automatic alerts via pager to specified agency personnel for resolution.
- **Option 2**. In this option, a third-party company conducts the alert review and analysis and then contacts the applicable agency personnel as appropriate. When the third-party receives the alert for review and analysis, the agency personnel may be also contacted simultaneously via pager.
- **Option 3**. This option is very similar to Option 2; however, the monitoring center is internal to the agency not a third-party. Also in this situation agency personnel may be contacted via pager at the same time as the monitoring center.

Many agencies utilize a combination of Option 1 and Option 3 by having agency personnel receive alerts directly from the software during regular duty hours (Option 1) and during off-duty hours utilize an in-house monitoring center (Option 3). In this case, the monitoring center would most likely only contact the agency personnel for priority alerts.

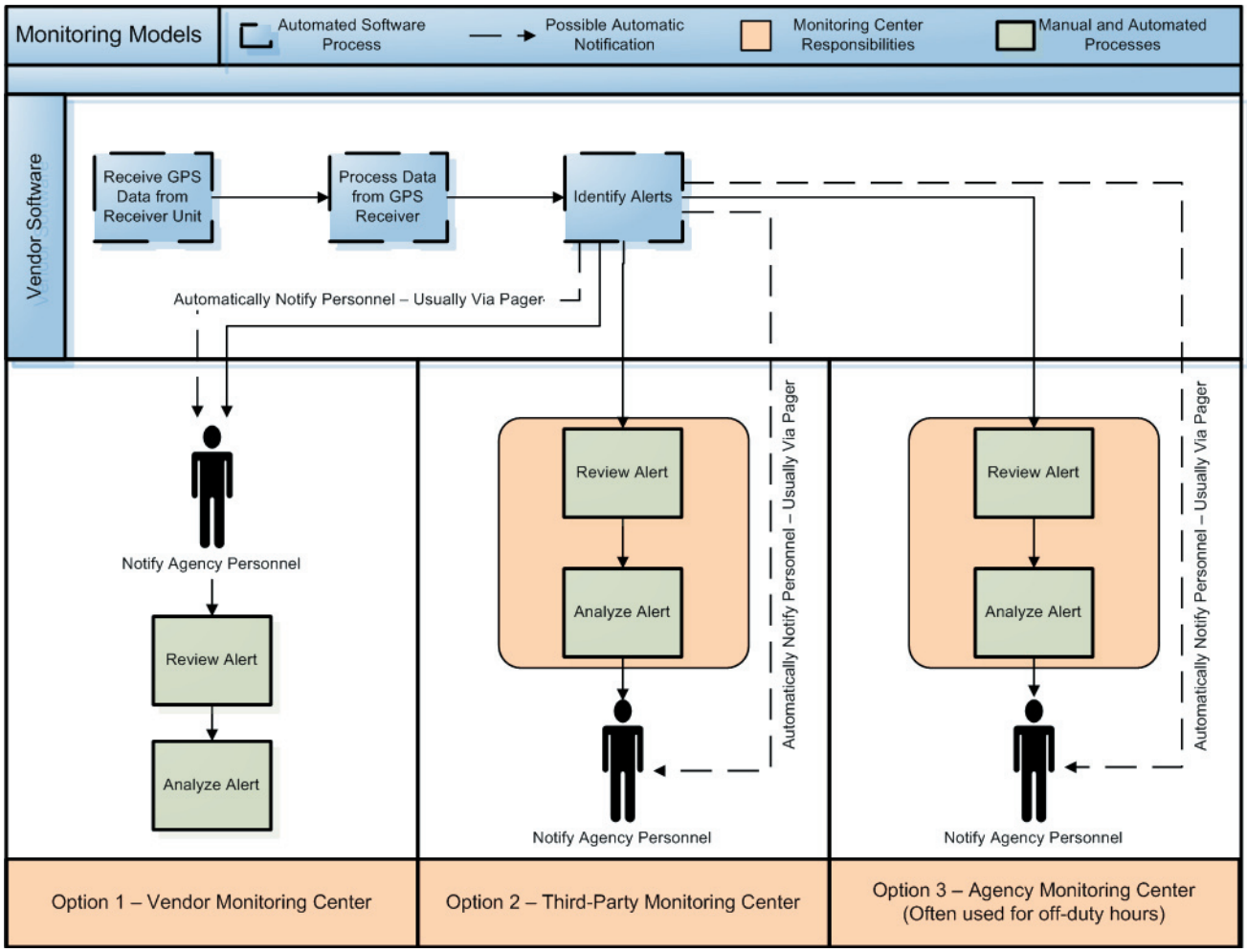


Figure 1-3. Monitoring Center Models

CHAPTER 2: CURRENT PRACTICES AND KEY CONSIDERATIONS FOR USING GPS IN COMMUNITY SUPERVISION

2.1 Introduction

This chapter provides details on agency experiences associated with developing and implementing a community supervision program using GPS. The intent is ***not*** to evaluate or grade each agency's practices, but to draw upon information from all agencies to establish a broad look at how various elements of using GPS in a supervision program are addressed. These results should serve as a comprehensive and informative look at common strategies agencies use when implementing and managing GPS in their programs. While such common trends can be seen across all program types, where appropriate, the results presented in this chapter differentiate among pretrial, probation, and parole programs.

As discussed in Chapter 1, electronic monitoring (EM) and the use of technology in community supervision is nothing new. However, the use of GPS has become more widespread in recent years as many jurisdictions face mandates to use GPS as a condition of client release; while others have begun to evaluate its potential in advance of such mandates. Many agencies want to know how using GPS technology might impact their program and face various questions such as:

- How do we incorporate GPS into our overall community supervision program(s)?
- How can we use GPS in conjunction with other monitoring products, such as RF home detention?
- What are the strengths and weaknesses of applying GPS technology to community supervision?
- What are the lessons learned from other supervision agencies currently using GPS technology?
- What are the current practices for applying GPS technology to community supervision?

By interviewing agencies that currently operate community supervision programs with GPS, this report attempts to address these questions. Additionally, this report attempts to provide supervision agencies that are interested in GPS with a look at the current practices of agencies that have been using GPS for a number of years and their lessons learned. The best way to understand what works and what does not is to learn from the experiences of agencies that use GPS.

Therefore, how long an agency had been using GPS was a primary criteria in selecting participants for this study. Also taken into account were the size and nature of the agencies, while also considering a mix of local community supervision agencies and state and federal agencies operating in various phases of corrections (i.e., pretrial, probation, and parole). An additional consideration was the vendor each agency used; every effort was made to select agencies that were using a variety of GPS vendors. However, given the evolving nature of the technology and the requirement for selecting mature programs, the variance in vendors was somewhat limited.

Using the previously described criteria, the following seven community supervision agencies were identified for inclusion in this study and on-site interviews were conducted during summer 2006:

- **City and County of Denver, Colorado Electronic Monitoring Program**: pretrial and post-conviction programs.
- **Court Services and Offender Supervision Agency (CSOSA) for the District of Columbia (Washington, DC)**: probation and parole programs.
- **Marion County, Indiana Community Corrections**: pretrial and post-conviction programs.
- **New Mexico Corrections Department**: probation and parole programs.
- **Oakland County, Michigan Community Corrections**: pretrial program.
- **Texas Department of Criminal Justice**: parole program.
- **US Pretrial Services, Central District of California**: Federal pretrial program.

See Appendix A: Project Methodology, for more details on the project methodology including the personnel

interviewed. For summary descriptive information on each agency, such as types of clients and number of clients each agency serves, see Appendix B: Participating Agencies' Summaries.

2.2 Program Areas

During the course of this study, six programmatic areas were identified as critical to a community supervision program's implementation and management of GPS. These areas are depicted in Figure 2-1.

Figure 2-1. Community Supervision GPS Program Areas

The six programmatic areas consist of:

- **Program and Policy Design**. This area addresses an agency's decision to use GPS whether due to legislation, mandate, or specific objectives; selection of the appropriate GPS type, such as Active, Passive, or Hybrid; and experiences with vendor contracts. This section also looks at internal guidelines, policies, and procedures for how GPS is implemented. Another key aspect described is how liability mitigation influences a program's structure.
- **GPS Tool Evaluation and Use**. This area addresses GPS tools research, testing, and tools assessment based on pilot program results. Also such operational considerations as equipment strengths and weaknesses and vendor technical support are discussed.
- **Funding and Cost Factors**. This area addresses funding models and annual budgeting for staff and equipment. It also looks at the operational costs of GPS versus other methods of supervision.
- **Staffing**. This area addresses officer selection, organizational restructuring, supplemental staff, and shift work considerations. Also discussed are vendor and internal training, as well as on-the-job and supplemental training. Average GPS caseloads and agency experience with how GPS affects staff caseload/workload are also discussed.
- **Operations**. This area discusses program types, GPS client selection, and collaboration and communication with criminal justice stakeholders. Also considered are alert processing, violations, treatment strategies, operational impacts of GPS, and contingency planning.
- **Equipment Inventory and Maintenance**. This area addresses practices for equipment maintenance, upgrades, and inventory management.

Each of these areas focuses on a unique aspect of using GPS as a tool for supervision. While some agencies may begin looking into GPS from the tools perspective first, others may begin by evaluating policy or legislation; still others may start by looking at funding and cost considerations. Therefore, Figure 2-1 depicts these areas as equal parts of a whole, each area being uniquely important to the success of a GPS community supervision program, regardless of where or how an agency initially approaches the problem.

2.3 Program and Policy Design

The tasks associated with planning and managing administrative elements of a GPS program are discussed in this section. Figure 2-2 illustrates the Program and Policy Design areas in the context of all GPS programmatic areas.

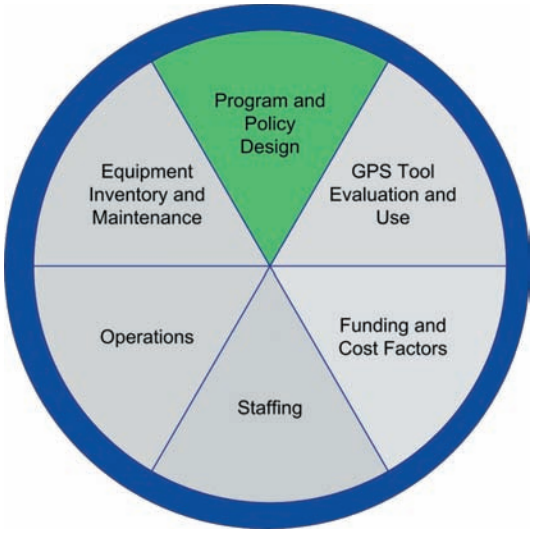


Figure 2-2. Program and Policy Design Area

Section 2.3.1 discusses the program and policy design experiences of the interviewed agencies, while section 2.3.2 summarizes key considerations in this area.

2.3.1 Practices

The following were identified as important aspects of\ program and policy design:

- Deciding to Implement GPS,
- Objectives for Using GPS,
- Legal/Judicial Factors,
- Agency Liability,
- Selecting GPS Type,
- Vendor Contracts, and
- Policies and Procedures.

Within each of these categories specific information was derived from the individual agency interviews and analysis of trends across all the interviews.

2.3.1.1 Deciding to Implement GPS

The decision of whether or not to implement a new technology is often influenced by many factors and GPS technology is no exception. Experience with existing EM strategies such as RF and alcohol monitoring often paves the way for deciding to implement GPS. Having a staff member who is comfortable with technology (a "techie") and who actively seeks out methods for incorporating it into a supervision program can also be a factor. The desire to provide an enhanced method of supervision for sex offenders, domestic violence offenders, and for clients released into the community due to jail or prison overcrowding also plays a role in deciding to implement GPS. Occasionally a high-profile case will drive an agency's decision to use GPS, or in some cases the approval of GPS legislation. Specific legislative and judicial dynamics are described in detail in section 2.3.1.3. Finally, whether or not an agency believes in GPS technology's maturity and stability can impact a decision to use GPS.

2.3.1.2 Objectives for Using GPS

While often not formally defined, an agency's objectives for using GPS are critical to the planning and policy design of a GPS program. Among interviewed agencies, eight key objectives were identified. Two of the most frequently cited were to ensure client accountability and to deter additional crimes. Accountability may be improved by the technology's ability to supply detailed data on a client's activities, while it also helps eliminate he said/she said situations between clients and victims.

Deterrence can be difficult to measure, particularly given most agencies' lack of formal performance measurements. However, one example of how deterrence might impact client behavior would be when a client's acquaintances no longer wish to associate with them while they are on GPS. This in turn may deter the client from engaging in illegal behavior, because they are no longer associating with possible criminal elements.

An additional objective for using GPS is a desire to more effectively protect the public. Agencies believe that GPS offers them an opportunity to more closely supervise clients, thereby better protecting the public. GPS is also often used as a sanctioning tool to enforce the consequences of a client's non-compliance with their release conditions under normal supervision. Another objective for using GPS is that it offers overburdened corrections agencies a means to relieve

jail or prison overcrowding situations by offering a more intensive form of supervision outside of a jail or prison.

Practical Example A: Objectives for Using GPS

CSOSA believes that GPS serves as a powerful psychological tool in dealing with clients. One client, who had previously been placed on GPS, was alleged to have committed a sexual offense, but the victim was not known. When faced with the threat of being placed on GPS again, the client offered the name of the alleged victim. CSOSA staff felt that without GPS as a potential sanction, the client would never have provided such information.

Another common objective for using GPS, primarily reported by pretrial agencies, is to provide a better method for ensuring victim safety via victim alert notifications. Other objectives cited by these agencies include mitigating pretrial absconding and providing defendants a means to maintain their lives within the community while awaiting trial.

2.3.1.3 Legal/Judicial Factors

There are a number of factors that may influence how an agency structures and operates their GPS program. These include legislation, local laws and regulations, as well as court related factors.

- **Mandates/Legislation**. In July 2006, the United States Congress passed the "Adam Walsh Child Protection and Safety Act of 2006". Among its many provisions, it mandates the use of EM as a condition of release for Federal pretrial defendants for specific cases involving a minor victim ("The Adam Walsh Child…"). In addition, throughout the United States, state and local jurisdictions have begun to legislate the use of EM, and specifically GPS, for various offenses. In November 2006, the state of California passed a ballot proposition that requires individuals who have been convicted of a felony sex offense that requires registration and have been sent to prison, to be monitored by GPS devices while on parole and for the remainder of their lives ("Official Voter Information Guide, Proposition 83…"). **Marion County Community Corrections** has also seen recent legislation passed in Indiana that requires the use of GPS. These various initiatives will certainly impact pretrial supervision programs throughout the United States. These kinds of applicable laws are integral to the design of a GPS supervision program.
- **Warrant Issuance**. The structure of a GPS program can be impacted by whether or not a supervision agency's officers are legally allowed to issue warrants or not. Whether an officer can issue a warrant greatly affects the processes for investigating alerts and applying warrants or other legal responses to a legitimate violation. For instance, if an agency is unable to issue warrants as part of their protocol, then they must consider how an outside agency or organization will interface with their officers and monitoring center.
- **Privacy**. Applicable privacy laws are another dynamic to contemplate when sharing a client's GPS data, particularly with regard to pretrial defendants. Pretrial agencies must recognize that the defendant has not been convicted and therefore may have different rights with regard to supervision than a convicted offender. This is especially true with GPS data as it relates to alleged victims and the court. For instance, supervision agencies must be very careful about sharing specific client GPS data with victims. Many will notify victims if the client enters their exclusion zone, but they will not tell the victim where exactly the client is, for fear of victim reprisal.
- **Judicial Discretion**. Judicial discretion in ordering GPS as a condition of release is another important factor of program design. When well informed about the benefits and limitations of GPS, judges generally impose GPS on appropriate clients. However, when judges do not fully understand the limitations of the technology, they sometimes assign GPS to inappropriate clients or in some cases fail to support a client schedule that mitigates equipment constraints. For instance, two agencies indicated that when a judge did not mandate a schedule for a client, the battery life of the equipment was exhausted before the client was required to be home. Without a judicially supported schedule that considers the equipment limitations, the potential exists for a client to be untracked for a period of time while ostensibly meeting the intent of their release conditions.

- **GPS Data as Evidence**. In most cases GPS data has been accepted as a legitimate source of technological evidence. Usually the supervising officer is responsible for testifying or presenting the GPS data to the court; however, expert witnesses from the GPS vendor have been used when necessary.

Legal and judicial factors are external influences which may impose requirements and/or constraints on a GPS program's policy and design.

2.3.1.4 Agency Liability

"With more information, comes more responsibility" is a common refrain heard from experienced GPS program staff. GPS data provides the opportunity to know much more about a client's activities and provides agencies with the tools for more intensive supervision. However, this additional data also raises questions related to liability, such as:

- What if a victim is harmed or a new crime is committed and the agency did not respond to applicable GPS data?
- What if critical information is received via GPS and is not acted on within a reasonable time? What constitutes a "reasonable time"?
- What if we "miss" something?
- What if the information the GPS equipment provides is inaccurate?
- When should we notify the victim?
- What if we don't have enough staff to support proper monitoring?

These and many similar questions surround the use of GPS in community supervision. The potential liability associated with GPS is a constant concern for agencies and one that is primarily mitigated through well structured and implemented policies and procedures. ***It is also critical for the judiciary, public, legislature, and most importantly, agency staff, to recognize that GPS cannot prevent crime; it merely assists an officer in supervising a client's behavior.*** Educating these stakeholders on the benefits and limitations of the technology enhances the success of GPS as a tool in a supervision program.

In addition to instituting solid policies and procedures and educating stakeholders, liability may be mitigated through use of the following strategies that have been adopted by one or more of the interviewed agencies:

- Limiting caseloads so that officers can be proactive and not reactive.

Practical Example B: Agency Liability

The **New Mexico Corrections Department** is currently piloting a program in collaboration with the Albuquerque Sheriff's Office to monitor a small group of Active GPS clients during off-duty hours. In this pilot, the Sheriff's Office participates in the selection of high-risk sex offenders to be tracked with Active GPS and then assists the Corrections Department by assuming after-hours alert responsibilities. This cooperative agreement benefits the Corrections Department by providing after-hours alert response and the Sheriff's Department has the opportunity to better observe potentially dangerous clients more closely. If the pilot proves successful, the agency would like to extend the program to other parts of New Mexico.

As a result of a high-profile case, the **Texas Department of Criminal Justice** instituted a strict policy of evaluating all client GPS data points – not just alerts. Predominant practice is to utilize the "exception-based" nature of the GPS alerts to manage clients with GPS. However, Texas had a situation in which a client who had previously been on Active GPS, but was being supervised with RF committed a violent crime. When his previous GPS data was reviewed following the crime, several trends were discovered that indicated that he had been "trolling" for victims while on GPS. Due to that case, all Active GPS points are now reviewed daily by the supervising officer and a back-up person, and all Passive GPS data points are reviewed by the supervising officer.

Oakland County Community Corrections outsources its GPS services to two third-party vendors who assume all liability for the use of GPS in supervising pretrial defendants. Outsourced functions include equipment installation and maintenance, fee collection, and alert response. Vendor logs are reviewed by corrections staff each day to ensure alerts are being handled properly. This arrangement suits Oakland County's limited resources while still providing the option for GPS supervision.

- Eliminating victim notification or limiting it to notification of high-priority alerts, such as exclusion zone alerts.
- Installing a back-up review process, having more than one person review alerts and responses.
- Employing a 24x7 monitoring strategy with a monitoring center for after-hours. This alleviates some burden from the officers.
- Closely evaluating the appropriate type of GPS to implement. This is discussed in greater detail in section 2.3.1.5.

2.3.1.5 Selecting GPS Type

Choosing the type of GPS most appropriate for their program is critical for supervision agencies. As described in Chapter 1, Active, Passive, and Hybrid GPS each offer differing capabilities, benefits, and drawbacks. While this determination is also integral to the tool selection process, it is equally important in terms of program design. Figure 2-3 shows the breakdown of Active versus Passive GPS use among interviewed agencies; no agency interviewed currently utilizes Hybrid GPS.

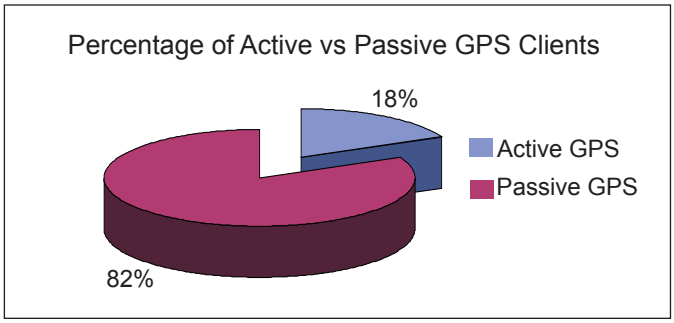


Figure 2-3. Interviewed Agencies' Percentage of Active vs Passive GPS Clients

There are several programmatic aspects tied to the type of GPS that is implemented. The data analysis constraints associated with Active GPS often prove to be too much for staff to effectively manage or are perceived as such. Therefore, many agencies limit the number of Active GPS units they deploy to certain types of clients that are deemed most "dangerous" and in need of more intense supervision. Section 2.7 describes the agency practices used to select GPS appropriate clients.

Practical Example C: Selecting GPS Type

New Mexico Corrections Department was concerned with being able to respond appropriately to Active GPS alerts and instead chose to implement Passive GPS for the majority of their clients. However, as described in section 2.3.1.4, the agency is conducting a pilot whereby the local sheriff's department has accepted responsibility for after-hours alert response for Active GPS clients. As part of this agreement, the sheriff's office has input into which high-risk sex offenders they would like to see on Active GPS.

The phase of the criminal justice process under which an agency conducts their supervision (pretrial, post-conviction[2], probation, or parole) is also important in determining which type of GPS to implement. Each of these phases has unique requirements and constraints associated with it. For instance, in pretrial situations, there is often very little data available when considering which clients are most appropriate for GPS supervision. However, in post-conviction, probation, and parole situations a much more extensive criminal history and personal profile have often emerged to help determine appropriate supervision methods for a particular client.

[2]Post-conviction in this case refers to using GPS following conviction but prior to sentencing. In Marion County Community Corrections, it also refers to a mandatory executed sentence and the timeframe following jail or prison release and the start of probation.

In both of these cases, the background details of a client and their offense may greatly influence which type of GPS is imposed. Figure 2-4 depicts the breakdown of GPS type across the interviewed agencies' supervision phases.[3]

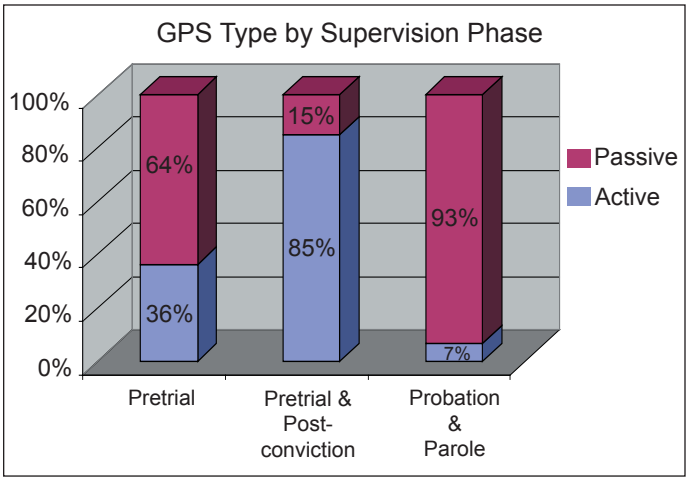


Figure 2-4. GPS Type by Supervision Phase

Another element is whether or not an agency intends to communicate client GPS location data to a victim(s). This is important to determine, as the type of GPS used is directly correlated to how quickly a victim can reasonably be notified. With Passive GPS, the location data is only sent to the vendor's software once a day and is generally not reviewed until the following day. In such a case a victim is therefore not notified in real-time of any zone incursions that may occur. For this reason, most agencies that conduct victim notification utilize Active GPS for those clients with victims. If an agency decides to notify the victim, it is essential to formulate clear policies establishing how and for which alerts a victim is notified. This not only mitigates liability concerns, it also provides staff with a clear understanding of their responsibilities as they relate to victims.

[3]Among the agencies interviewed, there are two that operate under pretrial conditions, two that operate both pretrial and post-conviction programs, and the remaining three operate probation and/or parole programs. The agencies operating both pretrial and post-conviction programs did not provide data differentiating Active and Passive GPS numbers for pretrial and post-conviction, therefore these form their own group within the figure.

Practical Example D: Selecting GPS Type

Early in the **City/County of Denver's** use of Active GPS, the officers received notification of every alert via pager. The officers, in turn, notified applicable victims of each of these alerts. They soon discovered that in addition to unnecessarily alarming victims, this practice also caused officer "burn-out". This was due to responding to so many alerts and the associated stress of possibly missing one. The agency realized that while GPS is an effective tool in assisting with a client's supervision, GPS itself is incapable of always ensuring a victim's safety. When the focus of the program changed from "protecting the victim" to that of ensuring more effective supervision, both officers and victims were happier. Victims are now only notified of client alerts that pose potential threats (such as the client venturing into the victim's exclusion zone). This also alleviates an enormous burden from the officers' workload, as officers only receive high priority alerts (e.g., bracelet tamper or exclusion zone) immediately via pager, while the remaining alerts are reviewed on a regular basis every few hours. This process ensures a more manageable workload for officers, while continuing to emphasize victim safety.

Geographic area is yet another aspect of selecting GPS type. This is important in terms of determining if the necessary cellular coverage is available for use with Active or Hybrid GPS. Some rural areas may not have adequate cellular service to allow for Active or Hybrid GPS and clients would therefore have to rely on land-line phones and Passive GPS service. The converse of this is evaluating whether or not clients are likely to have land-line phone service. In most cases this would be determined on a case by case basis, but is important when assessing the overall agency needs.

In order to allow for more flexibility, many agencies employ vendor contracts for both Active and Passive GPS. In addition, some vendors have recently introduced new GPS receivers that allow a single unit to be switched between Active and Passive GPS, thereby eliminating the need to make strict equipment decisions before knowing the day to day needs of clients.

2.3.1.6 Vendor Contracts

A key component of program and policy design is the relationship an agency establishes with the GPS

manufacturer or GPS services vendor(s). Section 2.4 discusses details about the vendor selection process; however, the program management perspectives on vendor contracts are discussed here.

A critical element of a vendor contract is the clear definition of an agency's ability to access client GPS data, both current and archived. The GPS data is generated as a result of the client's movements and is monitored and evaluated by the supervision agency; however, vendors typically own the GPS data and provide it to the agency via a proprietary software application. Because of this arrangement, agencies should establish vendor contracts that clearly outline the agency's ability to access new and archived data.

Some agencies currently collaborate with law enforcement by utilizing crime data and GPS data analysis techniques (both through automated software and manually). The long-term availability of client data points may become more important as vendors develop additional automated methods for GPS data sharing, and collaboration becomes more pervasive. In that vein, an agency may need to collaborate with law enforcement on an investigation by providing GPS data for clients from many years past. As such improvements are made; data availability will become an even more important consideration.

Practical Example E: Vendor Contracts

The **Texas Department of Criminal Justice's** vendor contract specifies that the GPS data for their clients will be available through the vendor for up to five years following contract expiration. After five years, the vendor will provide the agency with all of the information in a computer readable medium.

Service level agreements (SLAs) reflect arrangements between the agency and vendor on the degree of service that will be contractually provided ("Service Level Agreement"). With GPS contracts this may include such things as alert delivery time[4], equipment availability, and equipment failure handling. Although not typical in most community corrections GPS contracts, SLAs are gaining in popularity and serve to provide the agency with some recourse in the event that a vendor relationship is not satisfactory.

Whether specified in an SLA or addressed elsewhere in a vendor contract, equipment availability terms are of critical importance. Adequate availability of GPS equipment is a pervasive problem within the GPS vendor community and often results in clients either remaining incarcerated or being confined to RF home monitoring while GPS equipment is acquired. Availability problems range from inadequate inventory during program start-up and ongoing operations, to not being able to get new or replacement equipment in a timely manner.

Another contract factor is the vendor and agency's respective financial liability for lost or stolen equipment. Vendor contracts can be established where the agency does not pay for lost/stolen equipment, or the cost is split between the vendor and agency, or the agency assumes the full cost of replacement. This decision and negotiation is critical as it greatly impacts the budgeting and overall program policies of a supervision agency. For instance, if required to pay replacement costs, an agency may institute a policy passing that cost on the client. Such a policy would require additional procedures for collecting and administering those payments.

Ensuring that a vendor has a disaster recovery plan is essential to an agency's continued GPS operations in the event of a disaster. In order to effectively monitor client locations with GPS, agencies must rely exclusively on the GPS data that the vendor processes for them. If the vendor's system is not functioning properly, then an alternate process must be established. This includes even minor service interruptions of the software. One interviewed agency was left without software access to the vendor's GPS system for over a month and had to inquire directly with the vendor when a client alert needed investigation.

A final vendor contract matter is the agreement regarding distribution of hardware and software updates. Agencies tend to receive GPS software updates on a fairly regular basis without additional charge. However, with GPS hardware (i.e., GPS receiver, bracelet, and charger), more specificity may be required in the contract. Agencies must determine if they would like to automatically receive new hardware

[4]Alert delivery time reflects the time it takes between an alert occurring and when appropriate staff are notified through their chosen means such as a pager or email.

or if hardware updates must be renegotiated. Well-conceived vendor contracts are an integral part to the effective management of a GPS program.

2.3.1.7 Policies and Procedures

Clearly defined policies and procedures are the final element for successful design of a GPS program. "Good" policies and procedures help mitigate an agency's liability when it comes to GPS. This is reflected across the spectrum in everything from responding to client data to victim notification decisions. What constitutes "good" policies and procedures is defined differently by each agency but include clearly identified stakeholder responsibilities and consequences. Some commonly defined policies and procedures include:

- Detailed GPS client selection criteria.
- Participation agreements for the following stakeholders with the applicable responsibilities defined:
  - Client agreement – specifying responsibilities for proper equipment handling and program compliance. May also define consequences of violating the agreement.
  - Family/home owner – specifying equipment requirements for the home such as a "clear" land line phone, free of call waiting and other phone services that can interrupt GPS capabilities.
  - Victim – specifying that the victim does not hold the agency liable in the event of a problem related to the client and his/her supervision under GPS.
- Client payment procedures, including:
  - Client participation fees,
  - Fee collection methods, and
  - Lost/stolen equipment fees.
- Client equipment and installation set-up procedures.
- Alert response processing, including:
  - Agency staff responses (including on-call procedures),
  - Monitoring Center procedures,
  - Alert investigation processes,
  - Client contact, and
  - Victim notification.
- Other
  - Pretrial lack of confidentiality advisement to client.

Practical Example F: Policies and Procedures

Only one agency, **CSOSA**, does not currently utilize any Passive GPS units. This is due in part to their chosen vendor. However, in an effort to effectively manage the Active GPS data without structuring resource intensive after-hours duty requirements, CSOSA manages the after-hours Active data as if it were Passive by reviewing it the subsequent day. This is an example of how the impact of selecting Active GPS and the associated workload considerations were mitigated by an agency in their program structure and policies.

2.3.2 Key Considerations

Section 2.3.1 identified and categorized the various practices agencies deemed important to the overall program and policy design of a GPS program. This subsection summarizes key considerations for effective program and policy design.

- **Deciding to Implement GPS**. The decision to use GPS will impact virtually every element of an agency's supervision program, from staffing and technical resources, to policies, procedures, and contracts.
- **Objectives for Using GPS**. Although not common practice, formally defining, tracking, and measuring objectives are critical tasks to being able to evaluate the success or failure of a GPS program. Conversely, having formal objectives and methods for assessing those objectives may impact an agency in terms of time and effort.
- **Legal/Judicial Factors**. Due to legal or judicial factors an agency may be mandated to use GPS in such a way that seems inappropriate or inconsistent with the technology's capabilities. This may influence the success or failure of GPS to effectively assist in supervising particular types of clients. Another key consideration is privacy related issues, particularly those associated with pretrial defendants and victims.
- **Agency Liability**. Liability concerns can affect an agency's willingness to utilize GPS on certain types of clients. It can also influence the overall structure

of a GPS program with regard to establishing policies and procedures to mitigate liability concerns. Public, judicial, and legislative support for GPS can be greatly affected by the perceived or actual liability associated with a program.

- **Selecting GPS Type**. The type of GPS an agency selects directly impacts the type of clients that may be selected for GPS monitoring. Additionally, processes related to victim notifications and staff evaluation of GPS data are also affected by the type of GPS selected.
- **Vendor Contracts**. Without clearly defined contract requirements, if an agency feels they are not getting appropriate support, there may be little recourse with the vendor.
- **Policies and Procedures**. Well established policies and procedures can mitigate agency liability, client violations and misunderstandings, victim notification processes, and staff workloads.

2.4 GPS Tool Evaluation and Use

This section describes agency experiences with selecting and using GPS tools to track clients. Figure 2-5 illustrates the GPS Tool Evaluation and Use area in the context of all GPS programmatic areas.

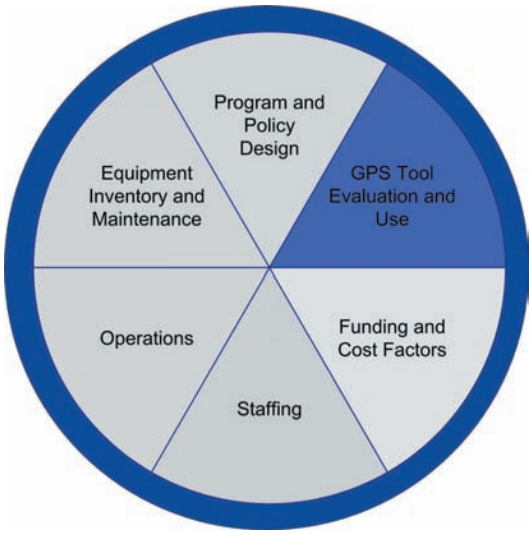


Figure 2-5. GPS Tool Evaluation and Use Area

Section 2.4.1 discusses the interviewed agencies' experiences in evaluating, selecting, and using GPS tools, while section 2.4.2 summarizes the critical factors related to GPS tools.

2.4.1 Practices

The following categories were identified as important aspects of GPS tool evaluation and use.

- Evaluation and Testing,
- Vendor Experiences,
- Defeating the GPS Equipment,
- Wish We Knew, and
- Standards.

Information detailed in these categories was derived from the individual agency interviews and analysis of trends across all the interviews.

2.4.1.1 Evaluation and Testing

When pursuing GPS as a tool for supervision, agencies spend time evaluating and testing products to determine which one(s) are most suitable for their organization. In addition, as new products emerge in the community corrections GPS market, agencies continue to evaluate the latest offerings. This is sometimes done in response to discontent with existing vendor products or in an effort to assess the latest available capabilities. Product evaluations typically consist of field tests conducted by agency staff assessing the effectiveness of the GPS unit within their geographic area. In most cases Officers, Technicians, and Monitors conduct testing while Planners/Administrators and Implementers/Supervisors[5] coordinate the testing and any subsequent Requests for Proposal (RFPs).

Common GPS system evaluation criteria include:

- **GPS Accuracy**. The ability for a particular GPS unit to accurately reflect a client's location is the most critical evaluation criterion. Unit accuracy tests are conducted by staff comparing their known location points against those which the GPS system identified.

[5]See Appendix A for a description of these roles.

Practical Example G: GPS Accuracy

When evaluating various GPS units' accuracy, **City/ County of Denver** staff compared multiple units' accuracy by wearing two units at the same time to determine which vendor's unit provided more accurate data for the Denver region.

- **GPS Signal Reliability**. Another very important factor is the reliability with which the vendor equipment is able to acquire and maintain the GPS signal. GPS reliability can be impacted by the terrain and obstructions in the client's location, by inclement weather, and also by the complexity and sensitivity of the GPS receiver. Without reliable GPS, the client's location cannot be consistently tracked.
- **Cellular Signal Reliability**. Although applicable only to Active and Hybrid GPS units, the ability to acquire and maintain a cellular signal is equally important. A cellular signal is required in order for GPS location data to be communicated to the vendor's software for processing. Agencies have found that some units provide better cellular service within their geographic region than others. Each vendor uses various cellular services for this element of the technology, and as most consumers of cellular phones know, depending on location, a particular provider's service is often more reliable than another.
- **GPS Unit Size**. The size of the GPS unit and associated components is an important consideration when evaluating GPS products. Many pretrial programs prefer to utilize equipment that is less obtrusive in order to minimize the social stigma a defendant might face. However, post-conviction, probation, and parole programs are less concerned with this aspect of unit size. Regardless of potential stigma, the smaller the device, the more easily it can be carried on the client's person and therefore the less likely it is to be left inadvertently.
- **Number of Components**. While closely tied to the issue of GPS unit size, the number of components in a GPS tracking system is a separate important criterion. The predominant desire is to have reliable single piece GPS units (versus a separate bracelet and GPS unit as described in Chapter 1). Although there are some single piece units currently on the market, most agencies currently believe they sacrifice GPS location data accuracy and reliability for single unit convenience.
- **Durability**. The ability of a GPS component to withstand the rigors of daily use is a key evaluation criterion. This is especially important in terms of the GPS unit and bracelet. A primary objective for many community supervision programs is to allow clients to continue to work while under supervision, and for many clients this means manual labor where equipment durability is critical.
- **GPS Signal Acquisition Time**. During installation and setup, the GPS unit must acquire the GPS satellite signal. Additionally, when emerging from a shielded area (e.g., an office building where no GPS signal is able to be received), the GPS unit must reacquire the GPS signal. This can take up to 15 minutes or more for a unit to properly acquire a signal, during which time the client's location is unknown. Therefore, this is an important evaluation factor for many agencies.
- **Battery Life**. The battery life of the various mobile component(s) is also a significant consideration. In some cases the battery life of the unit is so limited as to prohibit practical use. For instance, the GPS unit battery life may not be extensive enough to accommodate a typical work day with reasonable travel time to and from the workplace.
- **Amount of Client Feedback**. Each vendor offers various levels of client feedback with their GPS units. Some utilize voice communications that allow the agency to contact the client directly via cellular phone or two-way "walkie-talkie" communications. Others provide instructions via a Liquid Crystal Display (LCD) or audible or visual alarms, while still others offer all or some variation of these options. Desired client feedback is very clearly a preference that differs for each agency, but one that must be considered during evaluation.
- **Tamper-Resistance**. The ability of a GPS unit and bracelet to withstand tampering is essential to a good GPS system. Therefore, agencies conduct various types of tests to determine the ease with which a component can be tampered with as well as the reliability of the unit's tamper alerts.

- **Vendor Software**. The vendor software provides the interface for setting up a client's profile and applicable schedule, and for reviewing client alerts, and data points. In some cases, vendors may require that third-party software be installed as part of their set-up. The concept of software "user-friendliness" is often stated as an important evaluation criterion for agencies. While this requirement is somewhat ambiguous and user dependent, several specific examples include:
  - **Web Access**. Software that can be viewed using an Internet connection provides staff members with much needed flexibility for reviewing client alerts and other information, particularly during after-hours situations.
  - **High Quality Maps**. Fine-grained maps containing local landmarks and customization capabilities provide staff with valuable supplemental information about a client's location and travel patterns.
  - **Zones**. Exclusion and inclusion zones are a fairly standard capability of vendor software; however, the method for implementing zones differs by vendor. Some software allows only circular or rectangular zone establishment, while others offer arbitrarily shaped polygon zones. Each of these methods has benefits and limitations that ultimately become a preference of the users and are therefore an important evaluation consideration.
- **Victim Alert Capabilities**. When an agency decides to notify victims as part of their GPS program, the method by which that notification occurs can vary. This may include automatic notification by the vendor software via pager or it may be more process related and consist of a phone call from agency personnel. Therefore, assessing the various options for contacting victims in the event of a client alert can be another factor in GPS product selection.
- **Cost/Affordability**. Cost is an important consideration in terms of agency cost and for those programs that are client funded, in terms of affordability for clients. For many agencies, if a tool is not considered affordable for a client then it is not a viable candidate for selection.
- **Fee Collection**. Another potential evaluation criterion is whether or not the vendor can administer client participation fees. For example, when an agency is legally prohibited from collecting client fees they must consider whether a vendor can provide those services.

It is important to note that agencies evaluate vendor options with various trade-offs in mind. While an agency may select a cell phone GPS unit due to the client feedback options it provides, they may be deciding to trade-off some elements of durability or reliability.

Practical Example H: Evaluation and Testing

Because the **Oakland County Community Corrections** program outsources their GPS administration, installation, and monitoring activities, their evaluation criteria did not focus as heavily on the elements previously described, but on such items as:

- The monitoring services company's alert response processes, including documentation procedures and agency interface processes.
- Ability of the services company to provide 24/7 operations.
- The services company's reputation in the corrections field.
- Ability of the services company to obtain appropriate equipment inventory from vendors.

Upon completion of field testing and staff evaluations, agencies conduct pilots of varying durations in an effort to provide a real-world look at how GPS operates. Pilots evaluate the GPS monitoring process from start to finish and provide agencies with practical examples of how equipment responds in their local jurisdiction with real clients. Agencies use their pilot programs to help identify the most appropriate type of GPS and most suitable client populations.

Practical Example I: Evaluation and Testing

The **Texas Department of Criminal Justice's** jurisdiction includes five regions in the state of Texas. While the pilot was conducted in many of these regions, agency personnel indicated that a more wide-spread geographic dispersion of pilot participants would have provided a better evaluation of the equipment and processes, such as inventory management.

2.4.1.2 Vendor Experiences

This subsection looks at the different types of available client feedback from GPS units, the frequency of GPS unit failure, and the vendor support and maintenance that agencies experience (Chapter 3 discusses vendor products and agency perceptions in more detail).

The interviewed agencies use various GPS models from the following vendors:

- BI,
- ElmoTech,
- iSECUREtrac,
- Pro Tech,
- Sentinel, and
- STOP-LLC.

While this section is not intended to evaluate any particular vendor, it is important to identify typical problems that interviewed agencies have experienced with both their vendors and the equipment. Therefore, this section identifies a number of issues that agencies have faced, but does not attribute the problem(s) to a particular vendor or agency.

Agencies are generally unsatisfied with the vendor technical support they receive. In addition to equipment availability problems, vendor customer support desks are often ill informed about many of the intricate problems agencies experience in the field. Many times, the help that agencies receive is inadequate for their needs, with agency staff exhibiting a higher level of equipment competency than vendor support staff. In addition, vendors do not always demonstrate a sense of urgency in reconciling issues. However, when vendors provide on-site representatives, a much higher degree of service is perceived. Vendors also provide monitoring support for agencies, and in this area as well the support is lacking. Vendors also struggle to meet time commitments for such things as ad hoc reports and informational queries.

As discussed previously, the amount of client feedback that a GPS unit provides varies by vendor and GPS model and is subject to the preferences of each agency. There are a wide variety of opinions as to the most appropriate levels of client feedback and the associated impacts that feedback has on a client's compliance with their GPS supervision.

Some agencies believe that the more feedback a client receives from their GPS unit, the more likely they are to try and learn the weaknesses of the equipment and attempt to exploit it. For example, agencies that set up exclusion zones for victims are concerned with utilizing GPS units that inform the client of a zone incursion. In this scenario a client may purposely test the limits of a zone in an effort to try and determine the location of a victim.

Conversely, some believe that the more information a client has, the more likely they are to comply with the constraints of their supervision. An example of this is when clients receive feedback instructing them to take the GPS unit outside in an effort to locate a lost GPS signal. In either case, the agency's preference is really what is important, as there are numerous levels of feedback and customization available by the various vendors.

Some examples of various types of feedback include:

- An LCD screen that displays customized or standard messages.
- Cellular phone or two-way voice communication capabilities. This is often implemented in such a way so that only the agency can initiate contact.
- Vibration.
- An audible alarm such as a beep.

Another element of client feedback is whether or not the client must acknowledge the feedback. For instance, some equipment requires that the client acknowledge an alert by pressing a button on the unit. In most cases, vendor equipment provides some level of feedback customization. This may include the ability to customize the amount of feedback a client gets for a particular alert type, but perhaps not with regard to a particular zone infraction.

Since vendor GPS software is typically Web-based, software updates are usually available upon login by the supervision agency. Updates occur as needed for both large and small software changes and may reflect bug fixes, enhancements, and new functionality. As far as hardware updates are concerned, changes to hardware may also reflect fixes, enhancements, and new functionality; however, new hardware is typically deployed less often. An agency's ability to obtain new

hardware, such as a GPS receiver, bracelet, or charging stand, is often dependent on the conditions of the contract and in some cases requires renegotiation.

2.4.1.3 Defeating the GPS Equipment

Community supervision clients include pretrial defendants and convicted offenders. In either case, the clients are often intent on pushing the limits of their release, including testing the GPS equipment for vulnerabilities. Clients attempt to defeat GPS systems by:

- Failing to properly recharge the GPS unit.
- Leaving the GPS unit somewhere (either intentionally or unintentionally).
- Concealing the GPS unit (e.g., in the trunk of a car, in a purse, etc.) so it does not receive the proper GPS and/or cellular signals.
- Attempting to disrupt the GPS receiver, cellular service, or RF elements of the equipment by wrapping it in tin foil.
- Cutting or otherwise attempting to damage the bracelet.
- Attempting to open the sealed GPS unit case.
- Testing limits of the equipment, for such things as battery life and zones.
- Attempting to damage the equipment by playing sports.
- Blaming the equipment for various alerts or other issues.
- Using extension cords to charge the unit while outdoors.
- "Comparing notes" with other supervision clients to learn about various potential vulnerabilities.

Client compliance with proper handling of GPS equipment is one of the biggest issues with implementing GPS. Initial staff vigilance with regard to alert handling and technology issues really sets the stage for future client compliance. If a client thinks they can manipulate the equipment or agency staff, they will often attempt to do so; therefore, it is important for staff to be consistent and fair from the start.

2.4.1.4 Wish We Knew

With experience comes the wisdom of hindsight and this is especially true when implementing new technologies. No matter how prepared you think you are in the beginning, there are always issues you wish you had considered or known before you started. When implementing GPS, agencies indicated the following:

- GPS Equipment
  - The frequency with which GPS signal loss occurs and its detrimental effect on operations. The "urban canyon"[6] problem is a frequent limitation of GPS monitoring equipment and prevents the equipment from capturing accurate, real-time location data for a client.
  - General technology limitations and vulnerabilities, such as poor or no GPS reception indoors and battery life limitations.
  - The lack of adequate cellular coverage and its effect on operations. When there is intermittent cellular coverage, Active and Hybrid GPS cannot send data location information to the vendor software for processing.
  - The frequency of equipment issues and failures.
  - The lack of sophistication in the "tamper proof" characteristics of the equipment.
  - The lack of equipment durability.
  - The bracelet and GPS operate on RF technology which adds another layer of complexity among the components. Along with this are the potential issues related to having three separate components (e.g., easy physical separation of the pieces).
- Operations
  - The actual time required to analyze data and determine appropriate actions takes longer than expected. This relates to an overall understanding of the staff resource requirements necessary for supporting a successful program. It is sometimes difficult and time consuming to determine if a problem is a legitimate client

[6]An urban canyon is an artifact of an urban environment caused by streets cutting through dense blocks of structures, especially skyscrapers. An example of an urban canyon is the Magnificent Mile in Chicago. Urban canyons can cause problems with GPS reception ("Urban canyon").

violation or an equipment problem. One agency indicated that they did not realize the ambiguous nature of many issues they would encounter.

- There are a large number of alerts that one agency characterized as "nuisance alerts". These are alerts that occur frequently and in the majority of cases are resolved without intervention or are irresolvable. This includes an alert that indicates the maximum allowable distance between the GPS device and the bracelet has been exceeded. Another frequent "nuisance alert" is when a client is inside a building and GPS signal cannot be acquired, in this case an alert may be sent repeatedly, however, there is nothing that can really be done unless the client goes outside again. If the client's workplace presents such a problem, this can become a daily "nuisance". Both of these types of alerts tend to occur quite frequently and may lead to some complacency in analysis and response.
- A better understanding of which clients are most appropriate candidates for GPS monitoring. This is especially important for agencies in order to better educate other stakeholders such as judges, lawyers, and parole boards.
- The implication that having all of a client's location data at your disposal entails a responsibility to be able to react to all that information.
- Implementation requires a long-term investment and commitment to help iron out the wrinkles.

Although these are all items that agencies wish they had known before they started, in many cases, these kinds of issues are a matter of a natural learning curve that comes with implementing a new technology.

2.4.1.5 Standards

Although not currently available, it would be very beneficial to the supervision community to have a set of standards by which to objectively assess various GPS models. It is critical that any such standards be set and administered by an objective third-party, not a vendor organization. Standards would be especially beneficial for such things as battery life, GPS receiver signal strength and reliability, GPS signal acquisition time, tamper-resistance, and equipment testing. Standard setting for processes and software capabilities would also be valuable. Chapter 5 discusses the current state of standards for GPS in community corrections.

2.4.2 Key Considerations

Section 2.4.1 identified and categorized the various practices interviewed agencies deemed important to GPS tool evaluation and use. This subsection summarizes the key considerations of GPS evaluation, testing, and use.

- **Evaluation and Testing**. Thorough evaluation and testing can significantly impact the success of an agency's GPS program. A thoughtfully planned evaluation and pilot period allows for trial and error, providing staff with critical real-world scenarios from which to learn. Also during the evaluation and testing period, agencies have the opportunity to determine which GPS hardware and software capabilities are most important to their organization. These types of decisions will ultimately impact the policies and procedures that an agency implements, as well as the overall success of their program.
- **Vendor Experiences**. The experience agencies have with vendors impacts their perception of how effective GPS is in assisting with client supervision. When agencies have positive vendor experiences they tend to believe in the equipment, when the experiences are negative, agencies tend to lose confidence in the equipment. In addition, negative experiences can lead to an adversarial relationship with the vendor that can impact the overall program.
- **Defeating the System**. When agencies are aware of the common tactics clients use to attempt to defeat GPS technology they are better prepared to react to clients. In addition, having this kind of knowledge impacts their ability to differentiate between a legitimate equipment issue and one possibly caused by an unscrupulous client.
- **Wish We Knew**. As is the case with implementing any new process or technology, sometimes you simply cannot know everything beforehand. However, insight into issues agencies wish they knew can benefit other agencies in the future. In addition, recognizing these types of items can assist all agencies in future technology procurements.

- **Standards**. Implementing industry standards would help agencies evaluate legitimate vendors and provide a more reasonable and efficient process for vendor comparison.

2.5 Funding and Cost Factors

This section describes agency experiences related to the expenses of using GPS in community supervision. Figure 2-6 illustrates the Funding and Cost Factors area in the context of all GPS programmatic areas.

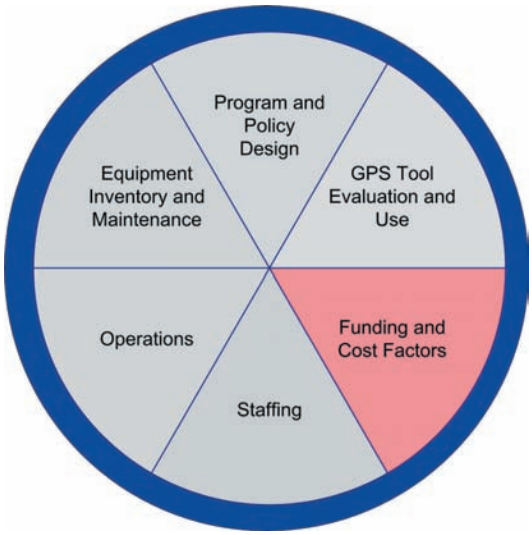


Figure 2-6. Funding and Cost Factors Area

Section 2.5.1 reflects the interviewed agencies' experiences with funding sources and cost factors, while section 2.5.2 summarizes critical considerations of a GPS program in these areas.

2.5.1 Practices

Agency experiences with obtaining and managing funding for GPS tools and resources are described in the following categories:

- Funding Sources and
- GPS Costs.

Information detailed in these categories was derived from the individual agency interviews and analysis of trends across all the interviews.

2.5.1.1 Funding Sources

Funding sources for programs using GPS generally follow one of three models. These include government funded programs in which clients do not pay any fees, client funded programs in which clients are charged a fee as a condition of being monitored with GPS, and third-party models in which the client pays a fee and the supervision agency receives government funding. Table 2-1 identifies the funding model for each interviewed agency.

- **Government Funded Programs**. Government funded programs are financed through federal, state, and/or local sources (including grants). These sources may finance alternative sentencing options or EM tools, with some specifying GPS. In some cases GPS is funded for a particular client demographic such as sex offenders. Due to the unpredictable nature of criminal sentencing, it is often challenging for government funded agencies to accurately plan their GPS budgets from year to year. However, this is rarely seen as an obstacle to installing GPS on required clients, as necessary funds are usually acquired. Many program staff in these types of programs dislike client funded

Table 2-1. Agency Funding Models

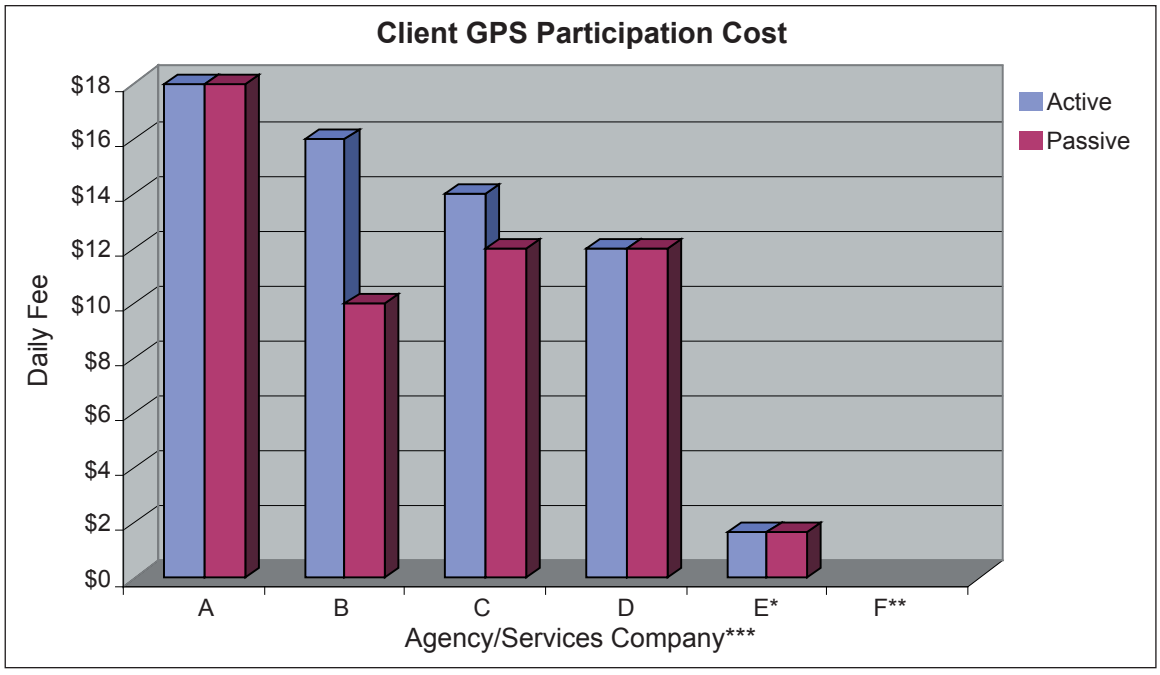
Government Funded	Client Funded	Government/Client Funded
CSOSA	City/County of Denver EM Program	Oakland County Community Corrections[7]
Texas Department of Criminal Justice	Marion County Community Corrections	New Mexico Corrections Department
		US Pretrial Services - Central District of California

[7]Oakland County Community Corrections utilizes two different GPS services companies which administer and manage their GPS programs with oversight by the agency staff. This agency is considered government/client funded because the services companies administer all client fees, while agency staff are supported by government funds.

programs due to their belief that it is unfair for client fees to prevent someone from being eligible for GPS monitoring.

- **Client Funded Programs**. In client funded programs the client must generally pay an installation fee as well as weekly or monthly fees in order to be released on GPS. In some cases, fees are prorated based on a client's ability to pay. Collected fees are used to fund the entire operations of a program, including GPS equipment costs, staff, and other necessary resources. Although client fees are intended to finance the entire program, some agencies receive a small subsidy from government sources to off-set fee collection problems. This is often necessary with typical collection rates at about 50 percent. The consequences of non-payment are often difficult to enforce unless a judge is willing to re-incarcerate the client, which does not typically happen. Agencies that fund their GPS programs in this manner often collect fees for other EM tools (such as RF and Secure Continuous Remote Alcohol Monitoring [SCRAM]) as well. In many cases the collection rates for other EM tools are much higher and help offset any fees lost from GPS clients.
- **Government/Client Funded Programs**. In this model, government funding is provided for some aspects of the program, but clients are also charged a fee. The difference between this model and the client funded model is that in this case, the fees are not intended to wholly finance the program. Agencies may impose the fee in an effort to elicit responsible behavior from a client and the government funding goes beyond subsidies and finances such things as staff and overhead resources. In addition, in some of these programs a third-party vendor is responsible for all GPS fee collection. These programs often have similar collection rates (approximately 50 percent) as fully client-funded programs.

Figure 2-7 depicts the Active and Passive GPS daily client fees for client funded and government/client funded programs. In some cases, the client participation fee is substantially higher than the actual GPS equipment costs, which can provide the agency with excess funding to offset low collection rates.



Legend:

* Agency/Services Company E charges a small monthly fee as opposed to a daily fee.

** Agency/Services Company F charges a pro-rated fee based on each client, therefore a single fee was not provided.

*** This figure includes two services companies serving Oakland County Community Corrections. Therefore there are six agency/services companies identified in the figure, even though there are only five agencies that charge fees.

Figure 2-7. GPS Client Participation Fees

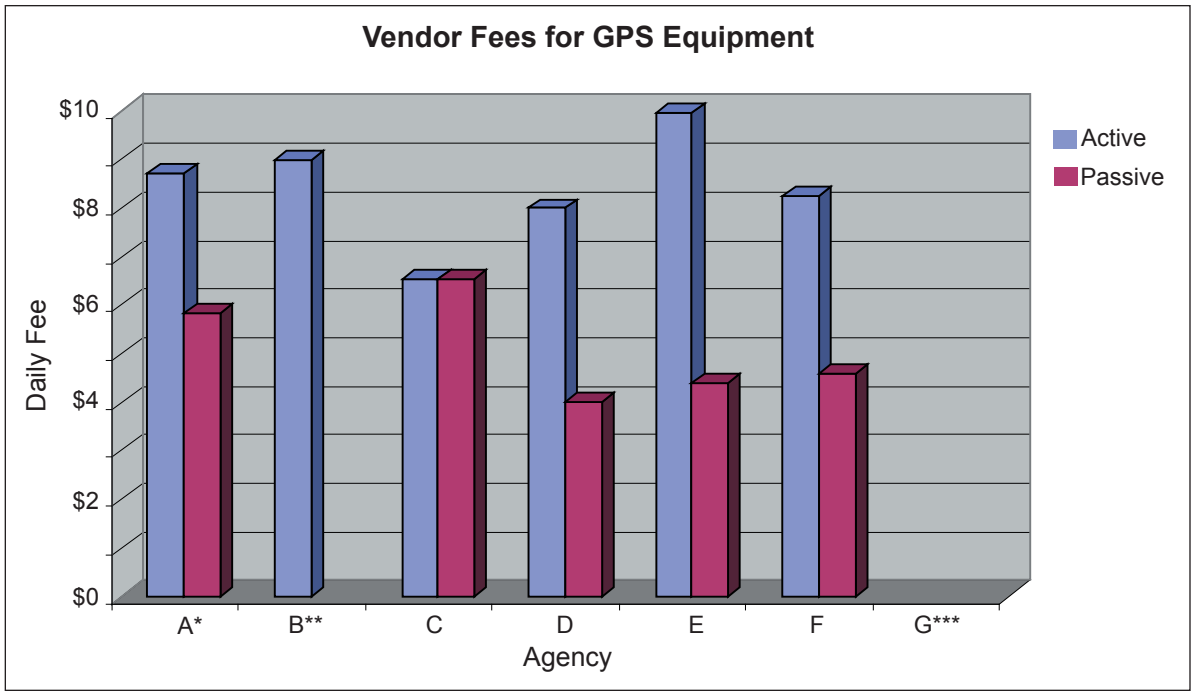
An additional funding issue for agencies is the high cost of replacing lost/stolen equipment. Most agencies do not charge the client for such losses. Therefore, depending on the agency's vendor contract this can be a source of considerable expense. It can be very challenging to accurately estimate the potential number of lost or stolen devices an agency may have in one year. Most agencies use the previous year's lost/stolen numbers for future budgets. However, this is not always an accurate predictor of future trends or in cases of expanded programs, not an appropriate measure in terms of scale. Regardless of funding model, equipment replacement can be a significant cost, as it is often difficult to obtain payment from clients.

2.5.1.2 GPS Costs

The cost of GPS equipment and vendor service is typically combined into a single daily lease fee charged per day, per client. For instance, a vendor may charge an agency $10 per day, per client for Passive GPS. As seen in Figure 2-8, there is generally a cost disparity in vendor fees between Active and Passive GPS service.

For most agencies, GPS is one EM tool among many designed to assist officers in community supervision. In the spectrum of EM tools, GPS is typically more expensive than other tools such as RF and drive-by RF. However, when compared with incarceration, GPS costs are significantly lower than daily jail or prison expenditures for comparable clients.

When discussing GPS, legislatures and agencies often publicize the cost differences of GPS programs compared to incarceration. However, these are difficult numbers to effectively compare without knowing the extent of items included in the costs. Table 2-2 depicts an example of cost differences across supervision techniques.



Legend:

* Agency A utilizes more than one vendor for Active GPS; therefore the two different vendor fees were averaged for this figure.

** Agency B does not utilize Passive GPS.

*** Agency G did not provide vendor fees.

Figure 2-8. GPS Vendor Fees

Table 2-2. Example of Costs of Supervision Techniques

Supervision Technique	Technology Type	Daily Vendor Cost	Total Daily Cost
Reporting Kiosks	Client Check-In	$1	$8
RF Landline Home Monitoring	Home/Curfew Detection	$2	$9
SCRAM	Alcohol Monitoring	$5	$12
RF Cellular Home Monitoring	Home/Curfew Detection	$6	$12
Passive GPS	Delayed Location-Based Tracking	$6	$13
Active GPS	"Real-Time" Location-Based Tracking	$8	$15
Incarceration	N/A	N/A	$82

It is important to compare the Total Daily Cost of supervision techniques, not merely the Daily Vendor Cost. For instance, when initially looking at Active GPS vendor costs against incarceration costs, it appears to be $8 versus $82, a savings of $74. However, the actual cost of running the GPS program includes the vendor fee as well as staff and overhead resources; all of which equals $15/day. This changes the cost savings to $67/day. As previously indicated, costs associated with lost/stolen equipment are often difficult to estimate and are therefore often unanticipated. Other potential costs may include overtime and specialized training.

2.5.2 Key Considerations

Section 2.5.1 identified the interviewed agencies' funding and cost practices. This subsection summarizes key considerations from those funding and cost practices.

- **Funding Sources**. Agencies may have no input into how their GPS program is funded. However, it is important for them to recognize the benefits and challenges of each funding model. Government funded programs may experience unique constraints and public pressure to perform that those which are client funded do not experience. However, client funded programs may experience funding shortfalls when collection rates do not meet expectations.
- **GPS Costs**. The actual overhead costs of running a program are often not considered during budget planning but play a critical role in evaluating the true cost benefits of any tool, including GPS. Cost evaluations between EM tools and incarceration should strive to accurately evaluate comparative elements. For instance, community supervision programs should include appropriate inputs such as staff, tools, office space and other overhead costs that are usually included in incarceration cost estimates.

2.6 Staffing

This section describes agency experiences related to staffing practices such as the agency's organizational structure, training, and staff caseload/workload. Figure 2-9 illustrates the Staffing area in the context of all GPS programmatic areas.

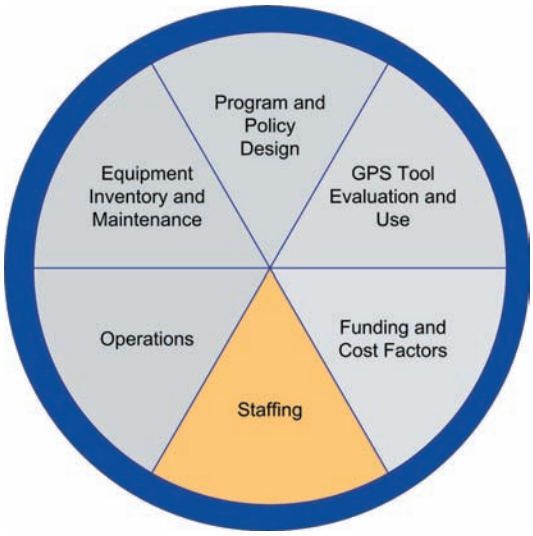


Figure 2-9. Staffing Area

Section 2.6.1 reflects the interviewed agencies' experiences with staffing, while section 2.6.2 identifies critical staffing concerns with regard to community supervision and GPS.

2.6.1 Practices

Agency experiences with staff issues are described in the following categories:

- Organizational Structure,
- Training, and
- Caseload/Workload.

Information detailed in these categories was derived from individual agency interviews and analysis of trends across all interviews.

2.6.1.1 Organizational Structure

For many agencies, the decision to use GPS imposes changes on the agency's organizational structure. This may include establishing or modifying a 24/7 monitoring center, or reorganizing existing staff schedules to accommodate after-hours monitoring requirements. In addition, supplemental staff may need to be hired and supervisory/staff reporting lines may require restructuring. As indicated in section 2.5, these kinds of requirements may impose additional expense to the agency.

Practical Example J: Organizational Structure

The **Texas Department of Criminal Justice's** Command Center was originally responsible for receiving and responding to RF alerts after hours (5:01 pm to 7:59 am). When the GPS program was expanded to include 1500 Passive GPS clients and 30 Active GPS clients, the Command Center was given the additional task of monitoring those clients during off-duty hours as well.

In order to accommodate a larger monitoring task during those off-duty hours the Command Center modified the shift structure from three shifts to two, with more staff working the 4 pm to 8 am shift when there were more clients being monitored.

Another factor of organizational structure is the selection of appropriate officers and other staff to manage GPS clients. Depending on the agency, the staff responsible for GPS clients may or may not also be tasked with traditional community supervision responsibilities. For instance, several agencies have separate EM units that are responsible solely for the EM technologies used on clients, with more traditional probation or parole officers supervising the client as well. However, other agencies have simply added the GPS duties to an officer's existing responsibilities. With this in mind, agencies may look to hire officers with strong computer and technology skills, while others rely more heavily on training to ensure an officer's competence with the technology.

2.6.1.2 Training

As with implementing any new technology or process, effective training is critical. GPS vendors tend to offer agencies one to two days of equipment and software training as part of their lease fees. Agencies sometimes offer additional in-house GPS process training to supplement the vendor training; however, this is often coupled with other staff training. All agencies also consider on-the-job training (OJT) to be critical to a staff member's aptitude with the GPS equipment and software. Due to the intricacies of alert investigation and response, agencies consider the learning curve for GPS to be quite steep. Most agencies offer refresher training at least once a year conducted either by the vendor or an agency staff member who has extensive knowledge of GPS and agency policy.

Practical Example K: Training

CSOSA does not operate with a separate GPS client caseload; GPS is used as a tool of general supervision. Therefore officers may not always maintain a caseload with GPS clients. This makes it challenging to ensure an officer's GPS competency, since there may be a large time gap between when they receive GPS training and when they use it. In an effort to mitigate this problem, CSOSA plans to institute regular monthly GPS training for new or existing officers.

Computer-based training (CBT) is a new method some vendors are using for training, and one that could help mitigate competency issues by allowing staff to refresh their knowledge as needed.

As part of the agency interviews, individual respondents (there were 66 total) were asked to complete a set of questions designed to reflect their thoughts on various elements of GPS. Respondents were categorized in one of five roles: Officers, Technicians, Monitors, Implementers/Supervisors, and Planners/Administrators (Appendix A: Project Methodology defines these roles). Figure 2-10 depicts agency responses related to how well vendor training prepared them to use GPS.

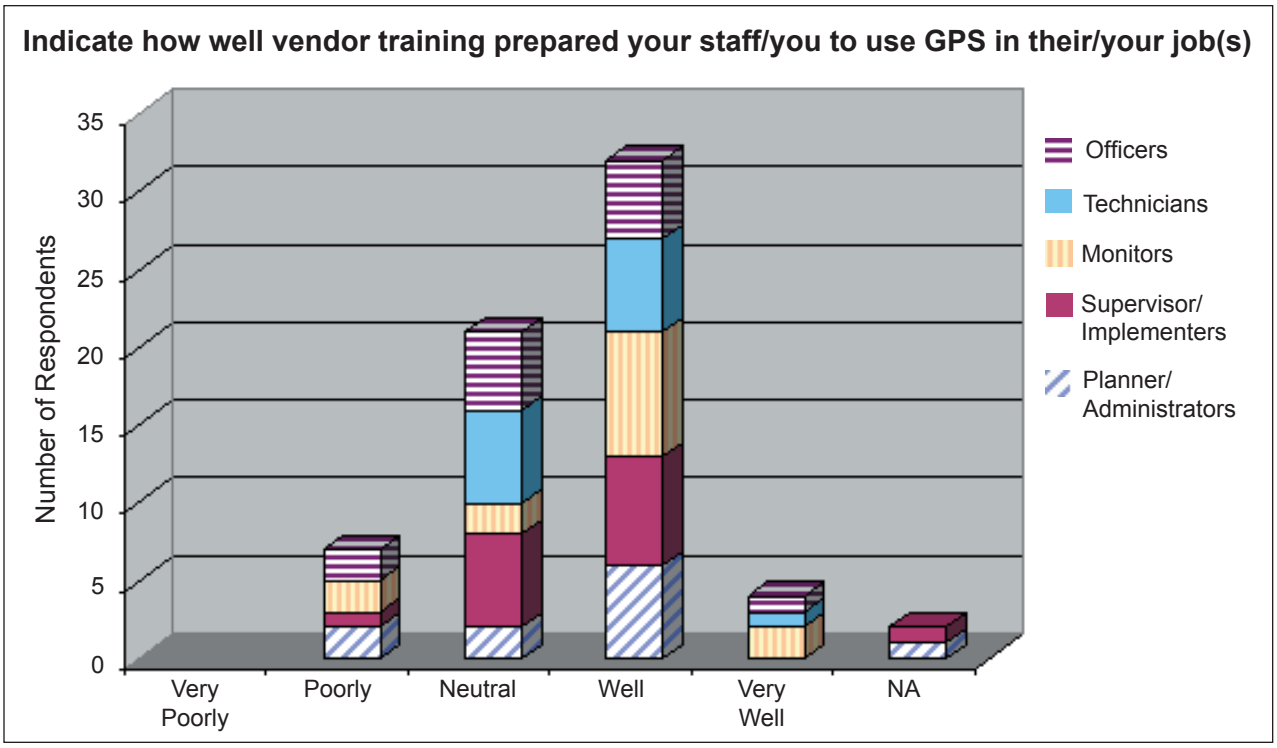


Figure 2-10. Vendor Training Preparedness

Figure 2-11 displays agency responses related to how well internal training prepared them to use GPS.

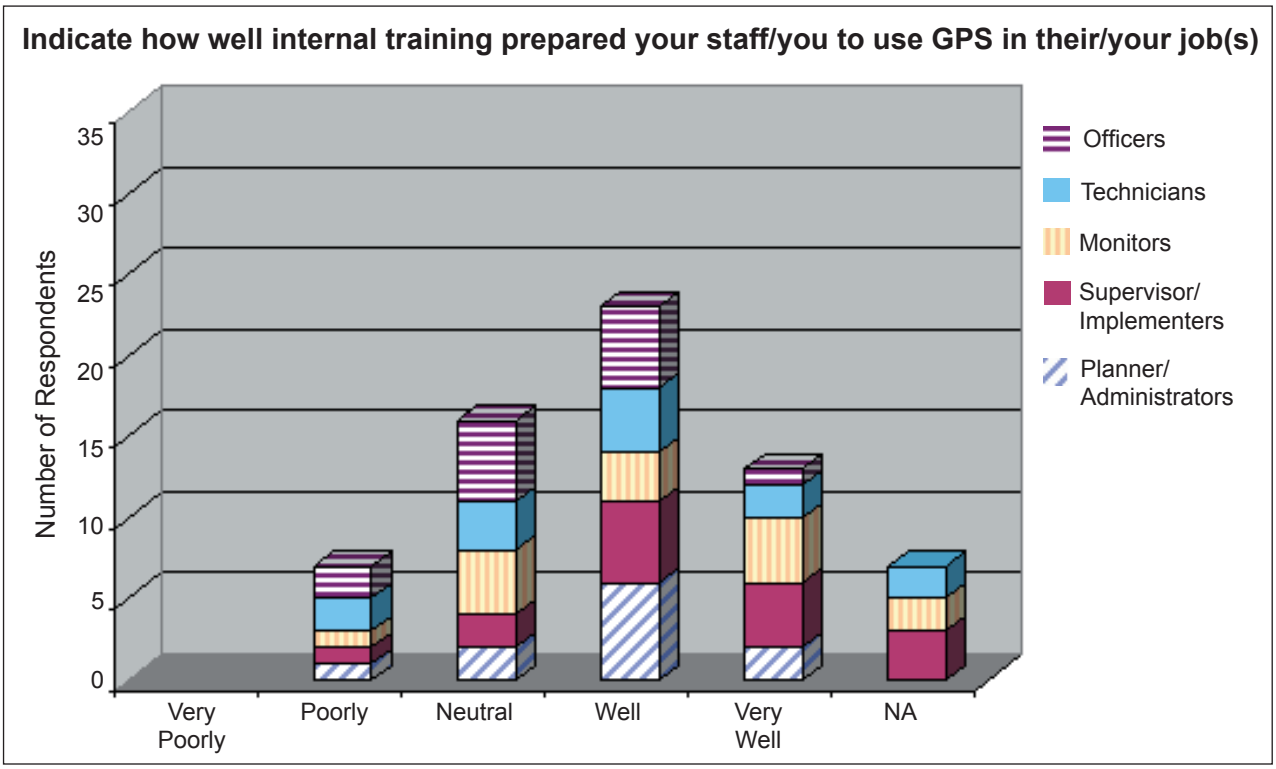


Figure 2-11. Internal Training Preparedness

The final aspect of training related to GPS use is instruction an officer or staff member may provide to clients and victims. While no agency offers formal training for clients on how to use GPS, all agencies utilize a written agreement to inform clients of their GPS equipment responsibilities. This includes outlining proper methods for carrying the GPS unit (e.g., not in a trunk or purse), charging, land-line phone restrictions (e.g., no call waiting or answering machines), and consequences of violating the guidelines. Some agencies also require other residents of the client's home to sign the agreement. For agencies providing victim notification, a victim must typically sign an agreement acknowledging their cooperation with the notification process, including releasing the agency from liability.

2.6.1.3 Caseload/Workload

Caseload comparisons among agencies are not really useful because each agency manages their GPS cases in different ways. Not every agency has a strict GPS caseload, GPS clients are often supervised within the context of a caseload involving intensive supervision or sex offenders, or GPS may be used for short-term sanctioning purposes or pretrial release. Using GPS for each of these purposes justifies differing reasonable caseloads. However, for those agencies with segregated EM case loads, GPS loads are typically smaller than RF caseloads (e.g., 10-15:1 for GPS versus 30-60:1 for RF). Caseloads also vary based on the type of GPS being used.

While caseloads are the formal number of cases an officer is assigned to supervise, workload reflects the perceived relationship of the staff member and the task demands. Staff workloads are impacted by implementing GPS; however, the degree of impact differs for various tasks. The perception is that there are increases in data analysis and alert investigation requirements (more computer time) and decreases in face-to-face dealings with clients and client associates, such as home visits and visits to employers and counselors. For example, the ability to verify a client's compliance with work and alcohol treatment conditions is aided by GPS because officers no longer must rely on timesheets and reports to verify that a client is attending work or counseling.

Since there are varying degrees of perceived impact on different elements of tasking, it is difficult to assess the overall impact of GPS on an individual staff member or agency's workload. However, as part of the agency interviews, all respondents were asked to respond to questions about personal and agency workload impacts. Respondents were categorized in one of five roles: Officers, Technicians, Monitors, Implementers/Supervisors, and Planners/Administrators (Appendix A: Project Methodology defines these roles). Figure 2-12 depicts that a majority of agency respondents felt that GPS had a neutral or positive impact on their personal workload.

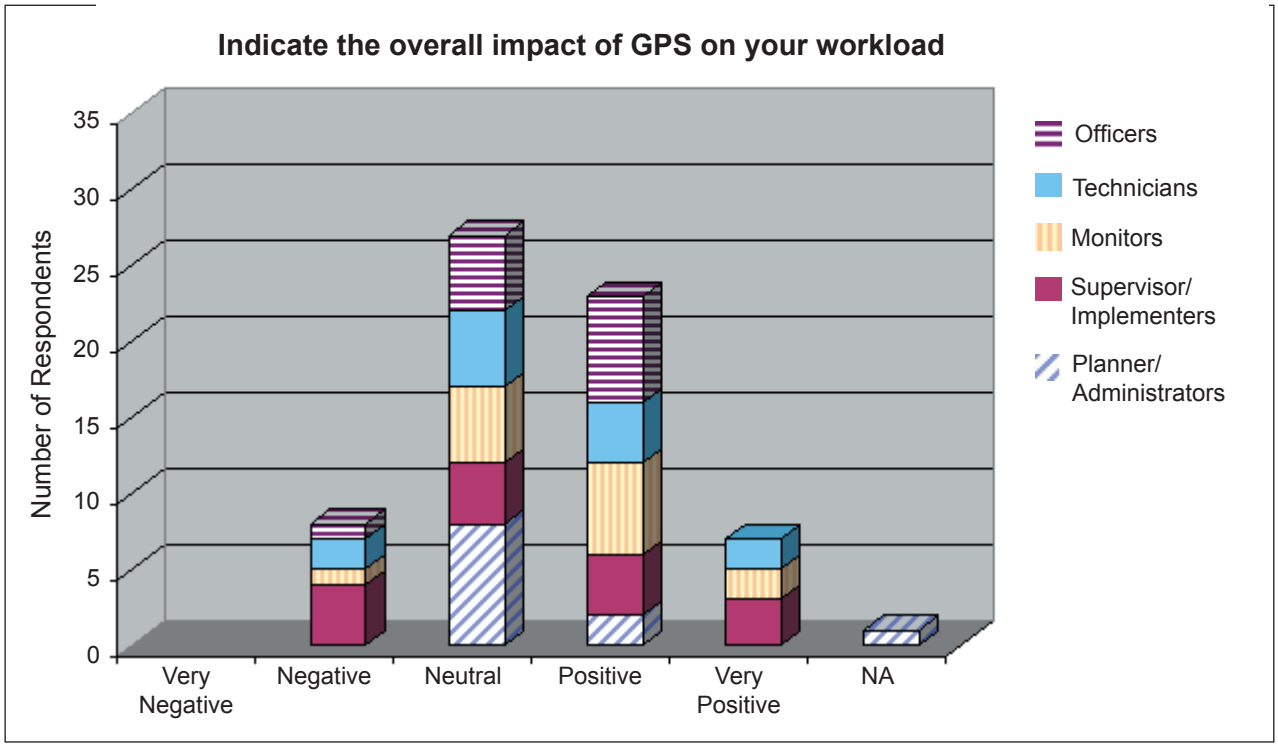


Figure 2-12. Impact of GPS on Personal Workload

Figure 2-13 shows that respondents' perceptions of how GPS impacts their agency's workload are quite different from their perceptions of their personal workloads; with more feeling the impact was neutral or negative.

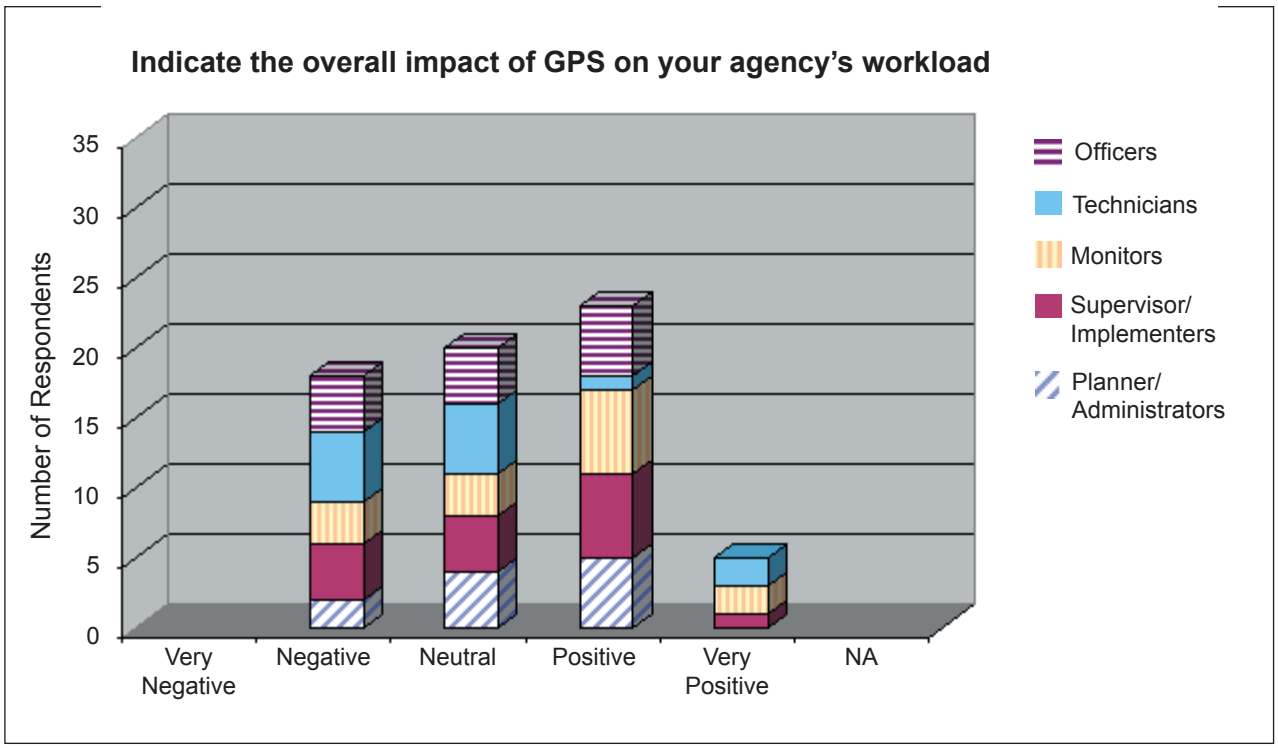


Figure 2-13. Impact of GPS on Agency Workload

It is interesting to note the different perceptions of personal workload versus agency workload depicted in these two figures, particularly for the non-management and supervisory roles. This may be a result of GPS impacting officers, technicians, and monitors personal workloads, whereas management roles may not interact with GPS on a day-to-day basis, yet see the cumulative impact of GPS across the agency.

2.6.2 Key Considerations

Section 2.6.1 identified interviewed agencies' staffing practices. This subsection summarizes key considerations from those staffing practices.

- **Organizational Structure**. GPS implementation will impose change on an agency's organizational structure and staff responsibilities. This stems from the need to respond to alerts in a timely and appropriate manner and may manifest itself in monitoring centers, shift changes, and additional staff.
- **Training**. As a supplement to classroom training, on-the-job training helps ensure that officers and other agency staff understand how GPS operates in real-world situations. Refresher training is another method for establishing ongoing GPS tool competency.
- **Caseloads/Workloads**. Determining appropriate GPS caseloads is dependent on staff competency, supervision intensity, and GPS type. Staff perceptions of workload will be affected by caseload size and programmatic support of GPS processes.

2.7 Operations

This section describes experiences of operating GPS as part of a community supervision program. Figure 2-14 illustrates the Operations area in the context of all GPS programmatic areas.

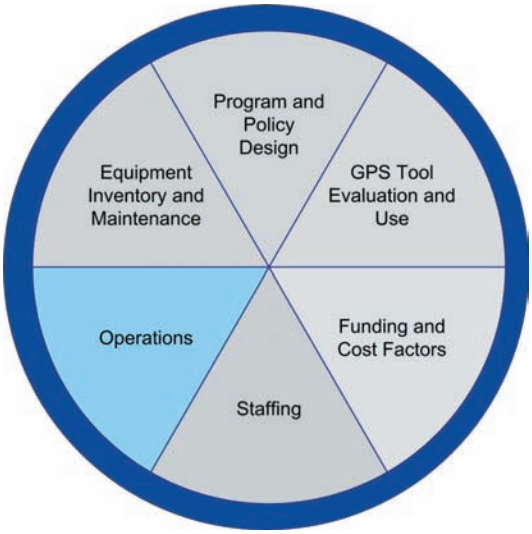


Figure 2-14. Operations Area

Section 2.7.1 reflects the interviewed agencies' experiences with operating GPS as part of their supervision program(s), while section 2.7.2 summarizes critical operational issues.

2.7.1 Practices

There are a number of operational aspects of a GPS program, these include:

- Program Type,
- GPS Clients,
- GPS Stakeholders,
- Alert Processing,
- Violations,
- Treatment Strategies,
- GPS Operational Impacts, and
- Contingency Planning.

Information detailed in these categories was derived from the individual agency interviews and analysis of trends across all interviews.

2.7.1.1 Program Type

Although each agency's mission and responsibilities differ per their jurisdiction and client base, there are

some factors common within each phase of criminal justice supervision.

- **Pretrial**. Pretrial supervision programs tend to place defendants on GPS that have a victim as a result of a sexual offense or domestic violence offense. In these cases, exclusion zone capabilities are frequently used to identify when a defendant ventures into a victim's prohibited area. GPS is also used in pretrial situations to help ensure a defendant's return to court. However, some agencies use GPS in pretrial cases as a reward for defendants who exhibit "good" behavior while under home confinement with RF. In other cases, a pretrial agency maintains responsibility for a defendant following their conviction, but prior to their sentencing; and here GPS is also used as a condition of continued release. The main objective of many pretrial supervision agencies is to enforce the terms and conditions of a defendant's bond release, and for GPS clients, GPS is simply another condition to enforce.

Practical Example L: Program Type - Pretrial

Oakland County, Michigan Community Corrections outsources the installation, management, and monitoring aspects of their program to one of two third-party monitoring services companies. These third-party companies contract directly with GPS vendors to provide Oakland County clients with GPS devices and service. When faced with GPS as a condition of release, the Community Corrections Officer refers the defendant to the third-party for hook-up, technical issues, and payment. The Corrections Officers then manage the case by monitoring the outsourcing companies' handling of alerts and violations. On a daily basis they review the third-party records to ensure that alerts are appropriately handled and that clients are being managed effectively. Victims are automatically notified via pager of exclusion zone violations by a client.

In addition to using GPS for pretrial release and post-conviction release orders, the **United States Pretrial Services, Central District of California** also uses GPS in response to a non-EM client's violations. For instance, if a defendant is released on bond, but violates the conditions of their release, they may be placed on GPS at that time. The agency recommends the best GPS candidates, but it is ultimately the presiding judge's decision.

- **Post-Conviction**. In some jurisdictions, GPS is used as an alternative form of sentencing. For instance, a client may be sentenced to GPS in lieu of jail or prison due to overcrowding problems. GPS may be used in these cases to help ensure clients abide by "no contact orders" with victims or simply to help enforce a client's work and home schedule.

Practical Example M: Program Type - Post-Conviction

Officers from the **City/County of Denver Electronic Monitoring Program** meet with local judges on a daily basis to discuss the docket and determine which clients appear best suited for GPS tracking. The judge ultimately decides, but the EM Program Office has indicated that this close coordination with the judges had led to more appropriate use of GPS for various types of clients.

Marion County, Indiana Community Corrections utilizes an in-house 24/7 monitoring center to process and analyze alerts. While Officers are notified of priority alerts (as configured in the vendor software), the Monitoring Center handles the predominate number of alerts and works with local Law Enforcement and the Officers to resolve them as appropriate. The Monitoring Center is also responsible for contacting victims via phone as appropriate.

Note: Both the Denver and Marion County programs also service pretrial defendants as well as post-conviction.

- **Probation/Parole**. In probation and parole situations, GPS is often used as a sanctioning tool within the context of a client's overall supervision program. GPS provides a client more freedom of movement compared to traditional RF technology and is therefore often considered a "reward" for good behavior. However, in some jurisdictions GPS is used as part of intensive supervision programs and may be considered a more restrictive term of release since all movements are monitored.

Practical Example N:
Program Type - Probation/Parole

CSOSA typically uses GPS in short-term spans for sex offenders, domestic violence, substance abuse, mental health, and other high-risk offenders. GPS is primarily used as a sanctioning tool within the context of a client's regular supervision conditions. These multiple levels of sanctioning include, having the option to install a GPS unit with/without phone, establishing tighter or loser zone control, and shifting curfew times as a client's behavior warrants. GPS is typically used in 30, 60, or 90 day cycles.

One-third of the GPS clients in the **New Mexico Corrections Department Probation and Parole Division** are enrolled in the Intensive Supervision Program (ISP) (high-risk, habitual offenders, drug offenders). The remaining two-thirds of GPS clients are sex offenders; with the vast majority of both groups being placed on Passive GPS. The agency uses GPS to augment personal observation, and to provide a method for client containment. In addition, GPS provides officers with the ability to verify curfew compliance and job attendance through the use of zones.

The **Texas Department of Criminal Justice** utilizes a Command Center for after-hours monitoring of GPS clients. The Command Center reviews Passive after-hours GPS alerts as they are downloaded when the client is charging their unit during the Command Center hours. On a daily basis, officers review ALL data points, not just alerts, but all points to identify any trends and behavior patterns.

For all program types, the ability to use either Passive or Active GPS provides agencies with a method for fine-tuning the intensity with which a client is supervised.

2.7.1.2 GPS Clients

One of the most challenging aspects of GPS operations is determining which clients are most suitable for GPS supervision. Depending on the agency's supervision type (such as pretrial, probation, or parole), client suitability decisions may not be left to the agency. Judicial orders, parole board orders, or legislation may mandate the offenses for which clients must be placed on GPS. In many cases however, the agency decides whether the client is placed on Active, Passive, or Hybrid GPS. The following list identifies some typical types of clients that warrant GPS supervision in the community:

- Sex offenders,
- Domestic violence clients,
- Clients with restraining orders,
- Clients with other types of victims,
- Substance abusers,
- Violent clients (for such things as armed robbery or burglary), and
- Gang related clients.

In pretrial situations many of these same types of offenses will warrant GPS; however, the presiding judge may order GPS for virtually any type of client. This is often done in an effort to provide assurance of a client's return to court using the least restrictive means of supervision that are consistent with victim and public safety. In some jurisdictions the concept of "intensive supervision" is used to identify clients with criminal histories and behavior patterns that warrant more substantive supervision, which includes GPS. Additionally, clients with identified mental health issues may sometimes be placed on GPS as an added layer of supervision.

Additional criteria for determining suitability for GPS supervision include:

- Client's case history,
- Potential risk to community,
- Nature of offense,
- Length of time between crimes,
- Polygraph results,
- Screening and risk assessment tool results (e.g., Static99 sex offender risk tool),
- Lack of previous issues while on EM or GPS (e.g., destruction of equipment), and
- For pretrial, the client's perceived flight risk.

Agencies indicated an occasional disconnect between the agency and judiciary regarding the best GPS candidates. This is especially true in release orders as a result of jail or prison overcrowding; in these cases, agencies suggest that the primary criterion for putting a client on GPS is often the need for more jail or prison space. Although the criteria that agencies use for GPS clients is often sufficient and seems to work well, there is a general impression among agencies that the methods are continuing to evolve.

Once clients are identified as candidates for GPS, there may be factors limiting the agency's ability to impose

GPS. These may include lack of residence, lack of land-line phone, or inability to pay GPS fees. Most agencies indicated that a client is not typically released from jail or prison without some housing assistance if needed (such as halfway houses, etc.). Agencies may place a client on Active GPS in lieu of Passive GPS if there is not an available phone line or they may require that the client report to the agency office on a regular basis to download their GPS data. Additionally, as indicated in section 2.5.1.1, agencies often develop reasonable payment plans for clients required to pay GPS fees.

Once selected for GPS monitoring, the length of time a client spends on GPS is dependant on factors such as:

- **Client Compliance**. A client's ability to comply with the conditions of their release, including carrying GPS equipment, is one of the most important factors in determining GPS monitoring length. Non-compliance may result in violations or re-incarceration which would end their GPS use.
- **Program Type**. Depending on the phase of the criminal justice process, GPS monitoring may be the result of a judge or parole board's order, in which case a specific time frame for GPS monitoring may be known. However, with pretrial use of GPS, the length of time is often dependent on the courts and trial length which vary considerably by jurisdiction and case.
- **Program Structure**. When an agency uses GPS as a method of sanctioning or reward, the length of time on GPS can vary depending on the client's behavior. For instance, a client may be initially placed on Active GPS and upon successfully completing some period of time be put on Passive GPS. Once they demonstrate compliance with the Passive GPS conditions a client may be removed from EM completely or placed on RF.
- **Supervision Intensity**. GPS is often used as at tool within an agency's intensive supervision program and length of GPS monitoring may be dependent on policies for such a program. For instance, an agency may have policies or laws that state all sex offenders are placed on GPS for the length of their supervision.

Due to these variables, the average length of time a client spends being monitored by GPS is difficult to quantify. However, the following ranges were derived from agency responses:

- Pretrial GPS use ranges from 75 – 330 days.
- Post-Conviction GPS use ranges from 60 – 300 days.
- Probation/Parole GPS use ranges from 30 – 90 days when used as a sanction and 120 – 381 days for more long-term use.

2.7.1.3 GPS Stakeholders

Many criminal justice stakeholders external to the supervision agency have an interest in programs that use GPS. Law enforcement and supervision agencies often collaborate by sharing crime and client GPS data. By reviewing client location points against location data from crimes, law enforcement personnel can exonerate or identify potential suspects from the community's GPS clients. Some vendors provide such automated crime correlation features in their GPS software.

Additional collaboration occurs when agencies notify law enforcement in the event of victim zone incursions. In these cases, law enforcement may be contacted in order to dispatch police to the victim's location to ensure their safety. Agencies also frequently notify law enforcement when a warrant is issued for a GPS client. Pretrial agencies must ensure that any information sharing with law enforcement is appropriate per the guidelines of their defendant's release. Law enforcement collaboration tends to occur on an ad hoc basis in most jurisdictions, but agencies anticipate more comprehensive cooperation as GPS becomes more frequently used.

Practical Example O: GPS Stakeholders

CSOSA actively collaborates with local law enforcement by sharing information about clients that are under GPS supervision in a particular area. In addition, law enforcement will periodically request to see a particular client's movements. CSOSA is currently in the process of establishing a Memorandum of Understanding (MOU) with the Washington, DC Metropolitan Police Department (MPD) to provide the MPD with direct access to the GPS system. In addition, CSOSA and MPD hold weekly meetings to discuss supervision clients and possible associated crimes.

Other interested criminal justice stakeholders are judges, lawyers, and parole boards. When a client engages in activities that result in one or more violations, agency staff will generally provide testimony or a written report to the court or board. The supervising officer typically testifies and may print tracking maps from the GPS software to illustrate the violation. For instance, if a client ventured into a known exclusion zone and ignored warnings from their GPS device, the printout from the GPS software would show the client's data points in the exclusion zone along with the associated alerts. Over time, GPS data has been accepted as meeting the standard for scientific evidence and courts and parole boards are generally comfortable with the technology. In rare cases, the GPS vendor may be called to testify as an expert witness as to the reliability of the GPS data.

In addition to such criminal justice stakeholders as the judiciary, parole board, and law enforcement, agencies must also communicate GPS practices to the legislature and public. The main purpose of such communication is to educate all of these stakeholders as to what GPS can and cannot do. There are often misconceptions on the part of many stakeholders that GPS is like an air traffic control system, with agency staff monitoring every bleep and flash on a screen in real-time. Such monitoring would be prohibitively labor intensive and provide little return for the time expended. GPS systems are typically set up on an exception basis; meaning that specific parameters are defined for each client, and when those are violated, an alert occurs. Agencies then review these alerts and determine an appropriate course of action.

Methods for communicating GPS technology and program details to stakeholders include:

- Agency websites that describe their use of GPS;
- Internet community newsletters;
- Community meetings;
- Email communications with stakeholders;
- GPS technology demonstrations for stakeholders;
- Local and national print and television stories;
- Stakeholder representatives on agency boards and committees;
- Press releases, brochures, and other print media; and
- Conferences, speeches, and workshops.

Practical Example P: GPS Stakeholders

As indicated previously the **City/County of Denver** EM Program conducts a daily docket review with judges to ensure they understand the benefits and limitations of GPS for different client populations. Since instituting this daily review, staff members believe that judges are imposing GPS orders on more appropriate types of clients. In addition, Denver staff have managed to get buy-in from defense lawyers by showing how GPS can exonerate their clients from allegations (e.g., in he said/she said victim situations). The program staff also conducted a mock arrest of the Denver city council and placed each member on a different type of EM technology for a few hours to demonstrate the various technologies, including GPS.

2.7.1.4 Alert Processing

Vendor GPS software typically operates on an exception basis. This means that during set-up agencies define specific parameters for such things as client curfew, schedule, and inclusion and exclusion zones. When those parameters are violated, the software generates an alert that someone must analyze and react to. In some cases the vendor does the analysis, or in the case of Oakland County Community Corrections, third-party services companies evaluate and respond to alerts. However, in most cases the agencies themselves are responsible for reviewing the alerts and determining their legitimacy and any necessary actions.

In any case, the basic concept remains the same. The GPS components relay information to the vendor software which processes the information and identifies alerts; the alerts are sent to the agency and are reviewed and analyzed. Interviewed agencies provided detailed information as to their response procedures for dealing with all GPS alerts. While certain agencies may differ slightly in their specific process flow, Figure 2-15 represents a composite view of how agencies typically respond to four common GPS alerts.

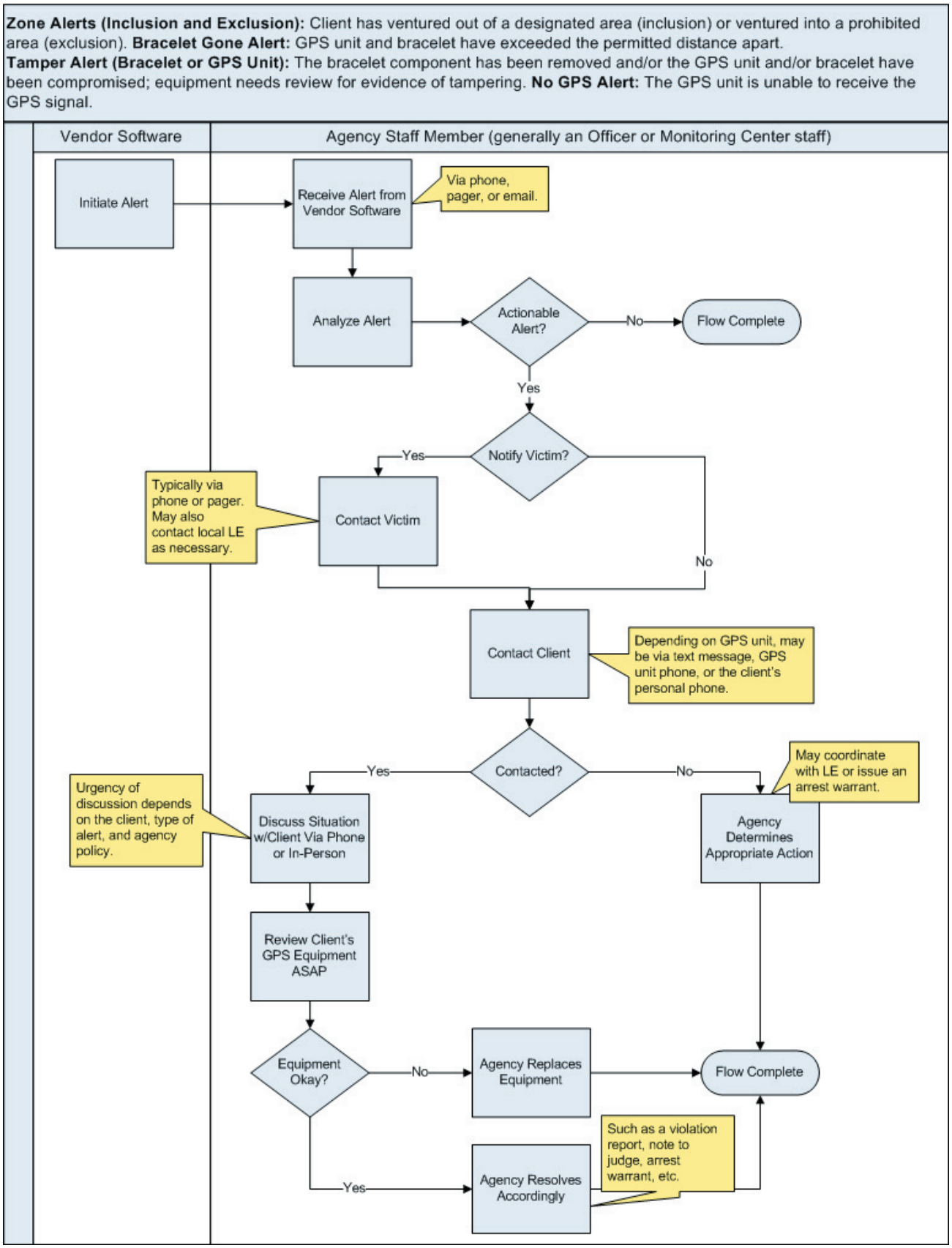


Figure 2-15. GPS Alert Flow Processing

As discussed previously, Oakland County, Michigan Community Corrections outsources the administration of GPS to third-party monitoring services companies. Figure 2-16 illustrates the unique alert flow processes that Oakland County and the monitoring services companies follow.

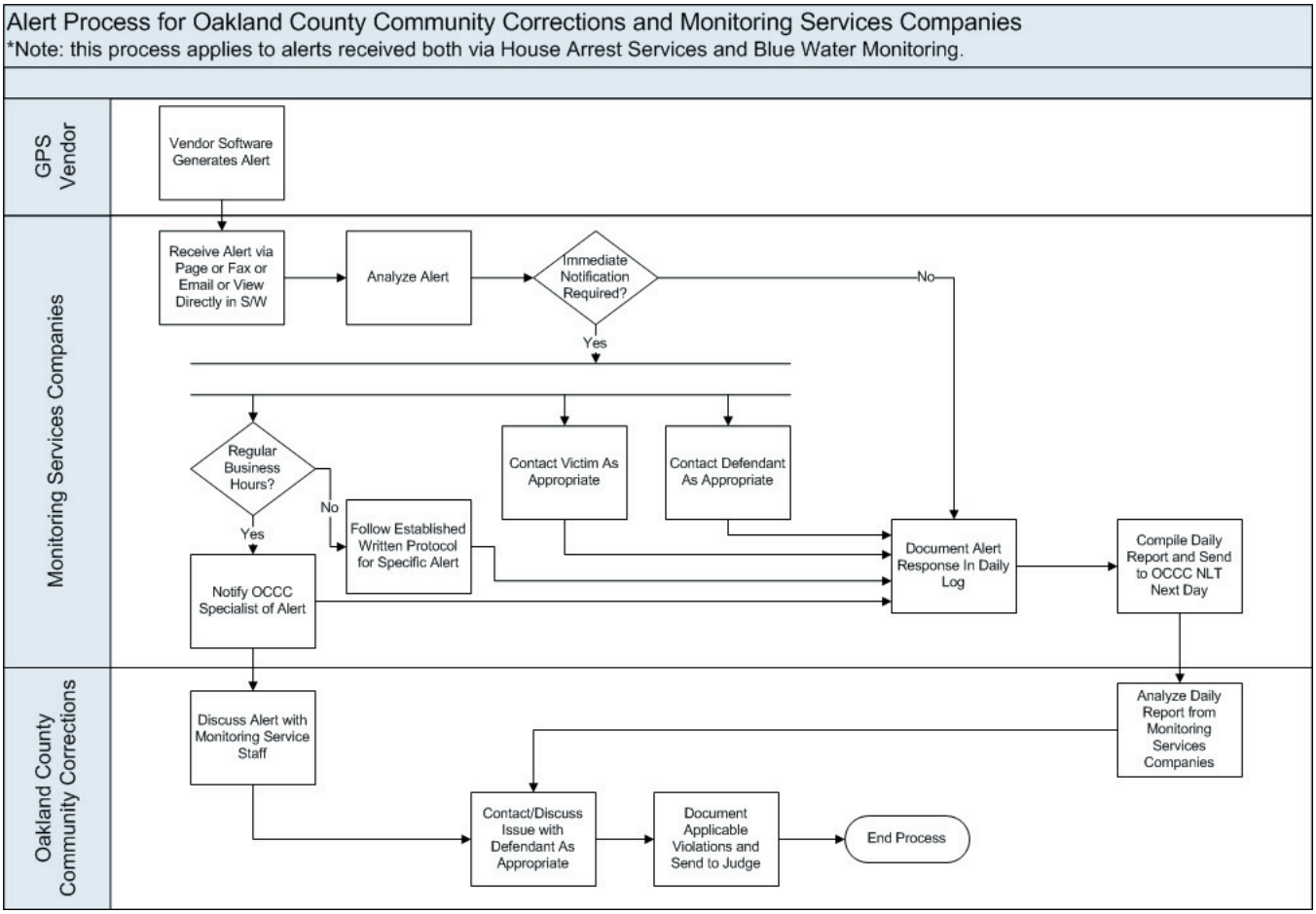


Figure 2-16. Oakland County Community Corrections Alert Processing

2.7.1.5 Violations

Once an alert has been assessed and its legitimacy determined, an officer or other staff member may determine that the client has violated certain terms of his/her release. In such instances, each agency's unique policies and procedures guide the process for documenting and acting on the violation. ***It is important to note that not all GPS software generated alerts result in violations.***[8] When clients do receive violations, most agencies will provide them with a written warning for their first violation, and if there is a pattern of behavior then an arrest warrant may be issued or stricter sanctions employed (e.g. curfew, etc.). In some cases, a first violation will result in a community service assignment, with second violations resulting in an arrest warrant and repeated violations resulting in a summons request to the judge. As indicated in section 2.3.1.3, the officer's ability to issue warrants will impact the violation process. The following conditions may result in the issuance of a warrant:

- "Tamper" violations.
- "Bracelet Gone" violations, especially if this happens frequently. This alert occurs when the

[8]An alert is designated as a breach of the GPS software parameters associated with a client. A violation is the result of a client's non-compliance with the conditions of their release. With respect to GPS, a violation may result from an alert.

GPS unit is too far away from the bracelet and may indicate that the GPS unit was left somewhere. Repeated "Bracelet Gone" alerts may indicate a pattern of intentional non-compliance.

- Failure to follow established schedule.
- Zone violations. In some cases, an exclusion zone violation will result in an immediate warrant if there is a victim involved.

In pretrial situations, an officer might file a motion in court to revoke bond or schedule a new hearing for repeated violations. Assertions of violation are easier to justify to judges with GPS data as evidence; however, there is still sometimes a lack of understanding by the judges as to what the violations mean and a new hearing may therefore not be granted.

Most agencies rarely impose criminal charges for violations. However, in cases of lost or stolen equipment agencies often levy fees on the client. For agencies that also conduct non-EM supervision programs, GPS is often used as a sanction for violations of regular supervision conditions.

Agencies indicated that because violations are easily recognized with GPS, officers are able to respond more quickly to a violation. As part of this, violations tend to be dealt with more intensely; for instance an agency may notify law enforcement immediately for an exclusion zone violation. GPS provides agencies with a method for imposing graduated sanctions and affects the "phasing" of how violations are handled. It also provides the ability to independently confirm what a client is telling their supervising officer about their actions. For instance, GPS allows an officer to confirm a client's attendance at work or required treatment without the need to contact an employer or therapist. Such tangible evidence results in fewer disputes in court, mitigates he said/she said situations, and reduces unknowns about a client's actions.

Practical Example Q: Violations

The **Texas Department of Criminal Justice** has issued fewer warrants since switching the majority of their clients from RF to Passive GPS. This is believed to be due to the additional information officers have at their disposal during alert/violation investigations that result in more alerts being cleared upon analysis, and therefore less warrants being issued.

2.7.1.6 Treatment Strategies

GPS is often used in conjunction with other tools and methods as part of an overall supervision strategy. Other strategies agencies identified for supervision include:

- RF monitoring,
- SCRAM,
- Urinalysis for alcohol and drugs,
- Substance abuse treatment,
- Sex offender treatment,
- Anger management treatment,
- Mental health counseling,
- Therapy,
- Employment assistance,
- Polygraph testing,
- Field visits,
- Regular office visits, and
- Half-way house or residential treatment center placement.

A pressing area of interest for many practitioners and community supervision stakeholders is whether GPS aids in behavior modification. Although this study did not evaluate the efficacy of GPS for that purpose, it is important that any such evaluation include consideration of other supervision and treatment strategies and their role on GPS client behavior.

2.7.1.7 GPS Operational Impacts

In an effort to better quantify agency experiences with using GPS, staff were asked to indicate their impressions of the impact of GPS in assisting with client supervision; Figure 2-17 depicts the agency responses according to staff role. Positive impacts were comprised of such things as better client accountability and the ability to have verifiable information available on the client's whereabouts.

Staff were also asked to indicate their perception of how GPS has impacted their ability to perform their job; Figure 2-18 illustrates the agency responses.

It is interesting to evaluate Figure 2-17 and Figure 2-18 against each other. The overwhelming perception by most respondents is that although GPS positively impacts assisting with client supervision; it also makes it harder to perform their jobs. This may be due to such things as time consuming data analysis activities and dealing with technical issues.

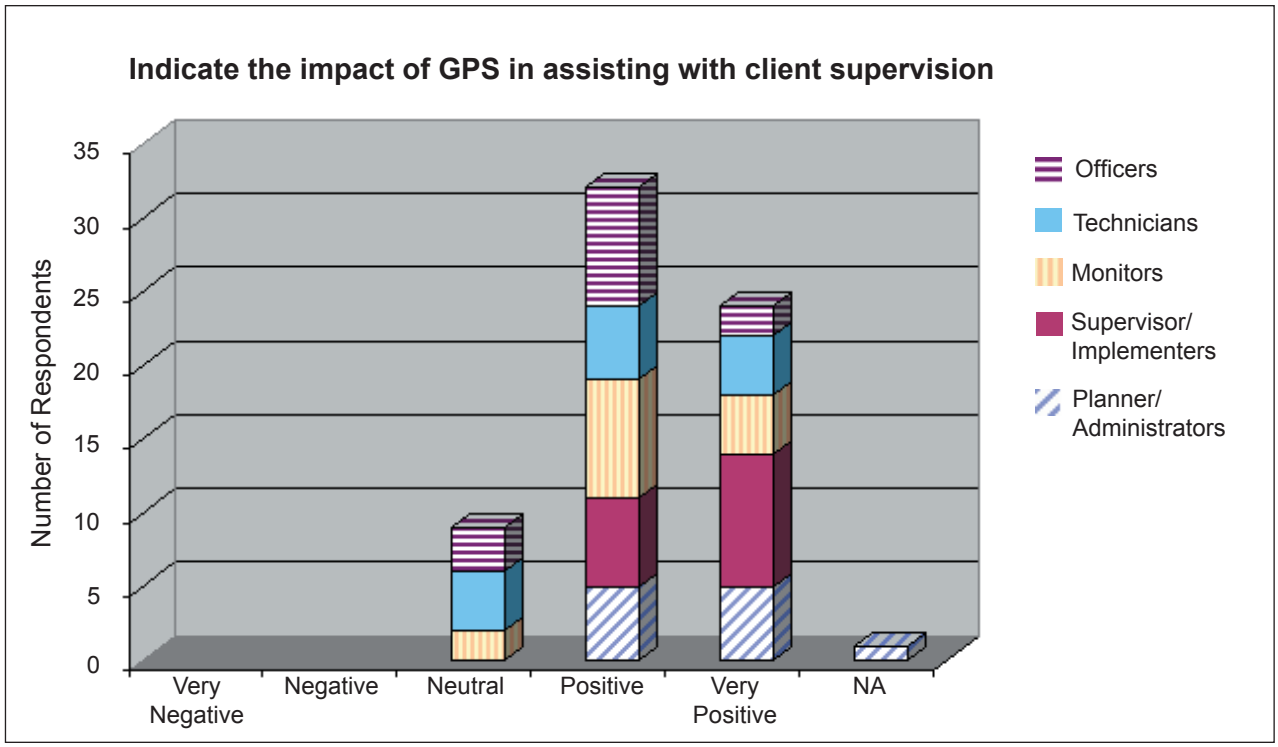


Figure 2-17. Impact of GPS on Client Supervision

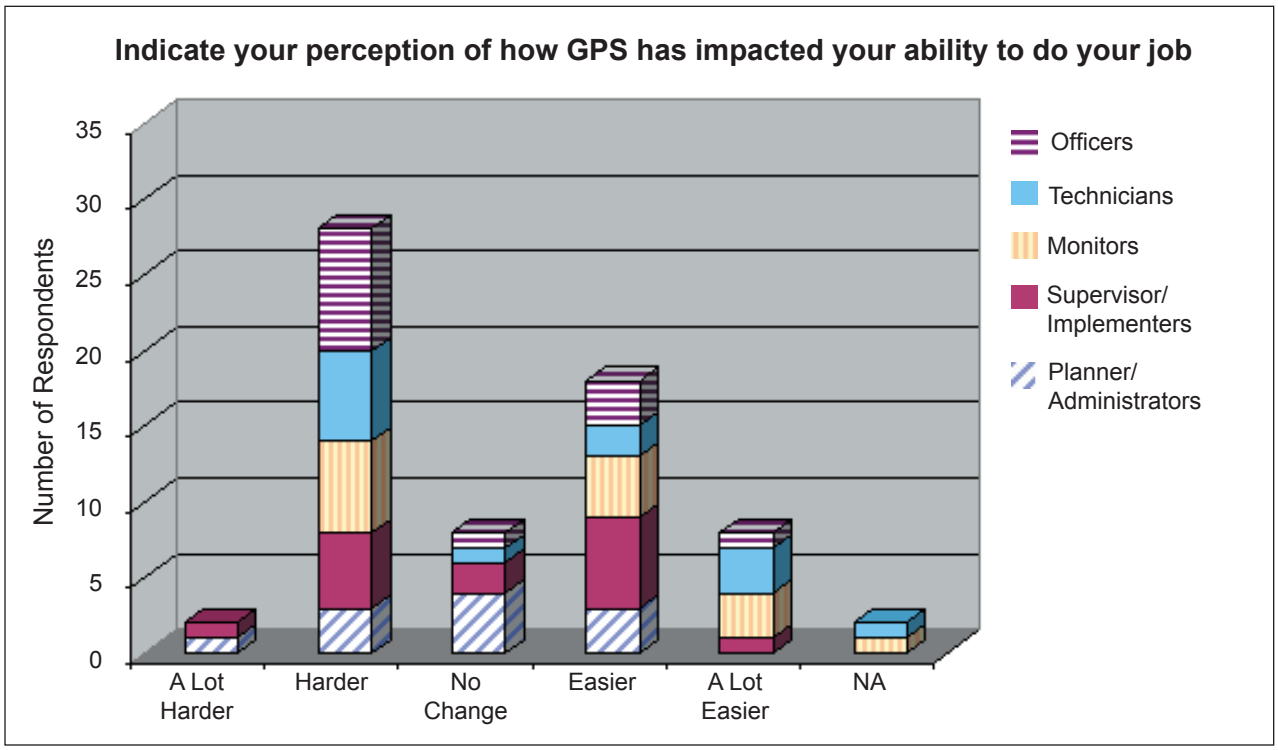


Figure 2-18. Perception of GPS on Ability to Perform Job

As discussed previously, none of the interviewed agencies currently are in a position to publish formal metrics on the impacts of GPS on client behavior, violations, re-offense, or re-incarceration. However, agencies discussed their thoughts as to how GPS has impacted their local criminal justice systems. Because agencies believe that GPS serves as a deterrent, several indicated that client compliance with release conditions seems to be better for those on GPS as opposed to those on regular supervision. Therefore, clients are more compliant and less likely to violate, resulting in fewer re-incarcerations.

In most cases, violations that result in re-incarceration are not strictly GPS violations, but rather violations that are verified by the GPS equipment (e.g., repeated attempts at victim contact or curfew violations). One respondent indicated that the number of clients who avoid incarceration as a result of being monitored with GPS is probably equal to the number that are sent back to jail or prison due to violations validated by GPS. Others indicated that re-incarceration rates were difficult to estimate because each violation hearing is highly dependent on the judge or parole board's discretion.

2.7.1.8 Contingency Planning

With reliance on technology comes vulnerability to a unique set of issues. With GPS, these issues include the potential interruption of GPS service due to such things as:

- Loss of GPS satellite service,
- Loss of cellular phone service,
- Loss of land-line phone service,
- Loss of paging service,
- Loss of electricity,
- Vendor software failure or loss of accessibility (e.g., no Internet), and
- Loss of software data (vendor application failure).

Such service interruptions can adversely impact an agency's ability to effectively monitor GPS clients. In such circumstances, it is essential for the vendors and agencies to have contingency plans in place. Most agencies indicated that minor interruptions are handled on a case-by-case basis. For instance, if a client's home loses electricity due to a storm, the client may be required to locate a temporary housing arrangement or may be brought to the agency. Many agencies did not report having emergency service or contingency plans in place for major service interruptions. However, most indicated that to the extent possible given the circumstances, clients would be found and incarcerated or experience more face-to-face supervision in the event of major emergency situations.

Practical Example R: Contingency Planning

The **Texas Department of Criminal Justice** learned a valuable lesson from Hurricane Katrina. After seeing such widespread devastation and the havoc it created for Gulf state criminal justice agencies, the Department instituted a policy stating that offenders must contact their PO or the Command Center within 24 hours in the event of an emergency such as a hurricane. If they do not, a warrant for their arrest will be issued. This policy was tested during Hurricane Rita for the southern region of Texas and worked very well.

In addition to contingency planning for technology issues, agencies must also consider contingency plans for staff shortages. Every supervision agency has policies for managing staff caseloads, shift work, sick time, and vacations. With GPS, agencies cross-train staff to ensure that in the event of staff shortages, other staff are able to assume additional temporary caseloads. In some instances, agencies will reschedule and prioritize client appointments during such times to ensure that the most pressing issues and clients are handled first. Other agencies offer overtime incentives during staff shortages to encourage additional hours. For long-term staff shortages, most agencies reported that additional staff hires are usually feasible.

2.7.2 Key Considerations

Section 2.7.1 identified and categorized the various practices the agencies deemed important to GPS program operations. This subsection summarizes the key considerations for effective operations.

- **Program Type**. Depending on the phase of the criminal justice system in which an agency's responsibilities lie – operational practices and objectives will differ. GPS is used in pretrial situations for victim safety and to provide defendants maximum freedom while ensuring public safety. In some cases, GPS is used as an alternative form of sentencing following a client's

conviction. In probation and parole, GPS is used as a sanctioning tool and as a tool for intensive supervision.

- **GPS Clients**. Many factors contribute to the selection of clients for GPS monitoring. Judicial or legislative orders are often a factor, as are client history and offense type.
- **GPS Stakeholders**. Agency communication and collaboration with judges, lawyers, parole boards, legislatures, law enforcement, and the public is essential to ensuring applicable stakeholders understand the value and limitations of GPS.
- **Alert Processing**. When vendor GPS software generates an alert, agency staff must evaluate the alert for legitimacy and determine an appropriate course of action. Each agency establishes its unique methods for alert response. Alerts are generated as a result of exceptions to pre-defined parameters for each client.
- **Violations**. Violations are the result of client non-compliance with the conditions of their release. With GPS monitoring, the GPS software generates alerts that must be analyzed to determine their legitimacy. Agency policy and discretion impact how valid alerts are then handled and if they become violations.
- **Treatment Strategies**. When assessing the overall impact of GPS on client behavior, agencies must consider all applicable treatment strategies such as counseling and drug or alcohol treatment.
- **GPS Operational Impacts**. Until agencies begin metrics collection and analysis for their GPS programs it is difficult to objectively assess the impact of GPS on agency operations.
- **Contingency Planning**. Agency consideration of continuity of GPS operations and contingency planning is critical to sustained GPS operations.

2.8 Equipment Maintenance and Inventory

This section looks at GPS equipment maintenance and inventory. Figure 2-19 illustrates the Equipment Maintenance and Inventory area in the context of all GPS programmatic areas.

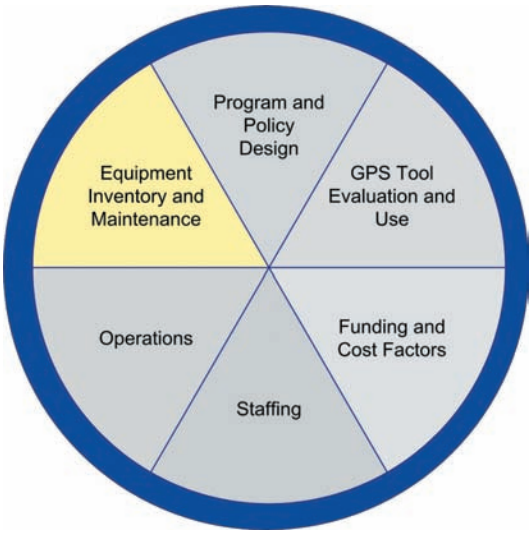


Figure 2-19. Equipment Inventory and Maintenance Area

Section 2.8.1 reflects the interviewed agencies' experiences with GPS equipment maintenance and inventory, while section 2.8.2 summarizes critical factors related to equipment.

2.8.1 Practices

There are a number of programmatic elements related to GPS equipment, these include:

- Maintenance,
- Hardware and Software Upgrades, and
- Inventory.

Information detailed in these categories was derived from the individual agency interviews and analysis of trends across all interviews.

2.8.1.1 Maintenance

Maintenance of GPS equipment is critical to the continued operations of any GPS supervision program and may consist of battery replacement or full component repair or replacement. In most cases however, the tamper-resistant features of GPS

equipment prevent agency staff from conducting maintenance on the GPS components. When repair or replacement is required, staff must send the equipment to the vendor/manufacturer. Therefore, in order to maintain operations, agencies maintain a percentage of GPS components in inventory (see section 2.8.1.3 for details).

As discussed in Chapter 1, GPS components typically consist of the GPS receiver, the RF bracelet, and the GPS unit charger. Most vendors offer the GPS receiver and bracelet as two separate components, although there are several one-piece units available. Although the GPS receiver contains rechargeable batteries, these ultimately require replacement at some point, and for most vendor units only the vendor/manufacturer can conduct the replacement. When the bracelet component is offered separately it is not typically rechargeable and must be returned to the vendor/manufacturer for replacement when the batteries fail.

One-piece units combine the GPS receiver and tamper-resistant bracelet into one component while also offering recharging capabilities. However, much like the stand-alone GPS receiver, at some point the rechargeable batteries will require replacement, in which case the agency must send the equipment to the vendor/manufacturer.

In addition to battery related maintenance, equipment repair or replacement due to malfunctions and failure is conducted by the vendor/manufacturer. Equipment failure is defined as the inability of the GPS component(s) to function properly. Failure can either occur out-of-the box upon initial receipt or in the field while the equipment is in use. Surprisingly, agencies experienced failure out of the box as often as in the field. Overwhelmingly, agencies estimate a lower percentage of GPS unit failure for Passive systems than for Active systems.

- Self-reported Passive GPS failure rates range from 5 – 30 percent of total units.
- Self-reported Active GPS failure rates range from 20 – 50 percent of total units.

One respondent indicated that equipment "failure" in the field could probably be attributed one-third of the time to improper client compliance, one-third of the time to improper alert handling by agency staff, and one-third of the time to actual equipment failure. This perception illustrates the many aspects that impact the successful operation of GPS in a community supervision program.

When equipment fails or batteries need replacing, clients are required to notify their supervising officer and the failing equipment is swapped for equipment in the agency's inventory. Faulty items are then sent to the vendor/manufacturer for repair or replacement. In some cases, vendors may provide a service representative on-site; however, this is not common.

2.8.1.2 Hardware and Software Upgrades

As discussed in section 2.3.1.6, each agency must establish the terms of their equipment and software upgrade agreements in their vendor contract. Most vendors offer software upgrades on a frequent basis to fix bugs or provide enhancements. Interviewed agencies indicated that in some cases this occurs weekly, while for others software upgrades occur every eighteen months. Some vendors provide notification to users upon login when there are changes to the software, others notify staff via email.

Depending on the contract terms, an agency may automatically receive hardware updates or they may need to renegotiate the contract to receive new hardware. Many interviewed agencies participate in their vendor's hardware beta testing and therefore are actively aware of new hardware options.

2.8.1.3 Inventory

The purpose of maintaining equipment inventory on-site at the agency is to establish a locally available surplus based on expected or known equipment shortfalls. These shortfalls may be a result of equipment failure, battery replacement, or lost/stolen equipment. As previously discussed, obtaining adequate GPS equipment inventory is an area of concern for all agencies. When equipment shortages occur agencies are often left to supervise clients without GPS, or in some instances, clients remain incarcerated while awaiting equipment. The optimum desired on-site inventory is 15-30 percent of the number of all units in use.

Inventory management is a severe problem from both equipment availability and tracking perspectives.

There is a perception that vendors/manufacturers follow a "just in time" manufacturing approach, which in the experience of the interviewed agencies is not adequate for the growing demands of the field. There are simply not enough functioning GPS units available when needed. In addition, agencies are disappointed with the inventory tracking capabilities of the vendor software; it does not typically provide a seamless view of the equipment inventory status. For instance, vendors usually consider an item as either their own responsibility or that of the agency. However, due to the frequent number of units that are sent back and forth between agency and vendor, agencies feel there is a need to identify the GPS components that are in transit as a third category which would not impact their inventory levels.

Inventory problems are exacerbated for large, geographically dispersed agencies that may need inventory at multiple regional sites. Some vendors monitor overall inventory numbers without taking into account the regional realities. For instance, Region A may have an excess of equipment, while Region B may need additional units and the vendor states that the agency as a whole has sufficient quantities to meet their contractually agreed to inventory. One agency mitigates this problem by having each region work with the vendor to manage inventory on their local level; however, this may lead to agency-wide oversight issues.

Another problem area for inventory is the need to track the numerous GPS components. Because a single client is actually assigned three separate components (or two in the case of one-piece units), this creates an additional inventory burden on agencies. For instance, a complete "GPS set" includes a GPS receiver, a bracelet, and charger; agencies and vendors track each of these pieces separately in the inventory. While this is beneficial when it comes to replacing a single component in a set, it does create additional tracking requirements from an inventory perspective.

The issue of lost/stolen equipment has been discussed in this report with regard to contracts and violations; however, in the context of inventory a lost/stolen component creates an additional burden. Agencies must coordinate with the vendor/manufacturer to identify lost/stolen equipment and request replacement components.

2.8.2 Key Considerations

Section 2.8.1 identified and categorized the various practices the agencies deemed important to GPS equipment maintenance and inventory. This subsection summarizes the key considerations of these areas.

- **Maintenance**. Due to the design of GPS equipment and its tamper-resistant qualities, there is very little on-site maintenance that agencies can conduct. Therefore, for battery replacement and full component maintenance, agencies must send the GPS components to the vendor/manufacturer for maintenance.
- **Hardware and Software Upgrades**. Upgrade schedules are vendor and contract dependent. However, agencies are typically notified of new software updates and cooperate with vendors to beta test new hardware on a regular basis.
- **Inventory**. Obtaining ample equipment inventory is an ongoing problem for all agencies. In addition, inventory management features of the vendor software are inadequate for current inventory practices.

CHAPTER 3: CURRENT STATE OF GPS TECHNOLOGY AND PRODUCTS

3.1 Background

This chapter summarizes the typical products and solutions currently provided by vendors of GPS equipment and services in the context of community corrections.

The information in this chapter is derived mainly from three sources.

- Observations made by interviewed agencies during the course of this study regarding the technology they are using in their location-based tracking programs.
- Information provided by GPS technology vendors in response to a survey questionnaire sent to them in the summer of 2006.
- Independent research and evaluation of public domain information about GPS technology.

It has been the intention throughout this document to present information in a way that is accurate, and reasonably up-to-date. The content of this chapter involves several special challenges to that intention.

- Regardless of the age or extent of their programs, the interviewed agencies are at various levels of sophistication regarding their level of knowledge about the underlying technology. In addition, some agencies mandate program policy based on factors other than technological capability. Therefore, some agency information may reflect how the technology ***is being used*** rather than how it ***could be used***.
- All of the primary and ancillary technologies involved in GPS tracking have advanced rapidly and significantly over the past few years. This is evident even outside the community corrections domain by observing the growing popularity of such devices as GPS-based guidance systems for vehicles, hand-held GPS devices for hikers, and GPS-enabled cell phones. While these advances are gradually finding their way into the solutions offered by vendors in the community corrections domain, agencies with extensive existing programs may not be able to take advantage of these as rapidly as they become available. An important reason for this at most agencies is the existence of vendor contracts that must run their course before a change can occur. In addition, agencies must also consider the logistics and cost/benefit of switching existing units and retraining staff.
- Despite potential shortcomings of the technology noted in other sections of this document, many political and economic factors are encouraging more widespread acceptance and/or mandate of GPS tracking as an alternative to incarceration. Consequently, vendors are recognizing that the potential market is barely penetrated and is becoming intensely competitive. The competition for the untapped markets is beginning to foster technology-based differentiators that may have been considered simply "nice-to-have" five years ago.

For all of these reasons, there appears to be some disconnect between what is actually used and "tolerated" in the field, and what is being offered by some vendors. The discussions in this chapter will therefore be organized along agency and vendor perspectives in order to call out differences where they are evident and potentially important. Appendix C: GPS Vendors provides unedited responses to the vendor survey.

3.2 Agency Perspective

This section discusses the current state of GPS technology for community corrections from the perspective of the interviewed agencies. That is, it reflects the equipment and business processes that are currently being used in the field by agencies with relatively mature programs of various sizes that encompass various tracking models and client types.

3.2.1 Hardware

With the exception of **CSOSA**, where one-piece units are now being used, the agencies interviewed utilize the typical hardware configuration described in Chapter 1, consisting of the GPS receiver, the RF bracelet, and the GPS unit charger. Although this configuration actually

has three separate components, it is often referred to as a "two-piece" configuration since the charging stand is stationary and not carried by the tracked client.

The primary reason for this ubiquitous configuration is historical; at the time these agencies started their programs, that was the only available option. Because early GPS receiver components were somewhat bulky compared to the smaller components available today, it was not practical for the earliest portable GPS receivers to be worn on a wrist or ankle by an individual. Unlike GPS receivers used in other personal and commercial contexts, one of the important requirements for community corrections is the necessity for equipment that cannot be easily disabled or abandoned by the tracked client without the knowledge of the responsible agency. The comparatively small RFID bracelet that is electronically "tethered" to the GPS receiver was the original solution to this problem. However, this configuration also fosters several problems.

The most significant problem in the long term is the high incidence of alerts related to the bracelet going out of range of the GPS receiver. Since there is no way to distinguish whether this event occurs intentionally or accidentally, monitors and officers are obliged to follow up on every occurrence. When Active GPS is used, the urgency of alert review can substantially increase agency workload. For Passive or Hybrid GPS situations, by the time such alerts are reviewed, the alert log may indicate that the event was accidental and has been resolved.

Another important issue is ease of installation. Effective installation of the GPS equipment now involves attaching the bracelet to the client, correctly associating the bracelet with a specific GPS receiver, and finally ensuring that both are functioning correctly and in tandem. This can be a time-consuming and logistically inconvenient task, especially considering the relatively high failure rate of "new" equipment (see section 2.4), and that the activity may take place inside a jail or prison where a GPS signal is unavailable.

Finally, this configuration exacerbates the problem of inventory management. In order for monitoring activity subsequent to installation to be effectively associated with a specific individual, it is necessary for the serial numbers of the components to be accurately recorded through the case management software provided by the equipment vendor. If one of the components fails, either during installation or subsequently, or needs to be swapped out for simple battery replacement, the correct association of replacement component serial numbers is critical. This introduces an administrative process that is time-consuming and fraught with the potential for simple human error. See section 3.2.2.3 for additional discussion of inventory management issues.

Besides two-piece configurations, other important characteristics of commonly used equipment include:

- GPS receiver size,
- Battery maintenance logistics, and
- Phone line dependencies.

Regarding size, the GPS receiver offered by the vendor with the longest history in the marketplace is rather large – about the size of a lunch box. While this has no particular effect on the electronic quality of the unit, it does have an impact on "philosophical" aspects of some agency programs since it can create a social stigma for clients (e.g., pretrial defendants who have not yet been convicted of a crime) that some criminal justice stakeholders may regard as unreasonable. In addition, some agencies feel that the unit size is directly related to a client's compliance with proper carrying of the equipment (e.g., not in a purse or backpack).

Regarding battery maintenance, the primary issues are battery life and replacement. GPS equipment uses batteries both in the RF bracelet and in the portable GPS receiver. For two-piece units, those in the bracelet unit are typically not rechargeable. While low power consumption provides a relatively long life, the bracelets are typically "sealed" units. Consequently, when the bracelet battery finally fails, the unit must be sent back to the vendor for battery replacement, although one vendor advertises their bracelets as being "disposable" after a nominal battery life of about one year.

The receiver battery is typically recharged by placing it into the charging stand provided with the receiver unit. High power consumption by the GPS receiver causes fairly short battery charge life – on the order of about 16 hours for most units in the field today. Furthermore, although the batteries are rechargeable, older units using first-generation NiCd batteries may lose the ability to be effectively recharged and also have a short

shelf-life because of "self-discharge" characteristics. These battery maintenance issues were cited by all interviewed agencies as things that they would like to see improved through application of more advanced technology.

Regarding phone line dependencies, the primary issues are the existence of an appropriate land-line phone, and cellular coverage reliability. The GPS receiver charging stand also doubles as a transmitter for sending the client's collected location points to the vendor's software for processing. The charging stand is typically connected to a land-line telephone and transmission is automatically initiated when the GPS receiver is placed into the stand. Several related circumstances can sometimes be troublesome.

- The required phone line must typically be configured without extra services, such as call-waiting. The main reason for such restrictions is that accurate transmission of the location data could be affected by spurious signals on the line resulting from an incoming call. If a tracked client is living in, for instance, a parental household, this can unfairly burden or constrain the other members of the household.
- Some clients may not be able to afford a telephone line, or may be denied such by the relevant telephone service provider because of credit and/or payment history.
- Some clients may live in very rural areas (e.g., tribal reservations) where land-line service is not available.

Cellular coverage reliability was also cited by many interviewed agencies as an obstacle. This is relevant for Active and Hybrid GPS tracking, since those models rely on cellular transmission to send location points on a regular basis to the vendor software. If the cellular connection is lost, this can result in an actionable alert even though the tracked client may be completely innocent of any transgression. Also, this sometimes bears on decisions whether to use Active or Passive GPS when juxtaposed onto the land-line availability problem. That is, if an agency typically uses Passive GPS monitoring, but has a client that lives in a place where land-line phones are not available but cellular coverage is, then the agency may need to use Active GPS to monitor that client. Besides being more expensive, this imposes an extra burden on the agency's business processes and possibly resources.

3.2.2 Software

Computer software categories that are most relevant to location-based tracking for community corrections include:

- Mapping software for visual display of tracked clients' movements,
- Analysis software for identifying correlations among data elements, and
- Administrative software for managing business processes.

The current state of software in these categories is explored in more detail in the following subsections.

3.2.2.1 Mapping Software

Software applications that can visually display the movement points of GPS clients on a local map are a very powerful tool for community corrections staff. For Active GPS systems, such displays can ***theoretically*** include a tracked clients' current location as well as their speed and direction of movement. However, in practice, the information is only as current as the frequency of data transmission from the GPS receiver to the vendor's server as well as lags between the time the location data is transmitted and the time when it is actually processed and made available via their software.

For all GPS types, such displays can include a client's movement history. When combined with overlaid information about the location of public buildings (e.g., schools, places of business) and the borders of inclusion and exclusion zones, corrections staff can derive a great deal of information about the movement patterns of a tracked client. This information can be useful when presenting evidence to the court about violations, as well as eliminating a client from suspicion. While GPS cannot actually prevent a determined individual from committing unlawful acts, analysis of movement data and follow-up action on the part of supervision officers may help to deter some recidivistic behavior by making GPS clients aware that they will be held accountable for their movements.

The current state of mapping software offered by GPS vendors is quite varied. To some extent, this variation is related to the vendor's choice of implementation platform. Nearly all vendors now offer Web-based mapping software. However, at least three different sets of underlying technologies are used to facilitate mapping – Environmental Systems Research Institute (ESRI) components, Microsoft MapPoint Web-service, and GeoMicro, Inc. AltaMap components.

ESRI has been a pioneer in the field of GIS software since 1969. Their development toolkits are quite extensive and can support very sophisticated mapping applications, but at a relatively high cost (ESRI). Microsoft MapPoint is a relatively new product, having been offered for serious application integration for only a few years. Nevertheless, Microsoft's extensive capabilities for advanced graphics on Web pages are reflected in their mapping application development toolkits. The AltaMap components from GeoMicro, Inc. are in some ways the least sophisticated (graphically speaking) of the three described here, but are finding a niche by specifically targeting wireless mapping applications through relatively high-speed data delivery.

The following characteristics were described by agencies as typical of the mapping software that is available to them today.

- The movement path of a client during a specific period can be "played back". Some displays also specifically indicate the direction and velocity of the client, while others require such information to be "inferred" through, for instance, the relative position and spacing between two dots on the map over a period of time.
- The location of client exclusion zones is shown. In some cases, this includes the ability to actually define exclusion zones by simply dragging a mouse over the relevant map area. This is in contrast to some mapping software that can display the zones, but require the definition of zones to be done through a text-based case management interface. Where graphical definition is supported, most require zones to be either rectangular or circular in shape. Only a few are now beginning to support zone definitions that are arbitrarily shaped polygons. This usually reflects the capabilities of the underlying development toolkits provided by the mapping technology vendor.
- The relative location of local points of interest (e.g., schools, parks, businesses) can be overlaid on the basic map.
- Location coordinates are generally given in the form of latitude/longitude coordinates. No products were identified that provide street address information or coordinates that conform to existing or emerging standards such as Universal Transverse Mercator (UTM) or United States National Grid (USNG) in order to foster unambiguous communication with law enforcement or emergency responders ("Universal Transverse Mercator coordinate system") ("United States National Grid").
- No interviewed agency is actively using mapping software that visually correlates crime scene locations with client movement paths.

3.2.2.2 Data Analysis Software

Historically, all GPS vendors for community corrections have provided their customers with three general types of reports:

- Summarized daily alert listings for all tracked clients, often grouped by the responsible officer. These can be used both as documentation of critical alerts (e.g., exclusion zone incursion) as well as non-critical alerts (e.g., low battery) that require follow-up. While these may be generated for Active GPS clients, they are typically sent for Passive GPS situations only and represent a critical element of the Passive GPS alert flow.
- Daily location data for each tracked client. This report is not received and used by all agencies, but is generally available from most vendors. These are painstakingly analyzed by some agencies to try and identify movement patterns that may not trigger alerts, but that may signal a need for further investigation. Examples of this are clients who frequently "hover" near an exclusion zone boundary without entering the zone, and clients who make regular stops at a particular location along a daily travel route.
- Custom reports are usually available "on request" from the vendor to the agency. These may include management reports or reports used as evidence in court proceedings long after an incident has occurred.

3.2.2.3 Administrative Software

Administrative software refers to that which is used to manage business processes associated with monitoring; the most fundamental of these are case management and inventory control features. These refer respectively to the process of associating a physical tracking unit with the individual to be tracked, and to the process of maintaining accurate records about the location and operational status of owned or leased GPS units.

It is important to note that the case management features of most GPS vendor's software are not as robust as specialized case management software. Therefore most agencies continue to operate their client case management software in conjunction with their GPS software. For GPS case management, the minimum software feature set includes:

- Recording the serial numbers of tracking unit components that are worn/carried by tracked clients;
- Defining basic client contact and victim information;
- Defining client schedules to accommodate for curfews, working hours, etc.;
- Defining inclusion and exclusion zones indicating geographic areas that the client may or may not enter; and
- Identifying the agency officer(s) responsible for monitoring the clients' activities, and how those officers should be contacted in the event of a critical alert.

All agencies currently use GPS vendor-provided case management features that support these minimum capabilities. Some software in use also includes more extensive case management features such as the ability to customize textual messages that are displayed on a client's receiver LCD for different types of alerts. This can be especially helpful in cases where language is a barrier to effective communication.

For inventory control, the purpose of the software is to enable the agency to accurately assess the state of the agency's GPS equipment inventory. As far as agencies are concerned, a given GPS component may be in one of the following states:

- Operational and assigned to a client,
- Operational but not assigned to a client (i.e., "on the shelf"),
- Not operational and in transit, or
- Not operational and being repaired or replaced.

For an agency that has only a few dozen units in use at any given time, with perhaps a few more "on the shelf", keeping track of the components is not a difficult task. However some large agencies, whose programs have grown in scope over many years, may have hundreds or thousands of GPS units in the field. Furthermore, some agencies are geographically large and dispersed, necessitating a distributed inventory model. For agencies of any size, the inventory management problem is exacerbated by the fact that the components of two-piece GPS units are usually interchangeable. That is, a specific bracelet may be electronically tethered to any GPS receiver (from the same vendor, of course). Although this allows flexibility in changing out malfunctioning components, it also complicates the inventory management process.

Most interviewed agencies indicated that inventory management was one of the most troublesome logistical aspects of their programs, due mainly to the factors above coupled with the paucity of vendor-provided inventory reports. In general, vendor-provided inventory software consists of a simple list of the serial numbers of components that are currently assigned to the agency by the vendor. All interviewed agencies have implemented their own inventory management process with varying levels of sophistication. Some have simply assigned an individual to keep track of components using paper-based processes, while others have computerized the process using various database technologies.

3.3 Vendor Perspective

In this section, the current state of GPS hardware and software technology are presented from the perspective of vendors. The information herein was obtained from vendor survey feedback, vendor literature, and statements about products on public vendor Web sites. This information is presented as fairly and accurately as possible. However, it has not been corroborated through independent testing of either the hardware or the software.

3.3.1 Hardware

At least three vendors now market one-piece Active GPS tracking units. These are typically about the size of a computer mouse, weigh about six ounces, and are attached to the ankle using the same type of tamper-resistant strap used for RF bracelets.

One of the interesting aspects of one-piece unit technology is battery life. Since the unit is designed to be attached to the client's ankle without daily removal, recharging the enclosed battery can be logistically problematic, as it implies that the client must remain stationary and somehow "attached" during the recharging process. One vendor addresses this with a rapid charging process requiring only 30 minutes. Literature from other vendors on this topic is not completely clear. One claims (on their Web site) a battery life up to 21 days. However, a company representative indicated verbally that about 60 hours is a more representative "average" life when the unit is configured for data transmission about every 5 minutes, and that recharging typically requires about 30 minutes.

One vendor, who did not respond to the GPS vendor survey, claims a battery life of about 20 hours on their Web site, but does not discuss the recharging process. Some vendor specifications indicate that their units are now using lithium ion batteries, which should provide both a better shelf life as well as better recharging characteristics.

Even for two-piece configurations, the typical size of the receiver units is being reduced. Although one vendor's receiver unit is still about the size of a lunch box and weighs several pounds, most vendors are now marketing units that range in size from about the size of a typical computer mouse (4.33 x 2.08 x 1.25 inches) and weighing only 6 ounces to a slightly larger unit (6 x 3.25 x 1.75 inches) weighing 13.5 ounces. These small sizes are made possible through advances in manufacturing techniques of micro-electronic devices, while the differences in weight are probably related to such factors as the materials used to manufacture the case, the type and size of battery used, and the number of capabilities included.

Another interesting technology feature currently touted by one vendor that actually transcends hardware and software is the concept of "on-board" alert processing. Some interviewed agencies noted that there can sometimes be a significant delay between the time when an actionable alert occurs and the time when it is actually posted by the vendor's monitoring center. The reason for this delay is that there may be thousands of GPS units around the country transmitting their way points to the monitoring center. Each individual transmission must be processed one way or another as it is received by the vendor's software. If this software has the burden of determining whether there has been a hot zone incursion, then some delay may occur before the datum that signifies the event is processed. On-board alert handling is implemented by storing a copy of the client's parameters in the GPS receiver itself. Circuitry and embedded software can determine when a violation has occurred and transmit appropriate messages immediately.

3.3.2 Software

3.3.2.1 Mapping Software

The most significant differentiators in mapping software currently noted by vendors are the ability to visually define inclusion/exclusion zones using arbitrarily shaped polygons and the ability to reverse geocode location coordinates to provide street addresses.

The first of these is directly related to the underlying mapping technology used by the vendor. As mentioned above, both ESRI and Microsoft offer software development toolkits that support the overlay of arbitrary polygons on displayed maps. The extent to which these capabilities are actually used by the GPS vendors is proprietary and variable, but the capability exists, and at least one vendor touts this feature in marketing literature.

The ability to reverse geocode latitude/longitude coordinates to street addresses can be provided by the mapping technology infrastructure, but can also be accomplished (technologically speaking) using separate database tools from a variety of sources. Only one GPS vendor claims the capability to reverse geocode location coordinates at this time.

No interviewed agencies are currently using either of these capabilities, although several indicated an awareness of their existence, and nearly every agency noted them as things they would like to be able to do.

3.3.2.2 Data Analysis Software

The most significant new feature being approached by some GPS vendors is crime scene correlation. This is being motivated partly by the growing recognition of the high incidence of recidivistic behavior among offenders, and partly by a growing recognition of the value of closer cooperation between corrections agencies and law enforcement agencies.

Of course, one of the biggest challenges to achieving automated correlation between law enforcement data and community corrections (i.e., GPS tracking) data is "seamless" access to both sets of data from a single software system. Historically, this has been hindered by both technology and politics.

Technologically (which is the only area that is addressed here), the typical obstacle is that the data collection and reporting systems involved are often "stovepipe" solutions that employ incompatible data formats, may be physically housed in different geographic locations, managed by different IT groups, and accessible over different secure networks. In general, this can be overcome in several ways, but all require high levels of trust and cooperation among stakeholder agencies. At one end of the spectrum, a law enforcement agency could provide data extracted from their records management system in a documented format that could then be imported into correlation software provided by the GPS vendor and compared to client way points. At the other end of the spectrum, fully cooperative law enforcement and community corrections systems could communicate without human intervention and automatically alert personnel on both ends of possible correlations between crime locations and client locations. The reality today is somewhere between these extremes.

Only one vendor currently claims to support automatic extraction of law enforcement data from a records management system for correlation with GPS tracking data. Note that this is still a "one-way" movement of data that relies on human intervention to interpret correlative information and act on it. Some vendors also claim to be able to export GPS tracking data from their databases in a form that can subsequently be imported by law enforcement systems. One vendor discusses crime correlation simply as an activity through which the coordinates of a location (e.g., a place where drug-related transactions are known to occur frequently) can be entered and subsequently "correlated" with the movement paths of tracked clients.

3.3.2.3 Administrative Software

The only significant differentiator in this area that can be gleaned from GPS vendor literature is the "ease of use" of case management software, and the extent to which it integrates with various other corrections programs that may be in use at the agency. For example, some GPS vendors also market equipment and systems related to detection of alcohol or drug consumption. It is not uncommon for a single individual to be part of such a program while also being tracked by GPS for a crime committed while under the influence of those substances. In such cases, a case management system that integrates information about the client and their programs can be a boon to the responsible agencies.

Some vendors advertise the availability of more extensive reports about the inventory of GPS equipment leased by the agency. However, these generally either reflect the vendor's perception of the inventory, or are simply a summary of what has been entered into the case management system. They do not necessarily address the inventory management problems of large agencies with distributed inventory models and hundreds of units in the field.

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CHAPTER 4: FUTURE OF GPS AND OTHER LOCATION-BASED TECHNOLOGIES

4.1 GPS

This section examines facts, trends, and predictions related to the future of satellite navigation systems. As mentioned in Chapter 1, GPS technology can be described in terms of three segments: Space, Control, and User. The first two of these may be considered as "infrastructure", while the third may be thought of as related to the "consumer" market.

Sections 4.1.1 and 4.1.2 focus mainly on the User Segment as it applies to location-based tracking for community corrections. Much of this information is speculative and, to a large extent, either describes observable "trends" or suggests what "could be done" to improve the technology. The reason for this is that most aspects of applied research and development currently being pursued are considered by the vendors to be proprietary information in a highly competitive marketplace.

Section 4.1.3 focuses mainly on the Space Segment of the United States' Navigation Satellite Timing and Ranging (NAVSTAR) GPS. However, a brief discussion of the European Union's planned Galileo system and its potential implications for community corrections is also included.

4.1.1 Hardware

In Chapter 3 the typical characteristics of the GPS hardware offered for community corrections were discussed. This section describes observed and anticipated improvements to GPS tracking hardware.

4.1.1.1 Equipment Size

Regardless of the precise size of a GPS tracking unit, the important trend is the movement toward smaller and lighter units. Besides the simple fact of easier shipping, storage, and general handling by vendors, agencies, and clients; this trend is also probably motivated by a desire to appeal to wider markets. That is, while early GPS tracking programs focused on violent offenders whose conviction and history did not instill much concern for "social stigma", more and more programs are tracking pretrial defendants in which such stigma may be an issue. In addition, some programs may be philosophically oriented around rehabilitation and reentry to society through such things as work programs, where smaller and less obtrusive tracking units may be more appealing to criminal justice stakeholders. Finally, interviewed agencies indicated that smaller GPS components fostered more client compliance with regard to proper equipment handling and use.

4.1.1.2 Equipment Usability

The word "usability" encompasses a potentially large number of subjective qualities that may be different from the perspectives of the agency and a tracked client. However, this section focuses on the following, as they seem to transcend both the agency and the client perspectives, and were also noted by interviewed agencies as being of particular interest.

- Durability and
- Battery management.

The issue of equipment durability was critical to many interviewed agencies, mainly in the context of damage in the course of daily living. Many clients, for example, may work in occupations such as construction where tracking units could be subjected to rigorous use.

Of course, there is a direct correlation between the manufacturing material used for tracking unit cases, its weight, and its cost. For instance, a case made of hard steel might be very durable, but it would also be heavy and expensive to manufacture. Likewise, plastics such as those used in toys are inexpensive and light, but not very durable. Materials science and technology are now capable of producing plastics and metal alloys that are both lightweight and extremely durable. There will probably be a movement toward more use of such materials that provide reasonable tradeoffs between these extremes. However, other factors are also being considered as well, such as water-proof cases that enhance durability when bathing or participating in recreational swimming.

Battery management was noted as a significant issue by nearly all interviewed agencies, and encompasses two different but related problems:

- Battery life and recharging characteristics, and
- Battery replacement techniques.

The former refers to the power consumption and recharging frequency of the GPS unit and bracelet, as well as the overall battery lifetime. In general, these are both improving as newer types of batteries are being employed. For instance, older nickel cadmium (NiCd) batteries were among the earliest popular rechargeable batteries, but often suffered from "memory" problems that limited their usable lifetime. That is, if the battery was not completely discharged before recharging, then the time before the next required recharge was reduced proportionally. This problem is less common in newer NiCd batteries, and is also not a problem for nickel metal hydride (NiMH) batteries, nor the much newer lithium ion (Li-Ion) batteries often found in laptop computers. These also have a much lower "self-discharge" rate than NiCd batteries, which may be important for tracking units that sit on the shelf for some period of time before being assigned to a client ("Battery (electricity)"). Undoubtedly there will be a continuing trend toward using the most efficient and cost effective rechargeable batteries.

Battery replacement techniques refer to the way in which batteries in tracking units must be replaced. These could either be the (rechargeable) batteries in the GPS units or the (typically non-rechargeable) batteries in the bracelets. For security reasons, both units are traditionally "sealed" and must be returned to the vendor for battery replacement. Consequently, field-replaceable battery solutions that allow the agency to replace the batteries as needed may become a differentiator as agencies' tracking requirements grow.

4.1.1.3 Equipment Configuration and Components

As described in Chapter 1, GPS tracking hardware has historically been packaged using a three-piece configuration consisting of a GPS receiver, a tamper-resistant bracelet, and a charging unit. The most likely change to this configuration is the continuing evolution of a one-piece unit. Although sometimes controversial, the one-piece unit concept is enticing to many agencies. The potential advantages of a one-piece unit include:

- Elimination of the tendency for clients to intentionally or accidentally walk away from the GPS unit or hide it. This was noted as a frequent problem by all interviewed agencies.
- A one-piece configuration reduces the agencies' inventory management burden.
- A one-piece configuration reduces the occurrence of "bracelet or GPS gone" alerts that need to be analyzed and/or followed up by agency staff, thus potentially reducing workload.
- One-piece units may offer agencies and other stakeholders the opportunity to foster greater cooperation from clients by reducing the "social stigma" associated with bulky multi-piece units.

However, there are also potential downsides to one-piece units, such as:

- Since most GPS bracelets are worn on the ankle, client feedback options may be compromised. For instance, text messaging and voice communications would be awkward at best with one-piece units designed for the ankle.
- Since the unit is intended to be worn 24x7, battery charging is most likely a cumbersome process. Typical battery chargers connect to a conventional 120v outlet, possibly with an in-line or built-in voltage transformer. Therefore, the client must remain more or less "stationary" during the charging process.
- Obstruction of the one-piece unit's antennae by various elements may occur more frequently due to it's proximity to the ground. For instance, while driving the device may be obscured underneath the vehicle's firewall which could prevent GPS satellite reception.

Aside from the emergence of one-piece configurations, there are several other hardware features that are likely to become more commonplace as general advances in micro-electronics occur. These include the following:

- Inclusion of omni-directional antennae will facilitate better reception and transmission of cellular signals regardless of the direction in which the antennae are pointing.
- More pervasive use of small LCD displays, capable of showing extra information in a more readable format, will enhance textual communication between the monitoring centers (or agencies) and tracked clients.
- Two-way cellular capabilities will enhance voice communications between the agency or monitoring center and tracked clients.

- GPS receivers will include additional channels to facilitate reception of satellite data on a wider variety of transmission bands.

4.1.2 Software

This section will expand on the three primary categories of computer software mentioned in Chapter 3 (mapping, analysis, administrative) from the perspectives of observable trends, desirable features that are currently missing, and speculation about possibilities for the future.

4.1.2.1 Mapping Software

The richness of the mapping display with respect to overlaid information, flexibility, and accuracy is becoming a differentiator between vendors of GPS systems for community corrections. Among the six vendors who responded to the technology survey, two are building their mapping displays around Microsoft's MapPoint technology, one uses ESRI components, one uses AccuGlobe components, and two continue to enhance custom-developed mapping solutions.

The clear trend here, which is consistent with the entire software industry, is a movement toward the customization of Commercial Off-The-Shelf (COTS) components to produce domain-specific solutions. The types and volume of data that can be integrated with maps are now so large, and the techniques for producing high-quality overlaid graphical displays are so complex, that it is no longer economically feasible to develop such software from scratch. Instead, it is much more productive to encourage developers to focus on the application domain and use COTS components for the mapping infrastructure. Thus, it is likely that the GPS vendors that embrace this paradigm will become the leaders in the area of sophisticated mapping options for community corrections.

Some of the important new features that will probably emerge include the following:

- Movement trails showing speed and direction will become more accurate and more fine-grained.
- Overlays showing important public areas such as schools and parks, as well as locations known to be associated with criminal elements will become automatically correlated with movement points. That is, it may be possible in the future for mapping software to call special attention, through visible and/or audible feedback, to the proximity of such locations to an individual's movement path.
- Arbitrarily shaped polygons denoting such things as city boundaries and exclusion zones will become easier to define, and it will be possible to define inclusion zones related to prescribed travel routes.
- Mapping displays will conform, both visually and with respect to reported locations of individuals and map features, to the USNG standard for geo-addressing ("United States National Grid"). This standard, endorsed since 2001 by the Department of Homeland Security, can facilitate consistent communications between all branches of criminal justice as well as emergency responders, and is much more precise than the latitude/longitude designations that have been historically used.
- Mapping displays will be offered on a wider variety of portable hardware platforms, such as smart phones and PDAs, thus enabling corrections officers to view such data while "on the road" without the bulk, expense, and connectivity constraints of laptop computers.
- Seamless integration with archived satellite imagery will provide both correlation of movement with points of interest, as well as "advance reconnaissance" information to officers in situations where apprehension may be necessary. (See section 4.2.7 for further details of the potential benefits of that technology for community corrections.)

4.1.2.2 Data Analysis Software

As mentioned in Chapter 3, GPS vendors for community corrections currently provide their customers with three general types of reports:

- Summarized daily alert listings for all tracked clients.
- Daily location data for each tracked client.
- Custom reports "on request".

There are several data analysis options conspicuously missing from this list compared to the capabilities of systems in many other application domains. These will be increasingly offered by competing vendors (especially if driven by customer demand), and will undoubtedly become market differentiators.

- Automatic analysis of client movement trends is quite feasible using a variety of techniques popularized by "data mining" applications. Such software would be a boon to agencies determined to use GPS data to proactively evaluate a client's behavior as opposed to the current reactive, exception-based model of GPS monitoring.
- Agencies from all branches of criminal justice are acquiring both the motivation and the technological means to share information. As the use of criminal justice data interchange standards such as Global Justice eXtensible Markup Language (XML) become more ubiquitous, correlation analyses between data provided by the GPS system and data provided by other law enforcement agencies will become more highly automated. This may help reduce the time required for both corrections and law enforcement officers to respond to actual and potential threats posed by tracked individuals.
- Information systems in many application domains now support the notion of ad hoc query by end users. The current paradigm of client GPS data being "owned" by the monitoring company is probably the most significant aspect that needs to change in order to facilitate better agency access to this information.

4.1.2.3 Administrative Software

As noted in the Chapter 3 discussion of the current state of administrative software, the focus is primarily on case management. While this capability is important, the GPS hardware inventory management activity was also called out by several interviewed agencies as one of their most challenging tasks, due mainly to the paucity of vendor provided inventory software features and reports.

An interesting point here is that the assignment of specific tracking unit components to an individual during the case management process could be integrated with an inventory management process. Such a feature would be commensurate with enterprise software systems implemented for many other domains. For instance, it is now commonplace to expect integration between retail point-of-sales software and inventory management software. It is not clear why such sophistication has not yet found its way into solutions offered by GPS vendors for community corrections. However, this may become a differentiator as agency programs grow in size and complexity.

4.1.3 Technology Infrastructure

This section focuses mainly on the Space Segment of the United States' NAVSTAR GPS. However, some discussion of the European Union's planned Galileo system and its potential implications for community corrections is also included.

4.1.3.1 New or Planned Upgrades to Constellations

US Satellites

At the present time, the GPS constellation maintained by the United States Air Force consists of 29 satellites orbiting in six different planes. The most recent was launched on October 12, 2006. However, on any given day, the Air Force is only committed to having 24 satellites operational. Satellites are routinely taken off line for various kinds of maintenance ("Satellite Navigation: FAQs") ("Current GPS Constellation").

A report produced by a Defense Science Board task force, under the auspices of the Department of Defense (DoD), recommended that the constellation configuration be modified to include 30 satellites orbiting in three planes (Defense Science Board 2005). One of the primary motivations for this recommendation is that research indicates that such a configuration would provide better operational coverage in urban and mountainous areas. The technical reason for this is that effective location finding can only occur if four satellites are simultaneously "visible" to the receiver – three for location triangulation, and one for timing. The "visibility" of a given satellite is lost altogether if it is less than five degrees above the horizon, and is only accurate for urban areas above fifteen degrees. The latter can only be guaranteed by the presence of at least thirty satellites. Unfortunately, the task force recommendations have not yet been accepted by the Air Force. This implies that GPS signal reception in urban canyon areas is not likely to improve in the near future.

DoD Constraints on Location Accuracy and Commercial Availability

All satellites of the U.S. NAVSTAR GPS are owned and operated by the U.S. military. Originally, signals broadcast by GPS satellites were intentionally

degraded to reduce the location finding accuracy available to civilian receivers. The signals actually contained accurate information in addition to degraded information, but the more accurate information was encoded and available only to military receivers. This feature is called Selective Availability, and was intended to deny enemy military forces the ability to use the NAVSTAR GPS signals to direct their own operations.

On May 1, 2000 the Selective Availability feature was disabled by order of President Bill Clinton. Since then, the military has implemented other techniques for disabling GPS reception on a regional basis (essentially "jamming" the signal to prevent enemy reception). This allows the U.S. military to deny enemy access to GPS signals in theaters of war while still providing accurate signals to the civilian community. Although the DoD has stated an intention to never reactivate Selective Availability, the capability still exists, and the "intention" could theoretically be rescinded at any time. Such an event would most likely occur only if the United States mainland became an active theater of war ("Satellite Navigation: FAQs").

Galileo

The Galileo positioning system is intended to comprise a constellation of thirty navigational satellites to be implemented by the European Union (EU). The effort is managed mainly by the European Space Agency (ESA), and funded by EU countries as well as a number of other non-EU countries including Israel, Morocco, Saudi Arabia, the Ukraine, India, and South Korea ("Galileo positioning system") ("The Future – Galileo").

The primary motivations for the project are both political and economic. Presently, the United States GPS and the Russian GLONASS are the only operational satellite navigation systems. As mentioned in DoD Constraints on Location Accuracy and Commercial Availability above, it is unlikely that Selective Availability will ever be reactivated, but if that occurred, it could have severe consequences for civilian users. The EU countries therefore consider the uninterrupted availability of a satellite positioning system to be in the interest of both their own military forces as well as European civilian institutions that rely on the technology ("Why Europe Needs Galileo").

The first "test bed" satellite of the Galileo constellation was launched in December 2005, and successful signal reception tests were conducted in 2006. Additional satellite launches are being planned for the near future, with a goal of completing the constellation in 2010 ("First Galileo Signals…"). The project is presently well-funded and appears to be making significant progress along a planned schedule.

There are several potential benefits that Galileo could bring to U.S. community corrections GPS programs. First, Galileo may bring a higher degree of accuracy to the business of location position. This is in large part due to the incorporation of newer technology than is present in the aging U.S. fleet of satellites, as well as the intention to use a constellation of 30 satellites rather than 24, and the fact that the satellites will have a greater inclination with respect to the equator ("How to build up…"). Second, while EU military organizations will have access to Galileo data, the project is not under the control of military organizations. This implies a stronger promise of continuity for civilian users. Finally, the ESA claims that Galileo will be "interoperable" with GPS. This may imply the future possibility of end user systems that are able to effectively "roam" between GPS and Galileo in order to improve both accuracy and continuous signal reception.

4.1.3.2 Other Considerations

Atomic Clock Accuracy

Positioning satellites operate fundamentally on the principle of triangulation. That is, signals from three different satellites with known locations in space are juxtaposed to pinpoint the receiver's location. However, the transmitting satellites are at different distances from the receiver, and the respective signals are not transmitted at precisely the same instant. Therefore, a time signal from a fourth satellite is used to "smooth" the difference between the signal receipt times of the triangulation satellites in order to compute an accurate location. Because all of these signals travel at the speed of light, the corrective timing information must be very precise in order to achieve fine-grained location accuracy.

Because of their precision, small size, and suitability for use in zero-gravity environments, chip-scale atomic clocks are now used ubiquitously in positioning

satellites. The principle behind the atomic clock is the ability to measure the resonance frequency of atoms. That is, atoms "resonate", or "oscillate" with known frequencies and instruments now exist that can "count" the oscillations that occur for a given atom.

There are three different types of atomic clocks in use today, generally classified by the type of atom measured. Original atomic clocks were based on the cesium atom. More recently, rubidium has come into common use, largely because of its comparatively low cost. Finally, during the late 1990s, joint research conducted by the National Aeronautics and Space Administration (NASA) and the Smithsonian Astrophysical Observatory (SAO) produced a "hydrogen maser clock" which combines the use of both hydrogen and cesium ("The Hydrogen Master Clock Project"). Hydrogen maser clocks are now considered to be the most accurate of all atomic clocks ("Precise Time and the Master Clock").

One distinguishing characteristic of the first Galileo project satellite is its use of an on-board hydrogen maser clock ("Galileo technology…"). However, at the present time, all American GPS satellites use either cesium clocks with rubidium backups, or all rubidium clocks ("GPS Overview"). This is one of the reasons for the ESA claim of potentially higher accuracy from the future Galileo system.

Differential GPS

Differential GPS (DGPS) refers to a technique for improving the accuracy of conventional satellite positioning by transmitting a "correction signal" from a fixed ground station that represents the difference between the GPS-derived location of the station and the known location of the station ("Differential GPS").

Originally developed during the 1980s as a solution to the Selective Availability constraint imposed on GPS accuracy by the DoD, the primary benefit offered by DGPS today (because Selective Availability has been discontinued) is related to correcting for troposphere and ionosphere interference. The troposphere is the atmospheric layer just above the earth's surface that is most affected by weather. Inclement weather and high humidity are observable causes of GPS inaccuracy. The ionosphere is the atmosphere layer high above the earth where satellites actually orbit. Strong sunspot cycles producing a lot of solar radiation can dramatically affect radio wave propagation speed in the ionosphere, introducing further GPS inaccuracies.

GPS receivers that are capable of also receiving DGPS signals and using that information in computing location can theoretically derive location accuracy of about 10cm (as opposed to nominal accuracy of about 5m when using only traditional GPS signals). This technology could be a boon to community corrections location-based tracking, especially in geographic areas where inclement weather (especially high humidity) occurs frequently, and in lower latitudes where the effect of solar radiation may be more strongly observed.

Receiver Sensitivity

GPS satellite transmissions are essentially radio waves transmitted on specific frequencies. Likewise, GPS receivers are basically radio receivers equipped to receive those transmissions. In very general terms, each "channel" in a receiver is capable of receiving and interpreting transmissions on a specific frequency or a narrow frequency range. (This range is sometimes called a "band" – a common example is the FM band on radios.). Regardless of the band(s) supported, however, the important point is that an electronic "channel" is typically capable of receiving only a single frequency from a single transmitter at any given instant.

GPS satellites transmit their signals on several different channels representing very narrow frequency bands. In general, the band is related to the age of the satellite. Older satellites in the constellation use what is known as the L1 frequency. Newer satellites also broadcast on frequencies known as L2 and L2C. Finally, planned future satellites will add a new frequency called L5 ("Satellite Navigation: GPS Modernization"). GPS receivers capable of receiving these frequencies must therefore be equipped with "channels" that are tuned to those frequencies. Furthermore, since GPS receivers must compute location-based on signals from at least four simultaneous satellite signals, a GPS receiver must have a minimum of four channels.

The manufacturing cost of GPS receivers is directly related to the number of channels in the receiver. Receiver accuracy and reliability of reception are also related to the number of channels – specifically the number of channels capable of receiving signals

on the various frequencies transmitted by different "visible" satellites at any given time. Therefore, GPS receiver manufacturers have always tried to balance manufacturing costs against receiver sensitivity by carefully selecting the number and frequency of installed channels.

As the cost of manufacturing miniaturized electronic receiver channels drops, GPS receivers will continue to become more sensitive by incorporating more channels. This will include not only channels for different satellite frequencies, but also channels for reception of differential GPS transmissions (see Differential GPS above) and possibly such things as conventional television broadcast transmissions (see 4.2.1 below).

4.2 Other Location-Based Tracking Technologies

Although the major vendors of location-based tracking systems for community corrections currently utilize GPS technology almost exclusively, there are several other potential technology solutions emerging. Many are being explored as augmentations of GPS technology – often to help overcome GPS limitations – rather than as replacements for GPS. The most prominent and/or promising of these technologies are described in the following subsections.

4.2.1 Television-Based Positioning with GPS

4.2.1.1 Concept of Operation

This technology provides a potential solution to the problem of GPS signal loss in buildings and urban areas with dense concentrations of large buildings.

The basis for this solution is the presence of conventional terrestrial television broadcast transmitters, in conjunction with Locating Units (i.e., typically carried by a client) that have a built-in television tuner as well as a GPS receiver. Because of the wave-length and strength of television signals, the waves typically have little difficulty penetrating walls – at least those that are not intentionally shielded.

As with GPS location-finding, it is assumed that at least three different transmission signals are available for the purpose of "triangulation". Because TV tuners are able to receive all television broadcast signals within their range, this system also generally includes one or more Central Receivers that continuously adjudicate the strongest available signals and also coordinate time signals carried by the waves. These communicate frequency and timing data to the Locating Units via cellular transmission. In return, the Locating Units transmit range information (from the adjudicated frequencies). The range information is used by a Dedicated Server to calculate the position of the Locating Unit. The configuration of such a system is depicted in Figure 4-1.

4.2.1.2 Benefits

- It is possible to monitor a client's location in urban canyons, inside a building, or when a client attempts to "hide" the Locating Unit (e.g., in the trunk of a car).
- Appropriately implemented signal reception and analysis software will most likely result in far fewer alerts being posted (e.g., "No GPS" type of alerts could be eliminated). Such a reduction would therefore reduce the workload of human monitors.

4.2.1.3 Limitations

- The system assumes the presence of at least three terrestrial television transmitters that are widely-enough spaced geographically to provide good triangulation. In many large urban areas, even if multiple transmitters are present, they are often co-located geographically. An example of this is Los Angeles, California, where most television transmitters are located on Mount Wilson. Such situations could make accurate triangulation difficult.
- When a tracked client is inside a building, lateral movement may often be constrained to a relatively small area, such as an office, or part of a factory floor. Depending upon the granularity of the triangulated location, the frequency of transmission, and the ability of software to "smooth" the client's movement path, this could cause mapping displays and/or position logs to become unwieldy.
- Television tuner antennae are typically somewhat "obtrusive" because of the wave-lengths that must be received. This could affect the size and configuration of Locating Units carried by clients.

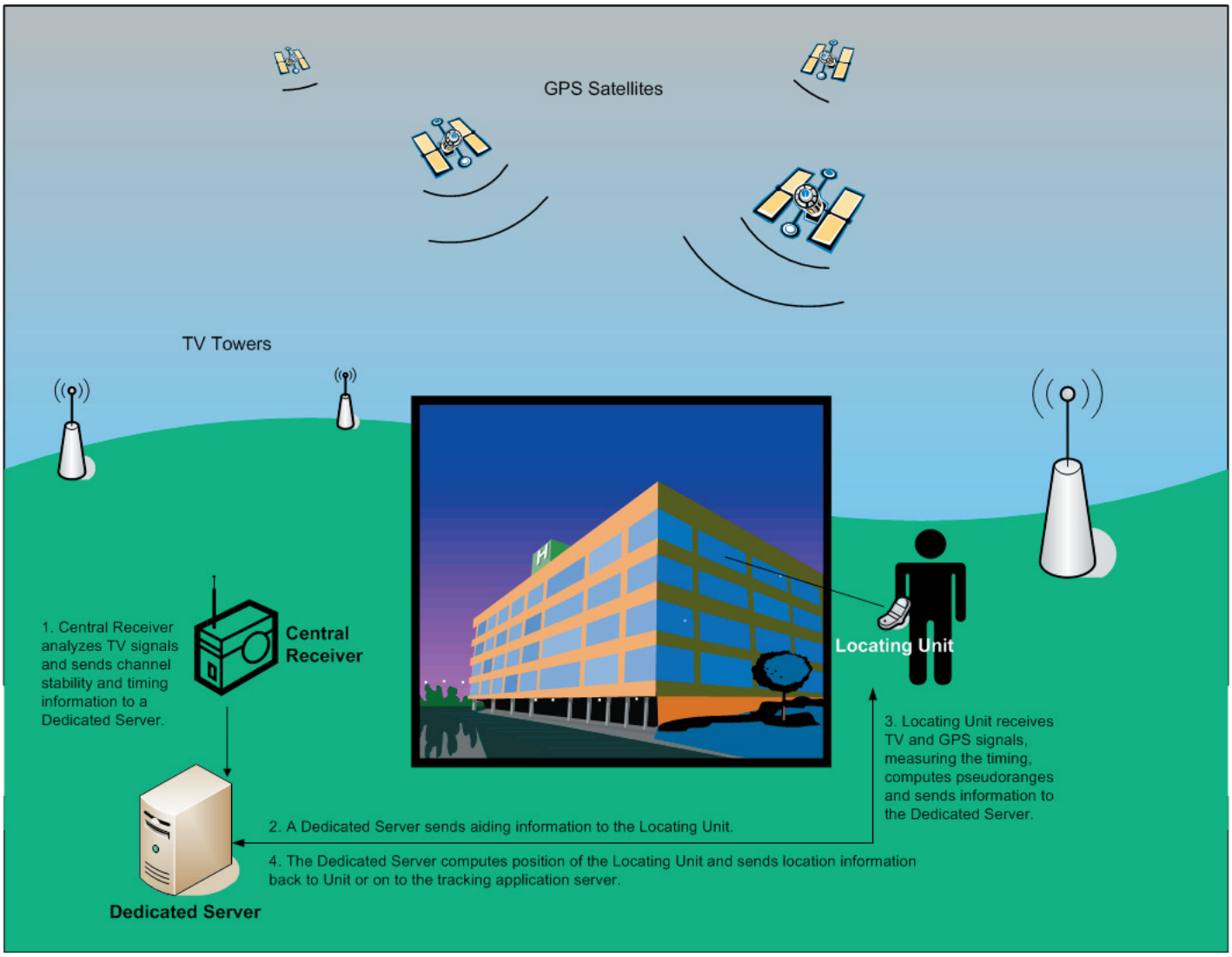

Figure 4-1. TV-Based Positioning with GPS

- Although the introduction of High-Definition television (HDTV) has, for the time being at least, stemmed the tide of competition from cable television suppliers that could potentially make terrestrial television broadcasting obsolete. However, this is an area to watch for future technology and market trends ("High-definition television").
- In the event of extremely inclement weather or natural disaster (e.g., tornadoes, hurricanes, earthquakes) television transmitters may become inoperative. This would impact the ability of this technology to mitigate loss of GPS signal.

4.2.1.4 Readiness Status

A system employing this technology is currently being marketed for use in the context of "People Tracking" by Rosum Corporation. The company is headquartered in Mountain View, CA and has a Web site at *http://www.rosum.com*.

Please note that vendors identified herein represent the results of limited research. Omission of other existing vendors is not intentional and should not be construed as either an endorsement of the vendors listed or criticism of any which may have been omitted. Additionally, it should be noted that no vendor's products have been inspected or tested in any way for reliability, accuracy, or suitability for use by any agency.

4.2.2 Wireless Fidelity (Wi-Fi)

4.2.2.1 Concept of Operation

Most people think and speak of Wireless Fidelity (Wi-Fi) as a fundamental technology. In fact, the term is a trademarked brand name owned by an industry trade group called the Wi-Fi Alliance ("Wi-Fi"). Originally formed in 1999 as the Wireless Ethernet Compatibility Alliance, the group comprises most manufacturers of equipment that conform to the IEEE 802.11 specification for wireless local area networks ("IEEE 802.11"). In the remainder of this section, however, the term Wi-Fi will be used to refer to wireless LAN technology in general.

The use of Wi-Fi technology in the context of location-based tracking is still a research topic (see 4.2.2.4) and is not presently offered by any commercial vendor. However, there are several reasonable concepts of operation that can be postulated for possible future implementation. Please note that these are entirely speculative at this time.

- Traditional GPS tracking systems require at least three simultaneous satellite signals in order to pinpoint a receiver's current location. However, in the absence of a GPS signal, it is possible to do so using Wi-Fi access point signals instead. For instance, typical networking hardware and software such as that found in most modern laptop computers and PDA devices is capable of detecting the presence of ***named*** wireless networks in the vicinity of the laptop or PDA. Given one or more nearby access points, appropriate network naming conventions and a suitable database of server locations, the device's location can be computed (however, see 4.2.2.3 for limitations). Figure 4-2 depicts how Wi-Fi triangulation might assist in tracking a client in community supervision.
- Traditional Active GPS tracking systems generally use cellular technology to transmit location information from the GPS receiver unit to a central monitoring center. However, a frequent comment by study participants was that

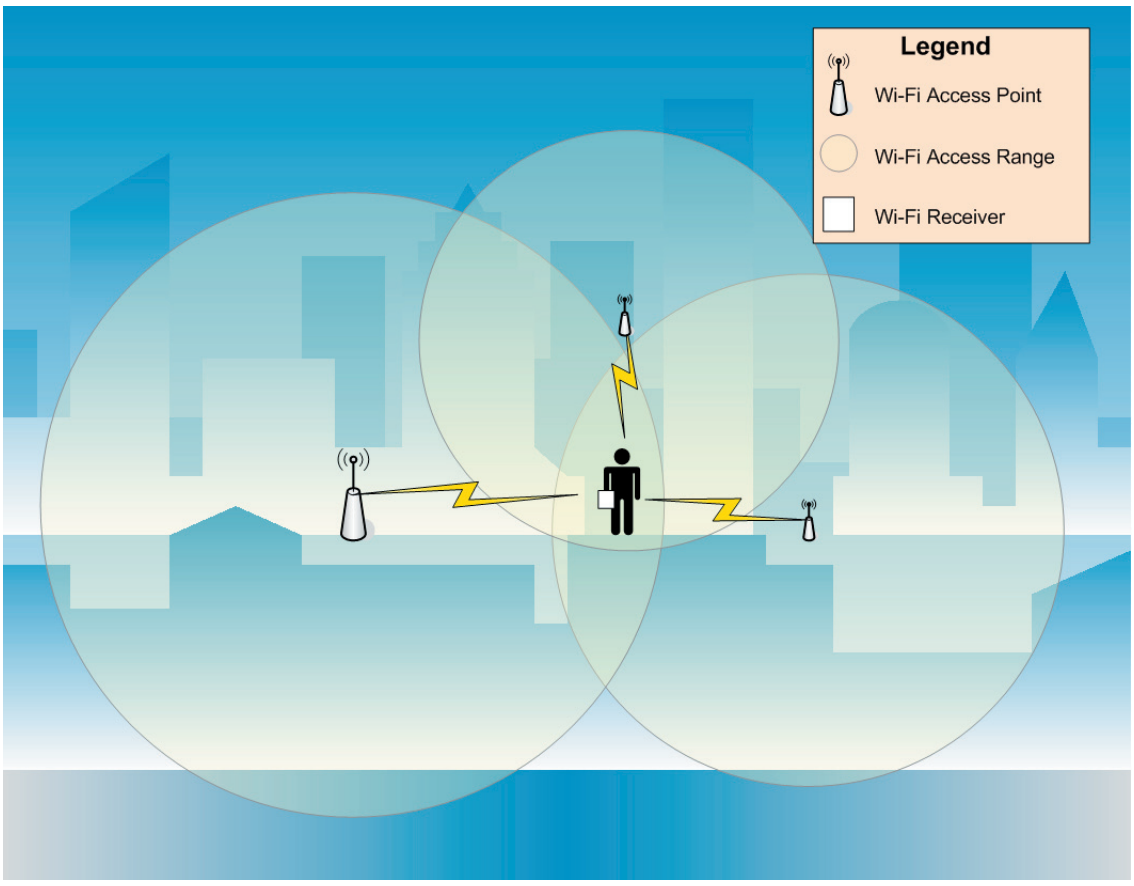

Figure 4-2. Wi-Fi Triangulation

unreliable cellular coverage is often an obstacle to continuous accurate transmission. Wireless networks are generally capable of connecting to and communicating with internet Web servers. This capability can be used in the absence of a cellular connection, but in the presence of a wireless network connection, to transmit location data.

- Traditional Passive GPS tracking systems often use conventional land-line telephone connections to transmit stored location data when the GPS receiver unit is placed into a charging stand at the end of a day. In some cases, tracked clients who may not have a land-line telephone available are required to visit the agency office frequently to facilitate both charging and data transmission. Both of these scenarios could be replaced by Wi-Fi connection and data transmission utilizing either a wireless access point at the client's home, or by instructing the client to visit a specific nearby location (e.g., an "internet café") that supports a known wireless access point.
- Some traditional GPS tracking units also support voice communication between agency officers and tracked clients. This is also accomplished using cellular technology, and can therefore suffer from the same reliability problems as mentioned previously. Wireless networks are increasingly being used to support Voice over Internet Protocol (VoIP) for voice communication, and could be used when a network connection is available ("Voice over IP").

4.2.2.2 Benefits

- Since ***no-cost*** Wi-Fi access points are appearing with increasing frequency, especially in urban areas, use of this technology for both location and voice communication could be more cost effective than cellular transmission.
- Unlike GPS technology, Wi-Fi works indoors quite well. This could help to overcome the "No GPS" signal loss problem. However, it should be noted that position derived from known Wi-Fi access point locations is not likely to be as accurate as that provided by GPS signals. The main reason for this is that the detection of an access point only places the device in the "proximity" of the access point, which may encompass a radius of about 300 feet. The true accuracy of the derived position will depend on such factors as the number of detected access points, the accuracy of the recorded known location of the access point device, and the distance between the access points. In Figure 4-2, we have used the term "triangulation". This is meant as a generic term for using multiple overlapping signal sources to narrow down the probable location of the receiver. In reality, even a single access point signal can be used to indicate a coarse-grained proximity to that location. More detected signals imply finer-grained location computation.
- Many small businesses either have, or are near, Wi-Fi access points. Use of this technology for location-based tracking could enhance employment opportunities for tracked clients by supporting the concept of location verification while working indoors.

4.2.2.3 Limitations

- One serious challenge to robust implementation of this technology in the context of community corrections is the establishment of a reliable database containing access point names/locations. At the present time, this is essentially a grass roots effort managed by private individuals and/or organizations. An interesting research paper on this topic asserts:

  > *"The positions of these access points are provided by a database cached on the same device. This cache in turn can be filled from a variety of access point databases that have been created by universities, radio hobbyists, 'war driving', and wi-fi clubs. The largest of these databases, wigle.net contains nearly two million access point locations…" (Borriello, et al.).*

  Perhaps in the future, this bookkeeping process may become the purview of a more official "gatekeeper" analogous to InterNIC (which regulates the registration of internet domain names).
- Unlike cellular technology, which supports continuous communication while traveling across a wide geographic area by automatically "bouncing" the connection between towers, Wi-Fi connections will drop when not in the proximity of the access

point. Even when a new connection to another access point can be acquired almost immediately, the original connection and its transmission "context" will be lost. It is as if a cell phone needed to re-dial the number to which one is speaking each time the phone went out of range of one tower and into range of another. One possibility for overcoming this limitation may eventually be provided by wireless mesh network technology that can route wireless communications by "hopping" between interconnected "nodes" ("Wireless mesh network").

- Standard Wi-Fi devices have a limited range – about 150 feet indoors and about 300 feet outdoors, extendible to as much as several kilometers outdoors with a suitable antenna. Thus, even technology improvements/extensions that can overcome the "dropped connection" limitation mentioned previously will be ineffective unless there is a proliferation of overlapping access points. Some municipal efforts, such as Wireless Philadelphia, are underway to provide seamless, no-cost, single network access within urban areas ("Wireless Philadelphia"). However, access point range will remain a problem until these are ubiquitous.
- Regardless of the frequency of "dropped calls" in a given area, GPS vendors arguably have some leverage with cellular providers regarding acceptable and improved service levels, simply because they pay for it through contractual agreements. However, no-cost Wi-Fi service bears no obligation regarding reliability and continuity of operation.

4.2.2.4 Readiness Status

No vendor of location-based tracking technology in the community corrections context currently markets any system that makes use of Wi-Fi.

The only advanced research project identified in this area is called Place Lab and is being conducted by a collaborative group from Intel Research and several universities including University of California at San Diego, University of California at Berkeley, University of Washington, and University of Michigan ("Place Lab: A Privacy…").

The Place Lab research has proceeded far enough to make downloadable software available at no cost for Nokia smart phones and laptop computers that can compute the location of the device from its proximity to wireless access points. Note that this research is not directed specifically at community corrections programs, but could be applied in that context.

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4.2.3 Radio Frequency Identification (RFID)

4.2.3.1 Concept of Operation

Chapter 1 of this study discussed the existing role of RF technology in community corrections. This section will discuss the underlying technology known as Radio Frequency Identification (RFID), and its general applicability to location-based tracking.

In order to understand RFID technology, it is first necessary to understand the basic function of a transponder. Basically, a transponder is a device that can both transmit and receive electronic signals. Typically, a transponder includes an antenna that can receive a signal. In response to a "recognizable" signal, an integrated microchip is activated that, in turn, causes an electronic response to be transmitted. Transponders are of two types – passive and active. Passive transponders have no internal power source. Usually, energy generated upon receipt of a signal by the antenna is used to provide power for microchip activation and subsequent transmission. This is usually a very small amount of energy, and accounts in part for the short transmission range of which passive transponders are capable -- about 3 meters. Active transponders have an internal power source such as a battery. This can support greater transmission ranges (up to about 100 meters), but also implies that the battery must somehow be recharged or replaced for continuous operation ("Transponder").

For many years, RFID technology has been used for tracking objects of all sorts, including boxes in a

warehouse, vehicles, and even fish (Biomark). In these applications, RFID tags are attached to the object to be tracked. Technologically speaking, an RFID tag is simply a Passive Integrated Transponder (PIT) that can receive a signal from a "tag reader" and responds by transmitting a unique identifier back to that reader.

As discussed in Chapter 1, in the context of current RF monitoring for community corrections, a tracked client's ankle bracelet contains an RFID tag. For home detention, the reader is stationary and typically attached to a telephone. The reader continuously sends a signal to the bracelet and expects a response with the bracelet's unique identifier. If a response is not received, the assumption is that the client has left the home and appropriate authorities are notified via the telephone connection. For GPS monitoring, the reader is incorporated into the GPS receiver, which is typically carried by the client, and communicates a lack of bracelet RFID tag response to authorities using cellular technology (for Active and Hybrid GPS) or land-line phone (for Passive GPS).

With the discussion above as background, other ways in which emerging RFID technology could be used as a boon to location-based tracking are described below. Several concepts of operation can be postulated.

- Several corrections agencies throughout the country have begun using RFID technology to track the location of inmates within their jail or prison. Bracelets issued at the time of incarceration allow corrections officials to track the location of inmates relative to each other (seen as a means to help prevent altercations), as well as time spent in various locations throughout the corrections facility (Swedberg).
- As an alternative to Active GPS monitoring, especially for low-risk clients, one can envision the placement of RFID readers throughout a community. These could be housed in specifically constructed structures such as kiosks, or could be more inconspicuously placed atop such things as lamp posts and signal lights, or could be located within government structures such as general office buildings, police stations, corrections agency buildings, visitor information bureaus, courthouses, etc. Depending on the placement and ubiquity of tag readers in a community, a tracked client could either be identified as she simply "passed by" a reader, or could be required to "visit" the vicinity of a reader periodically.
- A recent development – dubbed RFID-radar™ by its inventors, claims to significantly increase both the range and location-finding accuracy of RFID systems while still using small and inexpensive passive tags (Trolley). This technology could help facilitate less restrictive movement limitations for some clients at places of employment (e.g., construction sites or warehouses) or large residences (e.g., farms).
- RFID tags (i.e., transponders) can be manufactured in a large number of sizes, and "disguised" in arbitrary ways for practical or aesthetic reasons. For instance, RFID tags packaged to be attached to a keychain are now available to facilitate rapid payment at gasoline pumps and passing through highway toll booths. However, advances in microchip technology allow RFID tags to be manufactured in even smaller sizes. So small, in fact, that they can pass through a syringe. This would facilitate subdermal (just under the skin) or subcutaneous (in the subcutis, or "fatty" tissue) implantation of such transponders. Transponder implantation is discussed in more detail in section 4.2.5.

4.2.3.2 Benefits

- RFID tags are very inexpensive to manufacture or purchase for inclusion in identification systems.
- RFID technology is well-established and (technologically) reliable.
- Unlike GPS technology, RFID technology works well indoors. This can facilitate tracking of individuals within, for example, a large office building or warehouse where they may be employed.
- Suitably deployed (for instance, with tag readers installed at locations throughout a community) the use of RFID might provide a relatively inexpensive alternative for tracking low-risk clients. The true total cost in a given community depends on the number of readers that need to be deployed, and the manner in which they are deployed.
- A problem often mentioned by study participants for GPS-monitored clients is that the limited range of most RFID readers/tags can unnecessarily

restrict a client's movements within their home, especially in very large homes or on farms. This could also be a factor for clients who are employed in situations (e.g., construction) in which it may sometimes be impractical or unsafe to have the GPS receiver within range at every moment. The incorporation of advanced RFID technology that significantly enhances transmission range into existing GPS client tracking systems could help facilitate less restrictive movement limitations for tracked clients.

4.2.3.3 Limitations

- The most severe limitation of RFID technology itself is the small nominal transmission range of passive transponders. Even emerging enhancements and improved antennae only increase the range up to about 100 meters.
- The requirement to outfit a particular geographic area with transponder readers is another severe limitation that would also have to be overcome before RFID could be considered a viable alternative to GPS. In particular this could be difficult in large urban areas where many readers would have to be placed to accommodate clients' non-restricted movements.
- Although RFID is a very reliable technology in "non-hostile" environments (that is, environments in which the object being tracked either doesn't know or doesn't care), it is also fairly easy to defeat the technology using simple foil shielding around the tag.
- There are a growing number of organizations and influential individuals that object to the use of RFID technology for any kind of tracking that relates information back to human beings. For example, while most would not object to tracking a container in a warehouse, many object to RFID tags on credit cards or passports. Some of these objections are based on ethical/religious principles, while some are based on privacy/security principles. Regardless of one's personal position on such issues, it must be recognized that many debates continue to rage throughout the country that may influence future legislation and/or investment in research for RFID.

4.2.3.4 Readiness Status

RFID technology in general is mature, reliable, and in widespread use for many tracking applications. However, except for the common use of RFID to tether GPS tracking bracelets to GPS receivers, all of the scenarios described are speculative at this time.

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4.2.4 Dead Reckoning Based on Speed/Direction Sensors

4.2.4.1 Concept of Operation

Dead reckoning technology aims to address the problem of GPS signal loss both indoors and as a result of travel over long distances in enclosed vehicles (e.g., planes, trains, boats) or in terrain (e.g., mountains, canyons) where GPS signals are masked by natural obstacles.

To derive accurate location data, several long-known and reliable technologies and techniques are combined with GPS receivers. The theoretical principle involved is a navigational technique called dead reckoning. Used by mariners for centuries and by aviators for decades, dead reckoning provides an estimate of current location derived by applying simple calculations to a last known location, and observed speed and direction. For example, pleasure-craft sailors can chart their position reasonably well by observing a fixed aid to navigation such as a buoy, and by observing speed through the water using a knot-meter, and detecting direction using a traditional compass. An excellent description of this process can be found on a U.S. Coast Guard Web site ("Dead Reckoning").

In the context of location-based tracking of individuals, four modern electronic devices are packaged together to achieve the same thing as a sailor may use, but with much higher precision. First, a GPS receiver is used to continuously establish a known location when the signal is available. If GPS signal loss occurs, the

dead-reckoning process takes over, starting with the most recently recorded GPS position as the last known location. Second, a device called an accelerometer ("Accelerometer") is used to derive velocity. Although accelerometers actually measure acceleration, it is easy to calculate velocity as a function of acceleration and time. Time is determined by an on-board digital clock that can be thought of as beginning to "tick" when the GPS signal is lost. Third, an electromagnetic compass (also called a fluxgate compass ("Fluxgate compass") is used to observe the direction of movement. Fourth, data from a barometric sensor ("Altimeter") can be used to calculate altitude above ground. These devices, all about the size of a postage stamp are depicted in Figure 4-3.

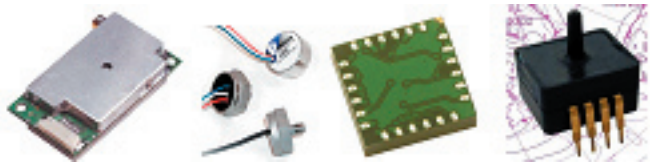

Figure 4-3. (L to R) GPS Sensor, Accelerometer, Digital Compass, Barometric Sensor

Using the electronic data supplied by these devices, miniature circuitry can then be used to derive current location by applying dead reckoning computations to the last reliable location provided by GPS (before signal loss), the velocity provided by the accelerometer and clock, and the direction provided by the digital compass. For accurate location above the ground (e.g., in an airplane or tall building), the barometric sensor data can be used to compute altitude. Figure 4-4 depicts the concept of dead reckoning as it interfaces with a GPS device.

4.2.4.2 Benefits

- The obvious benefit of this technology is that location tracking can be achieved independently of the presence of a continuous GPS signal.
- Besides providing a more continuous set of location data, there is a potential side-benefit of fewer "No GPS" alerts requiring analysis.
- Although some GPS tracking software can display an indication of speed and direction of movement based on the difference in position between successive signals, the very sensitive speed and direction sensors that are an inherent part of this unit may provide a basis for more accurate and/or more graphically clear displays of the movement path in a mapping display, especially with respect to an individual's location within a building.
- By also including altitude data, the reported location can be more precise than traditional latitude/longitude information. For instance, it can be determined that an individual is on a particular floor of a building, at a certain level of mountainous terrain, or in an airplane.

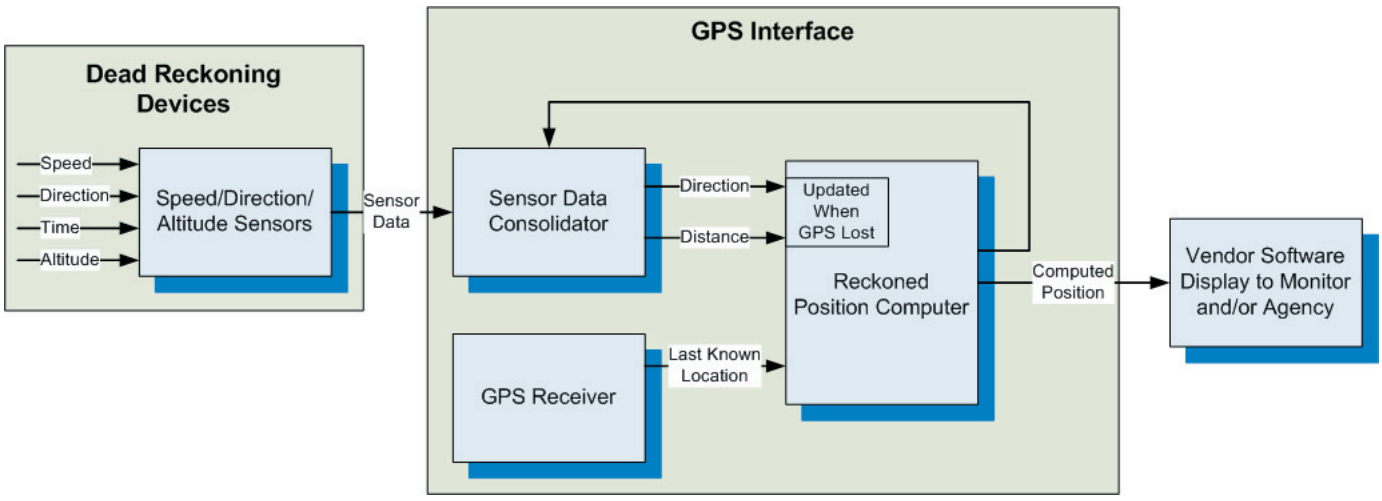

Figure 4-4. Dead Reckoning Concept

4.2.4.3 Limitations

- The most significant limitation of this technology may be cost. Traditional GPS tracking devices have typically included a GPS receiver, memory for storing location data, and a (cell-based) transmitter. Devices based on this new concept must also include the three additional sensors depicted in Figure 4-3, as well as the circuitry to process their data. The amount of memory may also need to be increased to accommodate the large volume of additional data.
- The presence of additional electronic components and circuitry may also impose additional size, weight, and power consumption requirements for the receiver unit.

4.2.4.4 Readiness Status

Virtual Shadow is a system employing this technology that is currently being marketed for use in the context of community corrections by Virtual Technologies, Ltd. The company is headquartered in Spokane, WA and has a Web site at *www.virtualtechnologiesltd.com/*.

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4.2.5 Transponder Chip Implantation

4.2.5.1 Concept of Operation

Section 4.2.3 of this chapter describes the general function of a transponder device and the role of such devices in RFID technology. In this section a closer look is taken at transponder-based systems that are small enough and packaged in such a way as to be implantable in human tissue.

Implanted RFID transponder chips have actually been used for many years in animals ("Microchip implant (animal)"). For example, a chip can be implanted without surgery into the soft tissue that is usually present above a dog's shoulder. This can help veterinarians and private/public pet rescue organizations to identify a stray dog. This technology is also available for other household pets and farm/ranch animals such as cattle and horses.

The implantable device shown in Figure 4-5 is slightly larger than a grain of rice (12mm long) and, as shown in Figure 4-6, is inserted as an injection using a large diameter syringe (Chip Your Pet). Once implanted, the chip is not externally noticeable. The transponder's electronic elements are encased in a capsule made from inert material that does not react with the animal's tissue. Assuming a sterile needle and capsule, infection also should not result from the process. Since the implant is a passive RFID transponder, it has no battery that requires recharging or replacement, and has no external connections to any other device.

Figure 4-5. RFID Implant for Pets
("Bigchip.jpg")

Figure 4-6. Inserting the Chip
("Chipcat.jpg")

Important issues, then, are whether such technologies can/should be used in humans, and if so, could they augment current location-based strategies. A transponder device that is to be implanted in human tissue for the purpose of mandated tracking in the context of community corrections should probably have at least the following characteristics.

- It should be small enough to be implanted without dangerous or invasive surgery, and without causing noticeable changes to the recipient's appearance.

- The implantation procedure should be inexpensive enough as to not cause a financial burden either for the recipient or for the sponsoring agency.
- It must be packaged in such a way as to be medically "safe". That is, its presence as a foreign body in human tissue should not produce undesirable physiological side effects.
- It should not interfere with other electronic devices in the vicinity, or with medical electronic procedures such as MRI.
- It must require little or no "maintenance" after implantation.
- It must be easy and safe to remove if that should become necessary or desirable. For instance, if subsequent legislation or judicial processes made such a device illegal or unnecessary, then it must be possible to remove it from the recipient without expensive, dangerous, or invasive surgery.

The RFID implants described above for animal tracking are manufactured predominantly by a company based in St. Paul, MN called Digital Angel Corporation (*www.digitalangelcorp.com/*). Digital Angel Corporation generally partners with others to produce tracking "systems" in various industry domains. However, it is not clear whether those partnerships are financially-based alliances or merely Original Equipment Manufacturer (OEM) agreements. In any case, the RFID implants used for animal tracking have been demonstrated to satisfy bullets 1, 3, and 5 from the list above.

One of the company's partners, VeriChip Corporation, markets systems based on Digital Angel's RFID implant for humans (*www.verichipcorp.com*). Marketing literature and press indicate a cost between $150 and $400 for the implantation procedure (Geracimos).

One physician, who received a VeriChip implant in order to personally evaluate it, published an article in the respected New England Journal of Medicine indicating general support for the implant and conformance of the device to bullet 4 above (Halamka). However, the article indicates (and this was the only reference to this issue found by the authors of this document) that removal of the implant would require "minor surgery".

Of course, a GPS-capable implant would impose additional technology requirements. For instance, a GPS receiver and antenna must be present. In addition, there must be a way, such as a cellular transmitter, for GPS data to be sent to the vendor's software. These requirements imply a need for a fairly strong self-sustaining power source (i.e., a rechargeable battery). One possibility here would be the implantation of two separate chips with an electrical connection between them. One would house the transponder circuitry, and other could be a photoelectric cell implanted near the surface of the skin that recharges a battery. The required circuitry would probably imply a much larger size than the implantable RFID chip described above. This may, in turn, affect the manner in which such devices would be implanted, for instance surgery may be required. Additionally, such an implant would be susceptible to all of the weaknesses of any GPS device.

4.2.5.2 Benefits

- Implanted transponders are basically invisible. For community corrections, this would be a boon in scenarios such as with pretrial defendants, where tracking of an individual is necessary and/or desirable, but where the social stigma associated with obtrusive tracking devices may be a concern.
- Implanted transponders that are designed to be maintenance-free may be useful for meeting requirements for "lifetime tracking" scenarios, such as released sex offenders, where the general whereabouts of an individual is important, but where 24x7 tracking is not necessarily called for. This would help mitigate the problems associated with requiring sex offenders to "register" their presence in a community, but could also support the efforts of those who wish to re-enter society in a lawful and rehabilitated way.

4.2.5.3 Limitations

- Any implanted device requires at least minor surgery for removal. This could be considered unnecessarily/unfairly invasive in any case involving a temporary tracking requirement.
- Even a highly reliable device may be subject to occasional malfunction or damage. Damage could occur coincidentally, for instance, with a traumatic injury in the vicinity of the implant. In such cases, surgical removal of the device would be required for repair or replacement.

- A GPS-capable implant that transmits its data via cellular technology is subject to all of the weaknesses and constraints of conventional GPS and cellular devices.

4.2.5.4 Readiness Status

VeriChip markets systems for location-based tracking in several different contexts (e.g., hospital patients, Alzheimer's patients, access control, emergency response teams), but not community corrections. This is interesting because, as discussed below, Digital Angel's original business plans included community corrections using ***GPS-enabled*** implanted chips (Foster).

In March 2001, Digital Angel Corporation applied for a U.S. patent for an implantable device with GPS capability. One of the enabling characteristics of the technology described in the patent application was a battery that would be recharged by a photocell that was also part of the implanted device. The patent was not actually granted until May 2003 ("United States Patent 6,559,620…").

In November 2001, the company issued a press release announcing an agreement with the California Governor's Office of Criminal Justice and Planning and the Department of Corrections to conduct a one-year pilot in Los Angeles County, California of parolee monitoring using an implanted microchip with GPS capability ("Applied Digital Solutions'…").

The following year, in June 2002, the company issued a press release announcing a partnership with BI Inc. "…to supply GPS-based tracking products for the criminal justice field under a long-term agreement …" ("Digital Angel Corp…").

In early 2003 the company began to report serious financial problems (Gossett "Implantable chip…"). After this time, no further references were found related to the Los Angeles County pilot, the partnership with BI Inc., or implants with GPS capability in ***any*** context.

In December 2004, following much allegedly contentious interaction with the U.S. Federal Drug Administration (FDA), the FDA classified the company's RFID implant as a Class II medical device, thus exempting the device from pre-market approval for use in humans, but subject to "guidelines" for the manufacture and application of the device ("Guidance for Industry and FDA Staff:…").

It is not known why Digital Angel Corporation ultimately abandoned their development and marketing of GPS-enabled implants. Some press indicates the possibility that the Los Angeles County pilot may have failed technologically (Gossett "Lawsuits plague…"). The partnership with BI Inc. was intended to provide domain expertise and end-user systems specifically for community corrections (www.bi.com), but this partnership may have been dissolved. In addition, almost immediately following the original press announcements about GPS-enabled implants, many debates began that focused on ethical, religious, and privacy issues of such a device (Kupelian) (Dougherty). It is possible that these issues were considered by corporate executives to be serious marketing obstacles. Finally, until the FDA's classification of such devices in December 2004, the implants could not have been legally marketed for human implantation.[9]

Any or all of these factors may have contributed to the abandonment of a GPS-enabled implant. However, there is a registered patent for such a device, and Digital Angel Corporation is now successfully marketing RFID implants. Thus, it is possible that the future may bring a resurrection of the GPS-enabled implant.

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[9]The FDA classification was officially for the RFID implant, but would most likely be applicable to a GPS-enabled device as well if it were similarly packaged. However, it is also possible that a GPS-enabled device, which would have also incorporated an ***active***, battery-powered transmitter, may not have conformed to some of the Class II guidelines imposed by the FDA ruling regarding interference with other medical electronic devices ("Guidance for Industry and FDA Staff:…").

4.2.6 Biometric Recognition Technologies

4.2.6.1 Concept of Operation

Biometrics is a science that studies automated methods of recognizing human beings using unique, or nearly unique, physiological characteristics. For instance, fingerprints have long been known to be unique to each individual. In more recent years, iris patterns, facial characteristics, voice patterns, and handwriting have become favorite research and development areas in the field of biometrics.

Although biometrics research has been quietly going on for decades, advances in many other areas (e.g., digital imaging, pattern recognition, audio analysis, and micro-electronics) as well as perceived requirements for heightened security world-wide, have brought biometrics research to the forefront as a popular and well-funded research area.

In general, biometric recognition can be used in two different ways – identification or verification. The purpose of ***identification*** is to learn the identity of an individual without *a priori* knowledge. An example of this is to match a latent fingerprint found at a crime scene against a database of previously collected fingerprints in order to identify the person who left the print.

The purpose of ***verification*** is to prove that a person presenting identity credentials is indeed who they claim to be. An example of this is comparison of the iris pattern of an individual claiming to be an employee having access to a building to confirm that the individual is indeed that employee (and, in this case, also that he or she has been granted access privileges).

For location-based tracking applications, verification recognition will likely prove to be most practical and useful. The most probable concept of operation would employ biometric "capture stations" strategically placed around communities (for instance, kiosks) for the purpose of collecting specific biometric information about tracked clients and transmitting that information to a central location. The biometrics to be captured would probably be determined by juxtaposing such factors as ease of collection (e.g., fingerprints may be easier than irises), cost effectiveness (e.g., fingerprint readers are cheaper than high-quality digital cameras), and the inherent reliability of the biometric (e.g., faces are harder to recognize and easier to defeat than irises). Figure 4-7 and Figure 4-8 depict examples of biometric capture devices (a fingerprint reader and iris scanner respectively).

Figure 4-7.
USB Fingerprint Reader
("prod_top-fpreader.jpg")

Figure 4-8.
Iris Scanner
("iris-sdi.jpg")

Another interesting scenario uses voice identification in conjunction with a technology called Automatic Number Identification (ANI) ("Automatic number identification"). The ANI service is typically supplied by telecommunications companies to inward Wide Area Telephone Service (IN-WATS) line telephone subscribers (i.e., 800 numbers). Even if caller-ID blocking has been used, the ANI service can reliably return the calling phone number and line type (e.g., residential land line, pay phone, mobile phone, etc.) to the 800 subscriber. A location-based tracking scenario would require a client to call a particular 800 number from a specific set of telephones (e.g., home or office) at specific times of the day. Voice identification technology would be used to identify/verify the caller, and ANI technology would be used to identify the caller's location. Calling from a phone other than one on a specific list could generate an alert. This scenario could also be augmented by providing clients with a GPS-enabled cell phone. This could be useful for clients that have a broader freedom of movement, but whose location still needs to be accounted for on a regular basis. Figure 4-9 depicts an example of how such a system would operate.

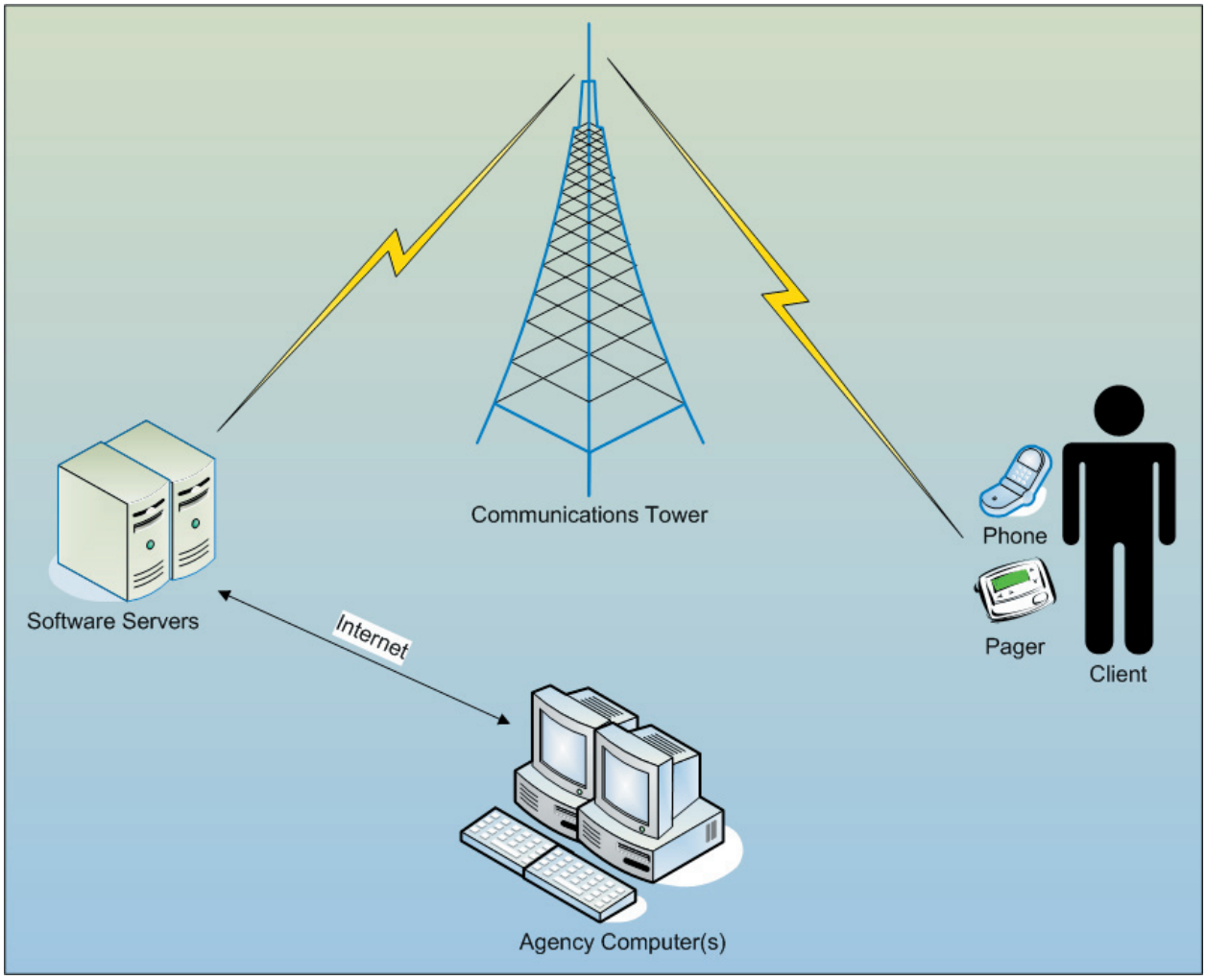

Figure 4-9. Biometric Voice Recognition for Location-Based Tracking

The current state-of-the-art for most biometric recognition systems is such that collection of any biometric of sufficient quality to be verified would have to be either supervised or voluntarily cooperative on the part of a tracked client. Thus, this technology will probably be most useful in the short term for verifying that a client has been at a certain place at a specific time. This would be most appropriate for low-risk clients who have a lot of freedom of movement, but who must observe a prescribed schedule of movement between locations such as home and place of employment. It may not be appropriate for high-risk clients or those in home detention programs, for example, because it is not possible to prove that the client is not at a certain place (e.g., at home), nor to detect that the client has entered a prohibited area or "exclusion zone".

4.2.6.2 Benefits

- For low-risk clients, biometric verification could provide an alternative or augmentation to other technologies. For example, biometric verification systems are probably much less expensive to implement than GPS. Because biometric characteristics are inherently unique, this could also be a viable alternative to RFID technology in some situations, because it does not require the presence of a passive transponder to provide information. This alternative could be especially effective for programs that track, for example, low-risk pretrial defendants since it allows those clients to blend more easily into society without carrying obtrusive tracking hardware.

- When used in conjunction with traditional RF home detention, it could be useful to ensure that a client is attending required treatment and meeting employment requirements by placing a kiosk at those locations.

4.2.6.3 Limitations

- Biometric recognition systems almost never achieve 100% accuracy. They are mostly limited by the quality of compared images (or sound samples, in the case of voice recognition). In the case of community corrections it will usually be easy to capture a high-quality biometric for inclusion in a database because the capture process can be a supervised activity. However, the biometric from a capture station in the field may be of questionable quality for a variety of reasons, even when a client is cooperative and wants to be recognized. For instance, a client may have an injury on one or more fingers obscuring the fingerprint from being reliably compared against the database image that may have been captured when the injury was not present. Voice recognition may likewise be impeded by an illness that affects voice quality or such things as traffic noise. Successful use of biometric recognition for community corrections must therefore include processes to deal with failures to recognize an individual for legitimate reasons.
- Biometric verification of identity depends upon both the deployment of suitable capture stations (limited by the size and cost of such stations) in appropriate locations and deployment of potentially expensive biometric recognition software on a central server.
- For biometric voice recognition systems, client convenience may also be a limiting factor. For instance, to ensure compliance during night time hours a client would have to be contacted via phone several times. This may limit its practical use during such hours when the client would normally be sleeping.

4.2.6.4 Readiness Status

There are currently a large number of companies that provide biometric identification components and systems. In most cases, a given company will specialize in technology related to a particular type of biometric.

An excellent general compendium of biometric technology vendors can be found online at *www.findbiometrics.com.*

However, one vendor, Biometric Corporation with headquarters in Dallas, TX (*www.biometric-corp.com*), markets a system called ParoleTrax that uses voice recognition technology and specifically targets the community corrections market. The system offers several different levels of interaction with the tracked client. At the most basic level, the client is simply required to call in using a standard (specific) telephone at specific times. At the next level, the client is issued a pager to which call-in requests can be sent by an officer. At the highest level, the client is issued a GPS-enabled cell phone to which the officer can call and/or send pages, and that can be tracked using GPS technology. In all cases, when the client calls in, random prompts for voice responses are used to verify the client's identify. The random prompts help ensure that the client cannot fool the system by using pre-recorded responses.

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4.2.7 Satellite Imaging

4.2.7.1 Concept of Operation

The concept of "spy satellites" has been a favorite theme of the science fiction and high-tech thriller genres for many years. Most of the movies and television episodes that highlight this technology postulate extremely high resolution cameras operating from a spacecraft that can perform such magic as allowing the observer to read a wristwatch dial or a vehicle license plate, or to distinguish the facial features of a single individual.

Although there are probably few people who actually know the true resolution capability of U.S. Government reconnaissance satellites, the fact is that the resolution of cameras aboard typical commercial imaging satellites only supports ***generic*** identification of objects

about the size of an automobile. That is, while it is possible to identify that an object is an automobile (and perhaps its relative size and color), it is not possible to clearly zoom in on details such as license plates or hood ornaments. Additionally, it is certainly not possible to zoom in on the facial characteristics of a person with sufficient clarity to identify him or her. Furthermore, while commercial satellite imaging services are available, the cost is high and such services do not generally include real-time image display (which would allow one to immediately view a real-time image of a tracked client's ***current*** location).

How then, can satellite imagery be used to augment other location-based tracking technologies? Give the current state-of-the-art, the most interesting and helpful potential use of satellite imagery may be to quickly identify subtle trends related to a tracked client's movement path that may not be readily available using daily location reports, or even some GPS mapping displays.

As an example, suppose that a registered sex offender, or perhaps a paroled drug dealer, is being tracked using conventional GPS technology. Each day, the client's ***movement points*** are reviewed by the assigned community corrections officer. During a particular week, the officer notices that each weekday the client seems to spend a lot of time during the mid-afternoon hours near a particular (latitude, longitude) location. Using the Google Earth software application -- available for free download on the internet -- it is possible to quickly see a satellite image of a specific location identified by its coordinates, zoom in on the images to the level of individual buildings, and to annotate the image with the names of such places as schools and restaurants (Google Earth). For instance, with minimal effort, it is possible to see an image similar to that shown in Figure 4-10. This figure shows that a bar is located at the coordinates where the client is spending time each afternoon, and that there is a school attended by troubled teenagers only a few blocks away. This information would very likely raise a red flag for the officer to investigate further.

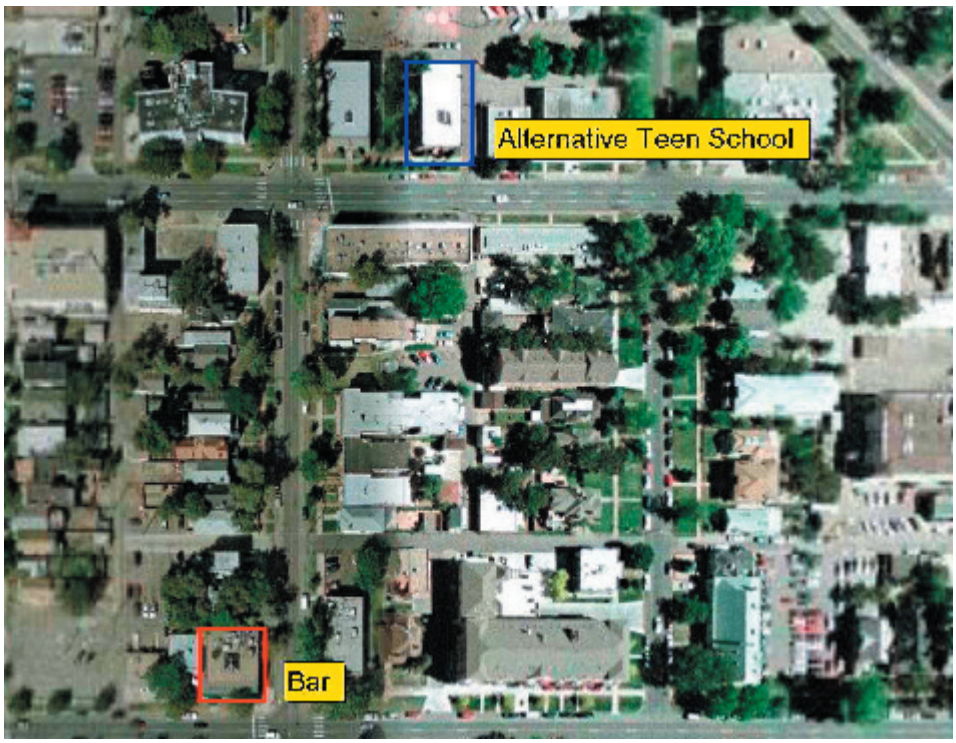

Figure 4-10. Satellite Image of an Urban Neighborhood

(Image selected and saved using Google Earth – annotations added by author for clarification.)

4.2.7.2 Benefits

- Agency officers can quickly and inexpensively identify specific locations of interest that may be related to a client's recorded movement paths.
- Such tools are readily available to all agencies at no cost, and are easy to use.

4.2.7.3 Limitations

- For most agencies, it is neither cost-effective nor logistically practical, to obtain real-time satellite images of a client's present location.
- Although the use of such satellite imaging tools is not likely to be mandated in most jurisdictions, once the information is sought and noticed, such knowledge may imply an obligation to follow up appropriately.
- Automated software tools to highlight trends such as the one used in the example above are not yet available from GPS vendors. Therefore, such analysis is currently a manual process.

4.2.7.4 Readiness Status

At least two no-cost software packages available for download from the Internet have been identified:

- Google Earth is distributed and supported by Google, Inc. (*http://earth.google.com/*). In addition to the free version, enhanced versions with additional features are available for purchase.
- World Wind (*http://worldwind.arc.nasa.gov/*) which is distributed by NASA.

Additionally, at least two Web-based satellite image exploration sites have been identified:

- Terra Server (*http://www.terraserver.com/*) which is operated by Microsoft Corporation.
- TerraFly (*http://www.terrafly.com/*) which is operated by the University of Florida.

There are several companies that market commercial satellite imaging services. These include (but may not be limited to) the following:

- Satellite Imaging Corporation, headquartered in Houston, TX (*http://www.satimagingcorp.com/*).
- GlobeXplorer Corporation, headquartered in Walnut Creek, CA (*http://www.globexplorer.com/*).
- Digital Globe Corporation, headquartered in Longmont, CO. Digital Globe is the owner of the QuickBird satellite. (*http://www.digitalglobe.com*).
- GeoEye Corporation, headquartered in Dulles, VA (*http://www.geoeye.com*). GeoEye is the owner of several imaging satellites, including IKONOS, GeoEye-1, OrbView-2, and OrbView-3.

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CHAPTER 5: GPS FUNCTIONAL TECHNOLOGY STANDARDS AND EVALUATION CRITERIA

5.1 Introduction

Criminal justice policy makers and managers are confronted with a number of issues when deciding whether and how to implement a program of community supervision using GPS. Two of the fundamental issues they must consider are whether the program will work and if it will be cost effective. At the most basic level the question is "Will the use of GPS improve the performance of those supervised?" For example, will those supervised in the community with GPS be more likely to appear for trial, avoid violations while being supervised in the community, and/or have lower levels of recidivism than similarly situated clients of the agency. This is the question increasingly asked by administrators of all criminal justice programs – does GPS work; does the scientific evidence demonstrate that the GPS program helps the agency achieve its goals of protecting the public and assuring justice. The emerging literature evaluating the effectiveness of GPS in community supervision is relevant to this issue.

However, there is another set of questions that precede program evaluation. These involve the issue of whether the use of GPS in community supervision meets the standards and expectations established by the agency or other organizations; these questions go to the integrity of the program. Is the program operating in a way that is consistent with the way GPS should work or at least is expected to work by the agency responsible for its operation? This requires that from the beginning of the use of GPS in community supervision there be clear statements about how the program should work and ways to monitor whether these standards or expectations are being met. For agencies that contract for GPS services this issue becomes relevant as they put together the request for services that will be used in the process of procuring GPS services.

This chapter pays special attention to the way standards for GPS use in community supervision have been developed, the use of such standards[10] in the operation of GPS, and the value they hold for improving program evaluations. The current status of electronic community supervision program evaluations is then considered and the relationship between standard setting and improved evaluations of effectiveness is demonstrated. Finally, the steps that can be undertaken to improve standard setting and program evaluations are considered.

5.2 Existing Standards

Every agency that has procured GPS services and equipment for use in community supervision has had to identify the requirements for their system and develop criteria for evaluating those who offer these services. After the procurement phase these agencies have to monitor vendor performance against the contractual requirements they have purchased. Two approaches to setting these standards or requirements have been identified: experience and logic or testing.

5.2.1 Experience

The most frequently used approach, in the absence of industry or governmental national standards, is that each agency must use its own expertise and informal lessons learned from other agencies to guide this process. A good example of this is the work of the State of Washington and the Western States Contracting Alliance. In 2005 they promulgated a procurement document for EM, GPS monitoring, and alcohol monitoring. In this document they identify a series of requirements that vendors must meet. These include (for GPS monitoring systems) on-site service, training procedures, alert notifications, remote programming, response time, replacements, tamper-resistance, staffing, and characteristics of the devices. However,

[10]The term standard refers to agreed upon characteristics for the design and operation of a GPS monitoring system. A requirement is a term used in contracting that can be related to standards but are usually less developed and universal. These terms are used interchangeably in this chapter to reflect the fact that for GPS monitoring systems little agreement has been reached on the characteristics (other than accuracy) that are essential for their operation.

the requirements are stated in general terms and do not indicate the ways in which assessment of compliance will be done. Also, there is no indication of how each element is related to user requirements, and the standards lack precision. The comprehensiveness of the Washington effort is commendable but this approach does not suggest standards that can or should be used by other jurisdictions. They do however identify the categories of requirements that other agencies should consider.

5.2.2 Testing

Without implying any criticism of those agencies that have developed their procurement standards in this way (this approach is reasonable in the very early stages of technology adoption), interest has been directed towards those who have attempted to establish such standards and then tested equipment and services offered by vendors against these standards. Using either cold (sometimes referred to as bench tests) or hot tests[11], these approaches seek to not only set the standard but use it for selection using empirical data, and then to use the standards to monitor performance. Two examples of this approach are offered, not because they are the only ones available, but because they represent two related but importantly different approaches to setting, testing, and using standards. In New Mexico, the Corrections Department sought the assistance of an independent contractor to examine specific GPS monitoring systems to "determine whether the system operates to the requirements as specified by the end users" (Justice and Safety Center, 2004). In this case the agency set the requirements they wanted in the system (i.e., the standards) and the independent agency conducted tests to determine how various vendors' products met those requirements. By far the most extensive use of GPS in community supervision is occurring in Great Britain, where they have developed detailed specifications for the systems they are procuring, conducted bench and hot tests, and used the results to develop detailed operational guidelines for monitoring vendor performance. Three major themes emerge from the review and analysis of these efforts to set standards:

1. The importance of testing;
2. The value of detailed specifications; and
3. The importance of program goals in standard or requirements setting.

The testing efforts of New Mexico and Great Britain are detailed in the following sections.

5.2.2.1 New Mexico

A series of tests were performed on the equipment of potential vendor's in two distinct locations of the state using simulated subjects and field observers who monitored subject activities and equipment performance. The elements of the test were developed to "determine which system is best suited for the needs of the New Mexico Corrections Department in order to monitor the paroled sex offender population in the state". The tests addressed five primary questions (Justice and Safety Center, Appendix A):

1. Will the system's coverage affect the ability to monitor offenders in remote parts of the state;
2. Will the technology meet specifications as provided by the manufacturer;
3. Will the offender be able to defeat or bypass the system;
4. Will the bracelet provide a proper fit to a variety of body types; and
5. Will environmental factors affect the operation of the system.

For each of these questions a series of tests were conducted by the Justice and Safety Center, which were directly related to the requirements of the New Mexico Corrections Department, and results were presented for each of the potential vendors. To demonstrate the New Mexico approach, consider the tests used to address the issue of the offenders' ability to defeat or bypass the system. For these criteria the Justice and Safety Center researchers assessed:

- The effectiveness of tamper alarms on the device;
- The ease of signal disruption by using a metallic device to interrupt the signal and system reaction;
- The effect of temperature on operation of the device by using it in a range of temperature conditions;

[11]These terms are used to differentiate between tests that involve wearing and testing of the equipment in real settings (hot tests) and those that are done in simulated conditions without actual users (bench or cold tests).

- The degree to which emersion in water effected the systems' performance; and
- Whether a unit could be disabled while submerged in water without activating the alerts in the system.

Each of these elements represented a requirement of the agency for system performance. The tests allowed the agency to have an independent assessment of the vendor's performance on each element of the standards. Table 5-1 summarizes the results of the testing for four commonly used systems that were under consideration by the New Mexico Corrections Department. While none of these results are from use under the actual conditions in which they might actually be used, they do represent an attempt to go beyond relying on the vendors to describe the functionality of their systems. Furthermore, this approach forced the agency to specify what requirements where important to them during operation of the systems and using those for the development of the testing protocol. Using this approach the Justice and Safety Center concluded that (Justice and Safety Center 2004, p. 37):

1. Although problems were encountered by the systems evaluated, each offered some level of functionality for the tracking of offenders. Fundamentally, each system used the same infrastructure for Active tracking.
2. The systems differed in the number of components, size, as well as messaging capabilities. For example, one system consisted of a one piece unit, while others utilized a two component system. Additionally, two of the units had the capability of sending text messages to the offenders.

Table 5-1. Independent Assessment of Vendor Equipment Performance – New Mexico

	Vendor 1	Vendor 2	Vendor 3	Vendor 4
1A enrollment in system	UE	P	P	P
1B inclusion/exclusion zone setup	P	P	P	P
1C System weight/dimension	N/A	N/A	N/A	N/A
1D unit placement	UE	P	P	P
1E system calibration	UE	UE	UE	UE
2 inclusion test	P	P	P	P
3 curfew violation	F	UE	P	P
4a exclusion zone 1	P	F	P	P
4b exclusion zone 2	P	F	P	P
4c exclusion zone 3	F	F	P	P
4d exclusion zone 4	P	UE	P	N/A
4e exclusion zone 5	F	UE	P	N/A
4f early morning	UE	UE	P	N/A
5 layered technology	UE	N/A	N/A	N/A
6a tamper test	UE	P	P	P
6b signal interference	UE	UE	P	F
6c temperature	UE	UE	P	P
6d water immersion	UE	P	P	P
6e bucket test	UE	UE	F	P
7 history report	P	P	P	P

Legend:
UE - unable to evaluate
P - pass
F - fail
N/A - not applicable

Adapted from table in report from Justice and Safety Center (2005: 38)

3. A variety of software platforms were used by the systems evaluated. These platforms included Web-based, remote desktop connection, and client based software. All systems required an internet connection in order to actively track offenders.
4. None of the systems could actively track in Roswell, NM (the rural test site). Roswell did not have the cellular infrastructure required for Active tracking functionality.

Finally, as Table 5-1 indicates, while all test products passed most tests, all of them failed at least one of the tests. Thus the agency was able to make a selection with a reasonably good idea of how each system would meet the needs of the agency (the standards they had set) and, where a system would not perform as desired, the agency could develop operational procedures to adjust for this. In this instance the most important findings concerned the failure of the systems to be an option in other than the most populous sections of the state.

5.2.2.2 Great Britain

By far the most comprehensive program involving the use of EM in community supervision has been undertaken in Great Britain. This program is operated by the National Probation Service of the Home Office. In 1989, EM was introduced in Great Britain for adult offenders on bail. Later, adult offenders sentenced to a curfew were added (1994), as were juveniles and persistent petty offenders (1998). By year 2000 EM programs were operating throughout England and Wales. In 2004, The National Probation Service began piloting GPS tracking in three communities. In Great Britain, GPS tracking use depends on the status of the offender. For those sentenced to community penalties, tracking can only be used to monitor compliance with the orders of the court that are directly related to their community orders (curfew and exclusions are the primary elements of community restrictions). For those on what the United States refers to as parole, tracking can be used to monitor compliance with parole conditions and for determining where the client is at all times. These pilots are being evaluated by a team of independent researchers with results expected later this year.

While most of the experience in Great Britain is with EM, the standards that have been developed and used in testing systems have been applied to GPS monitoring systems as well as more traditional EM systems. These standards have been developed for cold and hot testing and have established a comprehensive set of requirements that can be used during the procurement phase and in monitoring the performance of contractors. The cold or bench test standards are extensive and detailed. The cold test standards are described in a publication of the Home Office that is available on the Web (*www.probation.homeoffice.gov.uk/output/page251.asp*). They apply to EM and GPS systems and set requirements that vendors must demonstrate they meet. The criteria are used "to determine the suitability of the devices for their intended purposes." Contractors must demonstrate that all of the equipment they provide meets all of the standards. Furthermore, once the contract is awarded, the contractor cannot modify the equipment in ways that bring it out of compliance with the standards without submitting supporting data that the changed equipment also meets the standards. All cold testing is the responsibility of the contractors.

The standards cover a number of elements and vary for units that are attached to the client and equipment that is carried or otherwise used by the client. Each category is further specified and each of the subcategory standards is accompanied by test specifications. For example, for units attached to the client one standard is ergonomics. This standard requires a demonstration that the device:

- Does not cause unnecessary inconvenience or discomfort including the absence of sharp edges,
- Allows for good circulation,
- Avoids chafing and bruising,
- Has no significant odor,
- Operates at reasonable noise levels,
- Heat emission does not exceed 38 degrees Celsius,
- Does not vibrate above 48dB,
- Complies with radiological standards,
- Does not weigh more than 75 grams,
- Is made from hypoallergenic materials,
- Does not have a volume of greater than 75 milliliters,
- Is unobtrusive,
- Is of a neutral color,
- Does not have a logo, and
- Has a label for contact information that is not obtrusive but is easily seen during use.

The ergonomic standard for the monitoring unit that is ***not*** attached to the client also has heat, weight and other similar specifications.

Standards are established for reliability (no maintenance for six months), identification, robustness, tampering, fitting and removal, and operation (including location, accuracy, audit ability, and warnings). Similarly there are standards for the monitoring units (that address similar dimensions to those for personal units) and for monitoring centers (these address business continuity, backups, accuracy and data presentation). In each case the standard is defined, subcategories identified and testing procedures specified.

All of these standards have been developed from the experience of the last fifteen years and the delineation of the requirements that the enabling statutes and policies have established for community supervision electronic and GPS monitoring. These cold test standards outline a series of requirements that contractors must meet ***before*** they can be considered for use with any of the populations monitored in Great Britain.

In 2003, the Home Office approved a protocol for the hot testing of GPS in community supervision. These tests are designed to assess the tracking systems and to identify problems that can be addressed before larger scale implementation. The tests are primarily designed to test the accuracy of location data, the robustness of the equipment, and the time it takes to register data (including tamper alerts) at the monitoring center. Special attention is given to coverage by area and when entering and leaving buildings. The test involves Passive, Active, and Hybrid tracking. Each test occurs over a five day period with at least five volunteer subjects. Subjects maintain a journal of activities for comparison with the GPS data. The test also addresses battery life under varying conditions of use. GPS polling intervals and uploading are varied during the tests. These tests add to the standards assessments from the cold test to provide a set of performance standards that can be used to select contractors and/or better understand what can be expected from the system. When the testing is completed the results will be used to establish additional performance standards for vendors.

Finally, the National Probation Service has developed a detailed set of operational expectations that are derived from the standards and testing that is used by staff to monitor and assess vendor performance. While these are not generally available, staff have been trained in their use to increase the likelihood of early detection of system problems and vendor noncompliance (Great Britain).

5.2.3 Summary of Standards

There are no national standards for using GPS in community supervision systems. In their absence, jurisdictions have had to develop their own criteria for their programs and for the selection and monitoring of vendors who provide GPS services. For the most part, as happens during the early stages of technology adoption in criminal justice, requirements are established from experience, logic, statutes and policies. As the use of a technology spreads in the field, testing and evaluation begin to appear to assist in the development of standards. In the area of GPS technology this is just beginning. The work to date in Great Britain is well established and very thorough and should be consulted as a good example of how experience and testing can be combined with a thorough assessment of an agency's needs to develop comprehensive and detailed standards and test procedures for GPS use in community supervision systems. While some parts of the tests conducted in New Mexico and Great Britain may be incorporated in the requirements in other jurisdictions, anyone introducing GPS into community supervision should consider the value of cold and hot testing the equipment and systems of their potential vendors to determine how well they conform to local conditions and to the specific programmatic goals established by the agency.

None of the standards to date have incorporated knowledge of the effectiveness of properly implemented and operated GPS community supervision systems. Therefore, the following section looks at the literature of program evaluation, not to assess whether GPS monitoring "works" but to demonstrate why program evaluation and standards setting need to be related.

5.3 Evaluating Community Supervision Programs Involving GPS

Evaluations of the effectiveness of GPS use in community supervision are rare, contradictory, and poorly designed and executed. Far more extensive, but only slightly better in design, are studies of the effectiveness of EM. This section explores why this is the case, the implications of the absence of solid estimates of effectiveness on the improvement of EM and GPS monitoring, and how improved evaluations are related to the goal of standards setting.

EM of offenders has been in place for at least 15 years and according to researchers (Renzema and Mayo-Wilson, 2005) there are approximately 160 studies (for a list of recently published studies see Chapter 7 and Appendix D.) of the relationship between EM and various measures of success (most often recidivism). However, these same researchers conclude that only three of these studies meet the usual scientific standards for evaluation research. The rest are so poorly designed as to render the results of unknown value. Renzema and Mayo-Wilson, after reviewing the three studies, conclude that EM has no overall impact on recidivism. While others may quibble with their interpretation of these three studies (Padgett, et. al. conclude the results are "mixed" or inconclusive), the important point is that the research on EM is weak and does not provide guidance to policy makers on important questions, beginning with the basic one; does it work? In fact Maier, after reviewing studies of EM in Great Britain, concludes that there is "no evidence for its effectiveness and consistent messages about its problems" (2006). Finally, there have been no randomized controlled experiments of EM despite the fact that such a design is understood as the gold standard for research and could easily be done if criminal justice authorities would authorize such a study.

However, even with better research designs, the evaluation of EM and GPS monitoring would be of limited value without attention to the variation in these systems introduced by the standards used by each agency in the selection and monitoring of vendors and the actual operation of such monitoring. All of the research to date treats EM and GPS as a condition that is either present or absent, not as a condition that can vary in time and across jurisdictions. The failure to capture such variations in EM and GPS systems results in studies where the measurement of the intervention is unclear and possibly masks any effects – positive or negative.

Consider the most recent study of EM and GPS monitoring conducted on data from Florida (Padgett, et. al., 2006). This study considers outcome results (revocation for a new offense, revocation for technical violation, and absconding) for 75,661 offenders who were placed on home confinement. Beginning in 1998, Florida expanded its home confinement supervision to include GPS monitoring – EM monitoring had been in use in Florida since 1987. The results of this study, while encouraging (the authors report positive effects of EM and GPS on the outcome measures), are subject to many of the design criticisms mentioned in the broader reviews of this literature. However, the more critical point is the way this study measures EM and GPS monitoring. As the authors explain, "the variable of primary interest ... in this analysis is whether the offender was placed on EM while on home confinement. Two dichotomous, time-varying variables were created to indicate time on EM in any given week – one for RF monitoring and one for GPS monitoring" (Padgett, et. al., 2006:70). Given this approach to measuring the primary independent variable in this study, there is no way to know if variations in the use of GPS monitoring that are sure to exist in time periods and locations (even within one state) had any impact on the results. As Mair (2006: 57) summarizes his analysis of this research:

> *These findings are clear and unequivocal, but they cannot be accepted as definitive. Policy makers cannot conclude from this study that EM "works." Yes, it seems to have worked on this case, for this particular population, at the time the research was carried out. But we know little about the context in which EM was used: Padgett et al. have carried out a careful outcome evaluation, but without a full process evaluation, it is difficult to interpret the results.*

In the language of evaluation research, a process evaluation means a careful description of the characteristics of the intervention. For the use of GPS in community supervision this would include the type of GPS used, operation of GPS (e.g., the conformance with standards), the consistency of the use of GPS

(e.g., down times, location failures and errors, tampering, etc.), management of the use of GPS, and ways in which GPS monitoring is linked to other forms of community supervision and treatment. Simply treating GPS as a dichotomous variable leads to findings without regard for managers and policy makers who have to make decisions about the characteristics of GPS use, not just whether or not it will be used in a jurisdiction.

The failure of evaluation research to attend to the variations in GPS monitoring results from the failure to link standards and evaluation so that more detailed guidance to agencies using GPS can be given; from the fact that most all studies to date have been in one jurisdiction; and because the evaluation design employed involves the use of complex but always incomplete statistical models to make up for the absence of experimental designs. Without experimental designs researchers turn to the use of those control variables that are available to them. These are always incomplete and usually highly correlated, making estimates highly fragile and subject to small changes in the models being estimated. Increasingly in criminal justice research the limits of this approach, especially for program evaluations, have been recognized (Wellford, Pepper and Petrie, 2005). Models that have weak measures of independent variables (e.g., treating GPS as a dichotomous variable), data for multiple time periods, state data that has significant variation within the state, correlated control variables, and control variables that are not selected for strong theoretical reasons will result in fragile, highly variable estimates. Conflicting results from studies can almost be guaranteed as models are modified to include other locations, different time periods, different measures and different controls. The Padgett et al., work is just one more example of the significant limits of this approach.

Those trying to decide how, if, and when to implement GPS community supervision cannot learn much from the existing evaluation literature. However, this does not mean that evaluations of GPS supervision should be abandoned or should not attempt to improve overall understanding of the varying effectiveness of this technology.

5.4 Improving Standards Setting and Program Evaluation for GPS

Initially this chapter began by hoping to identify standards for using GPS in community supervision. The review has identified an emerging set of standards and specifications for their assessment resulting from cold and hot tests of equipment and systems. This has been greatly enhanced by the fact that in almost all instances private vendors are supplying the GPS systems. In order to fairly procure these services and equipment, supervision agencies have had to specify the requirements they desired and ways they will assess conformance with those requirements. As indicated, this approach is well developed in Great Britain but is also occurring in the United States. To date, hot testing has been limited to the issue of whether GPS monitoring systems work in simulated situations. A next logical step would be to hot test for conformance to standards and effectiveness in reaching agency goals.

As discussed previously, existing evaluations of GPS in community supervision are of limited value. Most are poorly designed and even those that are better designed have failed to provide results that are useful to those deciding whether and how to use GPS. Improving evaluation of GPS is another important next step in advancing understanding of the value of this technology.

It is also very likely that until the standards setting process is related to evaluation, standards will make competition fairer but their relationship to achieving an agency's goals will remain unknown. Using better research designs and careful assessments of the way GPS systems are actually used will produce better evaluations and produce results that are helpful in the further development of standards for GPS monitoring.

5.4.1 An Evaluation Design to Improve Evaluations and Align Standards and Agency Goals

In order to improve evaluations and align standards and agency goals, an evaluation design is needed. The basic research design should be a randomized controlled trial (RCT). This design has the advantage of high internal validity and eliminates the need for extensive control variables. When properly implemented this is the strongest possible design to measure program effects. Implementation would require the

agency involved to agree to random assignment of subjects to GPS community supervision and standard supervision. While in the best experimental designs the randomization is done without knowledge to the researcher or the subject (i.e., a "double-blind" design) this obviously could not be achieved in this instance. Random assignment would be to conditions that represent the range of options the agency is willing to consider to achieve their goals. For example, in addition to the control condition, assignment could be to Active, Passive or Hybrid GPS monitoring, would include inclusion/exclusion variation, and would vary the conditions of community supervision that accompany GPS monitoring (e.g., treatment/no treatment; levels of supervision). The more variations in treatment conditions the more complex the design and the greater the need for larger number of subjects in the study. Most likely in the initial stages of this research, variations in treatment conditions would need to be minimized. Once assignment had been made to treatment and control conditions, careful documentation of the quality and quantity of the intervention would be required. For the controls this would be to better understand the degree to which they acquire any of the interventions (treatments) that are assigned to the treated subjects; for the experimenters this would be to measure the integrity of the interventions (e.g., what was the degree of monitoring; were results used as intended; where treatments effectively delivered). In the analysis this would allow for estimates of intervention effects that account for the fact that few human interventions are delivered as designed. The design would have to be committed to the proposition that once a subject is assigned to control or experimental groups they are included in the outcomes for that group ("analyze as you randomize") – too often in RCT's dropouts are eliminated from the experimental groups rendering those groups less accurate compared to the control group. Finally, the outcomes selected to compare experimental and control groups must be directly related to the goals of the agency. Most likely these will include recidivism, violation of conditions of community supervision, failure to appear, and/or absconding from the jurisdiction, depending on the agency and it goals. In addition, agencies will want to see if the costs of the intervention outweigh the benefits of the intervention. The analysis must also include a cost/benefit component.

The cost/benefit component raises another set of issues – what are the costs of not using GPS monitoring? The basic problem here is what would have happened to those on monitoring if this option was not available to the agency. If they would have all gone to community supervision then costs will in every case be greater for the experimental group. For those who would have gone to jail or prison the costs will always be less for GPS monitoring. In the ideal world randomization would be from both potential groups – those who would have had community supervision without GPS and those who would have been incarcerated. If that does not occur then the experimental group costs will have to be estimated with models that include the likelihood that the person would have been incarcerated. For reasons previously discussed, those models are likely to be imprecise and therefore will result in a cost/benefit analysis that is less convincing than the basic outcome results. Even with this uncertainty, implementing this RCT would generate better evaluation results and would assist agencies in setting standards for the use of GPS in community supervision that are related to achieving agency desired outcomes.

CHAPTER 6: LESSONS LEARNED SUMMARY

6.1 Lessons Learned

The purpose of this report has been to identify how community supervision agencies are using GPS so other practitioners may benefit from the experiences and lessons of veteran GPS program administrators, officers, and staff. In addition, by looking at the existing and future state of GPS and location-based tracking technologies along with the efforts at standardization and evaluation, additional lessons can be identified. The key lessons learned derived from interviews, research, and analysis are identified in Table 6-1.

Table 6-1. Lessons Learned

Area of Impact	Description	Lesson(s) Learned
Agency Liability	GPS raises new concerns for an agency in terms of their responsibilities and obligations to victims, the public, and clients.	• The availability of client location data implies an obligation to act upon that data and a failure to act may result in liability. • Near real-time availability of ***Active GPS data*** implies an obligation to react in a timely fashion to Active GPS alerts. • Clearly defined policies and procedures with regard to victim notification should be implemented to mitigate liability. This includes policies related to the amount and type of information the agency shares with a victim about the client, as well as victim responsibilities (e.g., notifying agency of change of address, etc.). • In order to mitigate liability, agencies may consider reviewing all data points, not just alerts. • Not all alerts will result in violations.

Table 6-1. Lessons Learned (continued)

Area of Impact	Description	Lesson(s) Learned
Caseload/ Workload	Caseload reflects the formal number of cases an officer is assigned to supervise, while workload reflects the perceived relationship of the staff member and the task demands. GPS can influence both caseload and workload in unexpected ways.	• Workload issues can be impacted by the choice of monitoring model (i.e., vendor monitoring vs. in-house monitoring, vs. third-party monitoring) and GPS type (i.e., Active, Passive, or Hybrid). • Determining effective caseloads can be challenging during program start-up due to a steep learning curve with GPS. This includes both the technology components as well as evolving processes. • GPS supervision involves more data analysis than traditional supervision, which can lead to the perception of more time-consuming workloads even when the actual time spent may be similar. • GPS data analysis cannot completely replace field work. Thus, officers are challenged to establish a new balance between field and desk activities. • Active GPS workloads can be more time-consuming than Passive workloads. This should be considered when determining caseloads. • Depending on agency GPS program structure and alert response processes, GPS may dictate after-hours staffing requirements. • An agency decision to review all data points (not just alerts) may impact staffing requirements. • Using GPS, officers can verify compliant client behavior with fewer time-consuming field contacts.
Client Accountability	Client accountability reflects the officer's ability to review GPS data to determine where a client has been, and use this information to validate that the client is meeting the conditions of their release.	• GPS data provides agencies with the opportunity to better supervise their clients, not just "monitor" them. • Officers can use GPS information proactively to help guide clients to make better decisions. • Access to objective GPS information provides officers with the ability to ask "hard questions" of their clients. • GPS data can eliminate "he said/she said" situations between a client and victim.

Table 6-1. Lessons Learned (continued)

Area of Impact	Description	Lesson(s) Learned
Client Impact	Client impact is how GPS affects the client both in terms of behavior that the technology evokes, as well as what the technology imposes on the client.	• GPS equipment may be considered obtrusive or disruptive for a client to carry depending on the GPS receiver size and the client's situation. For instance, depending on the client's work, the client may need to continually go outside to acquire a signal, or the equipment may be cumbersome for such jobs as construction. • An agency's view on how GPS equipment impacts the client is often tempered by their criminal justice phase. For instance, pretrial agencies tend to be more concerned with obtrusive or cumbersome equipment, while post-conviction, probation, and/or parole agencies do not. • GPS supervision may impose unique requirements on the client. This includes requirements for such things as a telephone line or fee payment.
Crime Investigation	Crime investigation refers to agency collaboration with law enforcement to identify or exonerate GPS clients as potential suspects in a crime using the GPS data.	• Agencies can provide GPS tracking data to law enforcement to assist with crime investigations. • Crime scene investigation with GPS data requires a high degree of trust and cooperation between corrections and law enforcement agencies. • GPS data can serve to identify clients as suspects as well as exonerate them.
Deterrence/Behavior Modification	The use of GPS to deter behavior is often a primary objective of legislation or policies enacting GPS programs.	• GPS cannot prevent a client from committing a crime. • GPS clients may be less likely to engage in non-compliant activities because they believe they are being observed. • Exclusion zones may deter associations with victims and locations (e.g., known drug areas). • The presence of GPS may discourage a client's former associates (e.g., gang members) from having/maintaining contact with them. • Although agencies believe that GPS serves as a deterrent, in order to ascertain the effectiveness of GPS in deterring behavior, agencies must invest the time and resources necessary to conduct metrics and analysis. • The extent to which GPS modifies client behavior is not yet known. • GPS provides agencies with a viable sanctioning and sentencing alternative while continuing to provide for victim and public safety.

Table 6-1. Lessons Learned (continued)

Area of Impact	Description	Lesson(s) Learned
GPS Components and Technology	GPS components and technology encompass all aspects of the hardware and software of GPS monitoring systems.	• Equipment issues create a gray area in understanding an alert because agencies are often unable to differentiate between equipment issues and client compliance issues. • Equipment issues reduce confidence in the equipment both among agency staff as well as other criminal justice stakeholders (such as law enforcement, judges, lawyers, and the public). • Since GPS operates with complex technology, there are more opportunities for it to fail/break. • Battery maintenance is logistically troublesome. Vendor selection criteria should include investigation of battery life and recharging characteristics, and the availability of field-replaceable batteries. • Before selecting a predominantly Active GPS monitoring model, agencies should consider the availability of reliable cellular coverage in the geographical areas that will be monitored. • Agencies that will use both Active and Passive GPS should consider units that can be switched between both types of monitoring. • Units being considered for selection should be tested in realistic operational scenarios in order to assess their suitability for a specific agency. • Agencies should consider implementing a process to test units for basic functional capability as they are received from vendors in order to avoid equipment failure in the field. • Client compliance with the requirements for equipment handling is critical to properly functioning equipment. • Vendor contracts should contain conditions specifying agency accessibility and use of GPS data.

Table 6-1. Lessons Learned (continued)

Area of Impact	Description	Lesson(s) Learned
GPS Funding and Costs	GPS costs reflect vendor costs, resources, and equipment, as well as comparisons of GPS with other supervision techniques.	• Client-funded programs do not typically collect enough fees to fully fund the program. • Although more expensive than RF and other EM tools, the data that GPS units provide is perceived by some agencies as more valuable in terms of monitoring and supervising a client's behavior. • The high cost of GPS can sometimes be prohibitive to low-income clients. • In addition to vendor costs, GPS operating costs must be included when comparing GPS to other forms of supervision, including incarceration. • Once a program has been implemented using a particular vendor, the cost of switching vendors can be very high. • Depending on the type of GPS implemented and the policies associated with alert response, there may be additional resource requirements associated with GPS beyond merely equipment costs; these include such things as additional staff or extended staff hours and lost/stolen equipment replacement costs. • Establishing and maintaining an agency infrastructure that can support the number of GPS clients is critical and should be considered as part of the overall cost of a GPS program. This includes organizational structures as well as technological considerations such as computers and network capability.

Table 6-1. Lessons Learned (continued)

Area of Impact	Description	Lesson(s) Learned
GPS Stakeholders	GPS stakeholders are defined as those organizations or persons that have a vested interest in the operation of a GPS monitoring program. This includes the supervision agency, judges, lawyers, parole boards, legislatures, victims, the public, and law enforcement.	• GPS cannot protect victims; at best it can provide an early warning of client proximity. • Many stakeholders have misperceptions of what GPS can and cannot do. These often lead to inappropriate legislation, policies, procedures, and judicial application of GPS. • All stakeholders need a common understanding of the capabilities and limitations of GPS (e.g., GPS is ***not*** an "air traffic control" concept of monitoring clients). • In order to overcome the public's false sense of security regarding the preventative capabilities of GPS, the realities of GPS must be accurately publicized. • Agency staff buy-in to the addition of GPS to their supervision toolkit is a key success factor. • The orientation of the agency staff with respect to rehabilitation and enforcement will influence the way that GPS policies are implemented.

Table 6-1. Lessons Learned (continued)

Area of Impact	Description	Lesson(s) Learned
Standards and Evaluation	Standards and evaluation considers the current state of standards and program evaluation for the use of GPS in community supervision.	• No national standards for GPS use in community supervision exist or are likely to emerge in the near future. At this time there is no national organization that is developing standards for the use of GPS in community supervision and the industry supporting GPS monitoring is still in the development stage. Further development must include a rigorous program of cold and hot testing and a program of requirements-related evaluation. • Agencies contemplating implementing GPS monitoring as part of a community supervision program need to develop detailed statements of their goals and develop measurable definitions for these goals. This will facilitate the requirements specifications and selection criteria that will be used in establishing their program. • Agency standards or requirements should include cold and hot testing to assess how well various systems can meet the needs of the agency. When this is done the agency should be better able to structure a program that can achieve its goals. Cold tests done in other agencies will be useful but the results of hot tests are likely to be agency specific, particularly given the potentially unique geographic constraints of a particular agency. • Current evaluations of GPS in community supervision are of limited value. They have been poorly designed and have failed to address important variations in how GPS in community supervision is implemented. • Agencies should consider cooperating with researchers in experimental research that incorporates agency standards for implementation and clear measurement of outcomes related to agency goals. These results will not only inform those seeking answers to the question "Does it work?' but will also help in the further development of outcome related standards. • Expectations concerning the role of GPS in community supervision in reducing jail and prison populations should be clearly articulated during a planning phase and used as a guide is selecting subjects for GPS monitoring. • Well developed standards provide a valuable tool for monitoring vendor performance and anticipating problems of implementation and operation.

Table 6-1. Lessons Learned (concluded)

Area of Impact	Description	Lesson(s) Learned
Training	GPS training often consists of vendor and agency specific training.	• Agency staff should receive "just in time" and/or refresher GPS training to mitigate forgetting what they've learned before using the technology. • In addition to vendor technology training, staff should receive agency-specific GPS policy training. • OJT is an effective supplement to formal vendor and agency policy training. • It is often difficult to ensure a consistent level of product competency across all staff, regardless of training.
Vendor Relationship	Vendor relationship indicates the agency's association with the vendor both in terms of contract specifics and service needs.	• During the vendor selection phase, ensure that the prospective vendors have the number of required GPS units available for both start-up and anticipated growth. • Vendor contracts should include provisions for a vendor's inability to provide required equipmet components in a specified timeframe. • Although an important business process, accurate inventory management is largely unsupported by vendors. Therefore, appropriate resources and/or technology to assist with this task should be considered in planning. • Vendor support is perceived by many agencies as unsatisfactory. This can be mitigated by the presence of an on-site technical vendor representative. • Agencies wish they had included specific provisions (e.g., SLA for problem resolution response time) for vendor support as part of their contract terms. • Request agency references from the vendor and follow-up with them to determine their satisfaction with the equipment, service, and vendor responsiveness. Such references can also serve as good resources during implementation to discuss issues and challenges.

6.2 Key Success Factors

Agency respondents were asked to identify the key success factors for implementing a GPS program, these include:

- **Client Compliance**. Clients that understand the requirements for carrying the equipment and who abide by these conditions are critical to a successful GPS program. This is particularly true in terms of generating fewer alerts and thereby allowing agency staff to focus their attention on legitimate alerts.
- **Client Perception**. A client's perception of GPS and what it can and cannot do may ensure a certain level of success for a program. For instance, clients often find the equipment intimidating and may perceive that it offers a higher degree of monitoring than it actually does (e.g., they believe they are being watched continuously), which may help deter their behavior.
- **Equipment/Vendor Quality**. The quality of the equipment and vendor provided services are imperative to a successful program. Without properly functioning equipment and supportive vendor relationships, a GPS program is unable to operate. In addition, agencies must trust that the equipment works in order for them to have strong commitments to the concept of GPS.
- **Good Education of Stakeholders**. Actively informing criminal justice stakeholders (such as the legislature, judges, parole boards, law enforcement, and the public) about what GPS can and cannot do helps mitigate expectations. When stakeholders truly understand the benefits and limitations of GPS, they help ensure the success of a GPS program.
- **Pilot Programs**. A well-applied pilot program can help ensure the success of a full implementation by allowing staff to learn first hand how GPS equipment operates under real-world conditions with real clients. Such controlled growth of a program provides invaluable experience to both staff and management for planning activities for a full GPS program.
- **Policies and Procedures**. Policies and procedures which outline specific criteria for selecting GPS clients, proper alert responses, and other details of running a GPS program help ensure that staff engage GPS consistently and appropriately. Policies and procedures should also reflect what an agency actually has resources to do; for instance, if there is not enough staff to run 24x7 operations, then policies should reflect that.
- **Staff Knowledge and Dedication**. Respondents overwhelmingly replied that it was the dedication and commitment of their staff that made their GPS supervision program(s) successful. In addition to proper training and staff buy-in, the motivation of staff to learn the new technology and their positive attitude in meeting the challenges of implementation and start-up were critical success factors. To quote one respondent, "It's the people not the software".

6.3 Challenges

Agencies were also asked to identify the most critical challenges they faced during implementation and on-going operations, these include:

- **Client Compliance**. A client must comply with specific requirements for carrying and using their GPS equipment. If equipment is not carried properly or if component warnings and instructions are not followed, reliable GPS data may not be able to be transmitted. Agencies find this to be a constant challenge, particularly as new clients are placed on GPS.
- **Client Selection**. If an agency has the authority to identify or recommend clients for GPS, this can be a challenging task. There are currently no industry guidelines for agencies to use for such selections.
- **Determining Caseload**. Although agencies may speculate that GPS caseloads will be more time consuming than other caseloads, it is challenging to really anticipate the appropriate caseloads for staff until GPS is fully implemented.
- **Equipment Issues**. Agencies are constantly challenged by the GPS equipment. This includes everything from equipment availability to equipment durability and reliability. Agencies must also learn the idiosyncrasies of the equipment which helps them to distinguish between valid alerts and those related to equipment failure or limitations (such as no GPS signal indoors).

- **GPS Stakeholder Education**. Judges, lawyers, legislatures, parole boards, law enforcement, the public, and victims all represent valid stakeholders in GPS monitoring. However, educating these groups as to the real-world capabilities and limitations of GPS is an ongoing effort by agencies. Misperceptions by these groups can impact agencies' efforts to establish successful GPS programs.
- **Imposing Change**. Implementing any new process or technology imposes change on users; some will find the change invigorating while others approach it with apprehension. Implementing GPS into a community supervision program is no different. Management sensitivity to the changes ensures a smoother transition, while inviting staff feedback encourages staff buy-in.
- **Policies and Procedures**. While many policies and procedures for a GPS program can be anticipated and prepared in advance, until a program begins in earnest, it is difficult to know exactly how such guidelines will operate. Agencies must recognize that a certain amount of revision and tailoring of policies and procedures will be ongoing during the initial stages of a program.
- **Training**. While most vendors offer training as part of their vendor fees, agencies find it challenging to ensure that the training is retained by staff and that it is offered in a timely manner. For large programs, it can be especially difficult to schedule training for all staff in a condensed time frame.
- **Victims**. An agency's decisions related to victims both in terms of notification and communications can be challenging due to the apprehension or unwillingness of some victims to cooperate.

6.4 Agency Suggested Improvements

Based on experience with various equipment models and vendors, agencies reported a number of areas where they would like to see improvements and changes to GPS technology, equipment, software, and program operations. This section identifies those suggestions. In addition, suggested improvements to the general concept of location-based technologies are included.

6.4.1 GPS Technology

This section includes agency suggested improvements to the overall technical capabilities of GPS for community corrections use. These include:

- GPS units need to reliably and accurately track clients indoors, underground (e.g., subways), during poor weather conditions, and in urban canyons. This also includes the ability to determine receiver altitude to assist with location placement in multi-story buildings. This also includes eliminating drift and may reflect a need for better GPS signal strength or receiver sensitivity to eliminate interference.
- Resolution of cellular coverage issues, equipment needs reliable network coverage so that Active and Hybrid GPS can reliably transmit data.
- Better transmission speed for alerts. With some vendors, alerts are queued for processing by the vendor's servers from units all over the country; this can cause a time lapse between when the alert occurs and when an officer is notified.
- Ability for alert notices to be sent to wireless devices (besides pagers), preferably ones containing mapping software.
- Passive cellular GPS capability would eliminate the land-line phone requirement that is occasionally an obstacle for some clients while still providing a lower cost and resource alternative to Active GPS.
- An alert that differentiates between a power outage and a straight forward curfew violation.
- Ability to configure the perimeter range for the GPS unit's curfew mode in a client's home. For instance, a smaller perimeter would be more appropriate for an apartment while a larger one more suitable for a farm or large home. Auto detection of the dwelling perimeters would be a great convenience.

6.4.2 GPS Equipment

This section identifies agency suggested improvements related to the GPS hardware, including:

- Easily installed one-piece units that have a good recharging concept and battery life, are reliable, and do not have signal drift issues.

- Easy to install and use hardware (both the GPS unit and bracelet).
- For two piece units, a reduction in the number of alerts due to the RF link between the bracelet and GPS unit.
- Better ability to communicate with clients using LCD and voice communication features.
- Smaller more durable equipment.
- Longer battery life for GPS unit and a battery life indicator on the bracelets.
- Loud siren or other intrusive noise feature on the GPS components when there is an alert (e.g., if the client leaves the unit sitting somewhere and it exceeds the allowable distance from the bracelet). The respondent recommending this indicated they thought it would enhance client compliance.
- Equipment reliability that is independent of the client's actions. Currently, so much of GPS component reliability is dependent on strict carrying compliance by the client.
- Better tamper-proof designs.

6.4.3 GPS Software

Agency suggested GPS software improvements are identified in this section, these are:

- Ability to set detailed, irregularly shaped zones. This includes setting a zone of travel (via personal or public transportation such as a bus) for a work route or other approved trip. In addition, the ability to set irregularly shaped zones in polygons or other odd shapes is desired. Often agencies would like to set an inclusion zone that reflects their jurisdiction, but are unable to do so because the available zone shapes are either rectangular or circular and do not allow for irregularly shaped jurisdictions.
- Ability to specify "warm" zones surrounding "hot zones". The idea is to reduce alerts by allowing a little leeway around an exclusion zone. This may be necessary in cases involving an acceptable travel route that skirts an exclusion zone.
- Ability to apply established zones to more than one client in an efficient manner. For instance, if an agency identifies all the local schools and day care centers as exclusion zones for sex offenders, then these zones should be able to be quickly and easily applied to all sex offender clients.
- More frequent map updates (new neighborhoods are not always available on vendor maps).
- Ability to request an immediate indication of a client's current location, including a satellite view of the location.
- Finer grained map location data such as surrounding points of interest. This includes better integration of Geographic Information System (GIS) information (e.g. location addresses) on tracking maps.
- Ability to visually differentiate a client's data points on different days. For instance, applying different colored points for each day of a client's tracks.
- Ability to distinguish the direction of travel on printed maps. This is very important for cases where the agency must provide the court or parole board with visual proof of a client's location at a certain time.
- Ability within the vendor software to document how a particular alert was handled.
- Ability within the vendor software to document that a particular data point has been reviewed and to provide notations on the applicable action. One agency's policy states that every client point must be reviewed, however, the current software does not provide any capability to notate that all data points were reviewed.
- More robust reporting and analysis (patterns/trends) capabilities in the software, including composite views of all clients. The primary example of trend analysis software is software that highlights client travel paths over time that may indicate a particular pattern of behavior that requires closer investigation.
- More robust management reporting capabilities, agency supervisors need to be able to see that staff are managing their cases effectively.
- Higher level of software reliability.
- Integrated feedback mechanism in the software so that staff can make suggestions that are sent directly to the vendor for review.
- Reliable and "easy to use" inventory software that makes it easier to determine what items are actual inventory and what items are in transit.

6.4.4 Operations

This section identifies suggestions agencies believe would help improve overall operations of a supervision program that utilizes GPS. These include:

- Better inventory coordination and management with the vendor. Need an integrated inventory system that tracks equipment from vendor to agency site(s) and back. Agencies indicated that vendors often counted equipment that was in transit or being repaired as part of the agency's inventory.
- Readily available inventory from the vendor for both start-up and continuing operations.
- Better automated interfaces with law enforcement systems for such features as crime correlation and dispatch.
- Better vendor customer service. Vendors need to be more receptive to agency field experiences and suggestions in order to improve their products.
- Equipment cost reduction.

6.4.5 General Location-Based Technology

This section identifies agency suggestions for improving general aspects of location-based tracking (not necessarily just GPS). These include:

- Many agencies are interested in enhanced GPS concepts, such as those that utilize GPS for outdoor tracking, but switch to a more precise method of tracking for indoor use. Some of these types of technologies are described in detail in Chapter 4.
- An implanted transponder chip that would eliminate the client compliance issues of existing GPS units.
- An integrated physiological response for alerts (e.g., a small shock).
- A single monitoring unit that is capable of numerous EM strategies simultaneously such as RF and automated drug and/or alcohol monitoring. Along with this is the desire for this single model of tracking equipment to be configurable among these options and also between Active, Hybrid, and Passive GPS.
- Agencies would like to see more studies which help identify the most appropriate client populations for GPS monitoring.

CHAPTER 7: REFERENCES

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CHAPTER 8: GLOSSARY AND ACRONYMS LIST

8.1 Glossary

Terms that have been used throughout this report are defined in Table 8-1.

Table 8-1. Glossary

Term/Phrase	Definition
Active GPS Monitoring	In this type of monitoring the GPS device transmits its location at near-real-time intervals (e.g., once every minute).
Alert	This term is defined based on agency interviews. A "raw data" alert transmitted directly from the GPS receiver to the vendor software (e.g., exclusion zone incursion, tamper alarm, low-battery alarm, etc.). An alert is a breach of the GPS software parameters associated with a particular client. Vendors may refer to alerts using the term violation; however, see the definition for *Violation* below.
Analyzed Alert	An alert that has been evaluated for accuracy and validity. This analysis may be conducted by an officer, supervisor, or other staff member. An analyzed alert may also occur when there is a separate monitoring center (i.e., in-house, third-party, or vendor) that first reviews alerts prior to contacting the responsible officer for action.
Bench Test	Refers to tests that are done in simulated conditions without actual users. Bench tests are also referred to as cold tests.
Client	A person who is being monitored by GPS, this includes pretrial defendants and convicted offenders.
Cold Test	Refers to tests that are done in simulated conditions without actual users. Cold tests are also referred to as bench tests.
Dead Reckoning	Provides an estimate of current location derived by applying simple calculations to a last known location, and observed speed and direction.
Differential GPS	Refers to a technique for improving the accuracy of conventional satellite positioning by transmitting a "correction signal" from a fixed ground station that represents the difference between the GPS-derived location of the station and the known location of the station.
Exclusion Zone	A prohibited area for a particular client. This information is configured within the vendor's software to emit an alert when the zone is entered by the client. Exclusion zones are typically used to mark a victim's home or work, or for child sex offenders to mark places frequented by children such as schools and parks.
GPS Implementer/Supervisor	The individuals and/or groups responsible for procurement, process definition, hardware/software installation, maintenance, program management, etc. Also the individuals and/or groups responsible for supervising GPS Officers, and possibly Monitors and/or Technicians. These may or may not be the same person(s).
GPS Monitor	The individuals and/or groups responsible for first-line monitoring/analysis of position logs and alerts transmitted from GPS devices.
GPS Officer	A corrections officer whose primary task is client case management.
GPS Planner/Administrator	The individuals and/or groups responsible for planning, budgeting, policy decisions, legal compliance, etc. of a community corrections program that uses GPS.

Table 8-1. Glossary (concluded)

Term/Phrase	Definition
GPS Technician	The individuals and/or groups responsible for installation, maintenance, inventory, diagnosis, repair, replacement, etc., of GPS field equipment.
Hybrid GPS Monitoring	In this type of monitoring the GPS device transmits its location either on demand or at (semi-)regular intervals that are more widely spaced than real-time (e.g., every four hours).
Inclusion Zone	A prescribed area for a particular client. This information is configured within the vendor's software to emit an alert when the zone is exited by the client. Inclusion zones are typically used to mark a client's home or work, or in some cases the local jurisdiction in which a client resides.
Passive GPS Monitoring	In this type of monitoring the GPS device receives location tracking information, but only transmits a log of locations when hooked to a land-line phone.
Post-Conviction	Refers to the timeframe following conviction, it may include sentencing as well as appeal time. GPS is often used during this time as a sentencing tool in its own right.
Process Evaluation	In the language of evaluation research, this refers to a careful description of the characteristics of the intervention. In the context of GPS in community supervision this includes: the type of GPS used, GPS operations, the consistency of the use of GPS, GPS management, and ways in which GPS is linked to other forms of community supervision and treatment.
Radio Frequency (RF)	Refers to any frequency within the electromagnetic spectrum associated with radio waves ("Radio frequency"). When an RF current and antenna work together a field is created in which data can travel wirelessly. In the context of community corrections, RF is used in technology for house arrest/curfew detention as well as in GPS technology.
Schedule	Within the vendor software, the schedule refers to the approved times and zones in which a client may or may not venture. For instance, an inclusion zone may exist around the client's home, the software associates that inclusion zone as being active during the hours of 7 pm to 7 am. If the client ventures from the home during those hours an Alert would occur.
Self-Discharge Rate	Refers to the rate at which a battery will lose its charge even when "on the shelf" and not being used as a power source for any device.
Standard	Refers to agreed upon characteristics for the design and operation of a GPS monitoring system. A requirement is a term used in contracting that can be related to standards but are usually less developed and universal. These terms are used interchangeably in Chapter 5 to reflect the fact that for GPS monitoring systems little agreement has been reached on the characteristics (other than accuracy) that are essential for their operation.
Violation	This term is defined based on agency interviews. A violation is the result of a client's non-compliance with the conditions of their release. With respect to GPS, a violation is usually the result of an alert that has been analyzed and evaluated to confirm that the client has breached the conditions of their release.

8.2 Acronyms List

ANI	Automatic Number Identification
APPA	American Probation and Parole Association
BI	Behavioral Interventions
CBT	Computer-Based Training
CCJT	Center for Criminal Justice Technology
COTS	Commercial Off-The-Shelf
CSOSA	Court Services and Offender Supervision Agency for the District of Columbia
DGPS	Differential GPS
DoD	Department of Defense
EM	Electronic Monitoring
ESRI	Environmental Systems Research Institute
FDA	Food and Drug Administration
GIS	Geographic Information System
GPS	Global Positioning System or Global Positioning Satellite
HDTV	High Definition Television
IN-WATS	Inward Wide Area Telephone Service
LCD	Liquid Crystal Display
Li-Ion	Lithium Ion
MOU	Memorandum of Understanding
MPD	Metropolitan Police Department (Washington, DC)
NASA	National Aeronautics and Space Administration
NAVSTAR	Navigation Satellite Timing and Ranging
NiCd	Nickel Cadmium
NIJ	National Institute of Justice
NiMH	Nickel Metal Hydride
OEM	Original Equipment Manufacturer
OJT	On-the-Job Training

PDA	Personal Digital Assistant
PIT	Passive Integrated Transponder
RCT	Randomized Controlled Trial
RF	Radio Frequency
RFP	Request for Proposal
SAO	Smithsonian Astrophysical Observatory
SCRAM	Secure Continuous Remote Alcohol Monitoring
SLA	Service Level Agreement
STOP-LLC	Satellite Tracking of People – Limited Liability Company
USNG	United States National Grid
UTM	Universal Transverse Mercator
Wi-Fi	Wireless Fidelity
XML	eXtensible Markup Language

APPENDIX A: PROJECT METHODOLOGY

This project was conceived by the Noblis Center for Criminal Justice Technology (CCJT), the National Institute of Justice (NIJ), and the American Probation and Parole Association (APPA). During the Winter 2006 APPA Training Institute, members of the project team informally discussed the use of GPS in community supervision with various practitioners. This group of practitioners expressed a strong desire to know more about how GPS was being used by other agencies, as well as understanding the lessons learned from other agencies. Based on this interest, NIJ sponsored the CCJT's efforts to conduct a study of how GPS was being used by various types of agencies for community supervision.

Advisory Group

To ensure that the scope and objectives of the study remained consistent with the needs of the field, an Advisory Group was established based on recommendations from NIJ. This Advisory Group consisted of Steve Bock from the Michigan Department of Corrections, Gunnar Knutsen from Montgomery County, Maryland Department of Corrections and Rehabilitation, Joe Russo from the National Law Enforcement and Corrections Technology Center (NLECTC), and Carl Wicklund, the Executive Director of the APPA. The responsibilities of the Advisory Group were to:

- Ensure that project scope and results would add value to the supervision community.
- Assist in selecting agencies for participation in the study.
- Review and provide comments on study materials such as the interview guide, report outline, and final report.
- Attend periodic meetings to evaluate project materials and provide guidance.
- Provide other inputs as needed.

This group met twice, once to discuss and review the proposed interview questions and once to discuss and review the proposed outline for this report. The remaining reviews of study materials, including the review of this report were conducted via email.

Participating Agencies

The CCJT, NIJ, and the Advisory Group determined that in order to solicit lessons learned from agencies it would be most beneficial to interview agencies that had been using GPS in community supervision programs for a lengthy period of time. Mature GPS programs would better reflect the long-term challenges and lessons of a program. Also taken into consideration were the size and nature of the agencies. An effort was made to include a mix of local and state community supervision agencies with one federal agency. Additionally, the group determined that a mixture of agencies with pretrial, probation, and/or parole missions would most benefit practitioners in learning about GPS. The group deliberately decided to exclude juvenile GPS programs due to other potential influences present in juvenile community supervision programs. The final consideration given to selecting agencies was the vendor each agency used. Every effort was made to select agencies that were using various GPS vendors. However, given the evolving nature of the technology and the requirement for selecting mature programs, the variance in vendors was somewhat limited.

Using the previously described criteria, eight agencies were identified for inclusion in the study. The CCJT drafted a letter inviting agencies to participate in the study. Mr. Carl Wicklund of the APPA as well as members of the APPA staff were generous in their efforts to send out this letter to the agencies using APPA letterhead. This decision was made due to the familiarity of agencies with the APPA and Mr. Wicklund. The response was overwhelming with only one agency declining participation. Table A-1 shows the participating agencies and the corresponding interview date(s).[12]

[12]The agency data reflected in this report is accurate as of the date of the interviews identified in Table A-1.

Table A-1. Participating Agencies and Interview Dates

Agency	Interview Date
City and County of Denver, Colorado Electronic Monitoring Program	August 7, 2006
Court Services and Offender Supervision Agency (CSOSA) for the District of Columbia (DC)	May 3 and 18, 2006
Marion County, Indiana Community Corrections	June 29 and 30, 2006
New Mexico Corrections Department	May 25, 2006
Oakland County, Michigan Community Corrections	June 19 and 20, 2006
Texas Department of Criminal Justice	July 11, 2006
US Pretrial Services, Central District of California	August 7, 2006

Interviews

Upon agreement to participate, the CJJT contacted each agency point of contact (POC) (in most cases the Director or other senior management staff) to perform a short phone interview. The phone interviews were conducted to schedule the face-to-face interviews and to facilitate the CCJT team's preparation for those interviews by obtaining preliminary information about their use of GPS. The CCJT requested information on the number and types of defendants/offenders being monitored with GPS, whether Active or Passive GPS was being used, the vendor used, the number of years using GPS, and the stage of use, pretrial, probation, and/or parole. Also discussed at this time was the organizational structure of the agency in terms of staff for the GPS program(s).

The CCJT developed an interview guide for use during the face-to-face interviews that consisted of eight-three unique questions (see Attachment 1 to this Appendix for a list of the interview questions). This guide was reviewed by NIJ and the Advisory Group for completeness, appropriateness, and accuracy in terminology.

In an effort to solicit information from various members of the agencies' staff, five key functional roles were defined. The five key functional roles were:

- **Planners/Administrators**. The individuals and/or groups responsible for planning, budgeting, policy decisions, legal compliance, etc. This group typically consisted of an agency's director or other senior management official.
- **Implementers/Supervisors**. The individuals and/or groups responsible for procurement, process definition, hardware/software installation, maintenance, program management, etc. This group also included the individuals and/or groups responsible for supervising GPS Officers, and possibly Monitors and/or Technicians. In some cases we met with one Implementer and one Supervisor. Implementers and Supervisors were combined into one functional group because their involvement and knowledge of the program lent itself to similar types of questions.
- **Monitors**. The individuals and/or groups responsible for first-line monitoring/analysis of position logs and alerts transmitted from GPS devices.
- **Technicians**. The individuals and/or groups responsible for installation, maintenance, inventory, diagnosis, repair, replacement, etc., of GPS field equipment.
- **Officers**. A corrections officer whose primary task is individual client case management.

Since each agency was structured differently, the classification of interviewees into one or more of the five roles allowed for a structured method of comparing and contrasting collected data. In many cases, an individual fulfilled more than one of the roles. For instance, in several agencies, the Officers also served as Monitors and Technicians.

The CCJT requested to meet with one or more representatives from each applicable functional role. For all agencies except one, each functional role group was interviewed separately from the others. The agency that was not interviewed in this manner was because of time and scheduling constraints on the part of the agency. By interviewing each

functional group separately, members of each role were able to bring their unique perspective to each question. This also allowed the CCJT team to maximize each interviewee's time. Each role was not asked all of the questions, only those questions appropriate to the role or the interviewee's experience were asked (for instance Officers were not typically asked funding and cost questions and Planners/Administrators were not asked about the detailed workings of the vendor software). However, all interviewees were asked the Impacts/Outcomes and Lessons Learned sections of the interview guide.

This methodology for the interviews proved very successful, as it allowed CCJT to obtain data on the unique perspectives of various staff members within each agency's GPS program. Following each interview, the data collected was compiled into a Word document and sent to the senior management POC from each agency for review and comment. All agency comments received were incorporated as appropriate. The data collected from the agency interviews serves as the primary source for Chapter 2, of this report.

Vendors

The CCJT created a survey for distribution to community supervision GPS equipment manufacturers. This vendor survey was created with review and comment by NIJ and the Advisory Group. The CCJT relied on the APPA for distribution of the survey to the vendors. Nine vendors were solicited, with six responding. The vendors responding were:

- Behavioral Interventions (BI)
- iSECUREtrac Corporation
- Omnilink Systems
- Pro Tech Monitoring
- STOP-LLC
- StreeTime Technologies

The vendor survey questions are included as Attachment 2 to this Appendix. The data resulting from the vendor survey was used to develop Chapter 2. Additional information on the participating vendors can be found in Appendix C: GPS Vendors.

Emerging Location-Based Technologies

Throughout the agency interviews, the CCJT team inquired about each agency's methods for learning about new technologies for monitoring clients in community supervision. This information combined with research by CCJT into emerging location-based technologies, served as the basis for Chapter 4 of this report.

Standards and Evaluation Criteria

Chapter 5 was developed following an extensive literature review and assessment of current standards. It contains a description of the standards that have been used in selected locations in the United States and in Great Britain. In addition to describing the development of these standards and their use in managing vendors selected to provide monitoring services, this chapter discusses the role of standards in vendor selection and the relationship between standards and the emerging literature on the evaluation of the effectiveness of EM. The primary method used in the evaluation literature is meta-analysis, a technique that permits pooling of results from multiple studies to increase the confidence one can have in these results. While not the primary focus of the chapter, the results of these evaluations are used to suggest ways in which evaluation results and emerging standards can be related.

APPA Collaboration

During the course of this study, the APPA was in the process of revising their 2002 version of the *Offender Supervision with Electronic Technology* document. In an effort to better serve the supervision community, the CCJT and APPA worked closely during the development of this report and updates to the APPA document. While the APPA document addresses electronic technologies beyond location-based, the authors of both documents feel that these two efforts compliment each other and should serve practitioners in different ways. This study report identifies agency lessons learned and the impacts of implementing GPS in a community supervision program, while the APPA document serves as a hands-on guide to implementing electronic technologies in community corrections. The revised, second edition, *Offender Supervision with Electronic Technology: A User's Guide* will be available to practitioners in 2007. Contact the APPA for further information <*http://www.appa-net.org/*>.

Report Review

Prior to publication of this report, the following groups and organizations were provided an opportunity to review and comment on the draft:

- Advisory Group,
- NIJ Corrections Technical Working Group (TWG),
- NIJ, and
- Participating Agencies.

Based on comments and suggestions from these reviewers appropriate revisions were made.

Attachment 1: Interview Guide

Table A-2 contains the interview questions posed during the agency interviews.

Table A-2. Interview Guide

No.	Question
Program Description	
1	What was the genesis of your decision to use GPS for tracking offenders?
2	How has your use of GPS in your offender monitoring program(s) evolved since you started using it?
3	Describe how GPS is used in your current monitoring program(s).
4	Describe the geographic area in which your agency uses GPS to track offenders (e.g., primarily urban, rural, etc.).
5	How do you incorporate GPS into other offender supervision methods or treatments (e.g., RF, sex offender treatments, etc.)?
6	If they were not being tracked with GPS, would policy or legislation dictate that these offenders be in jail or prison?
7	Describe any partnerships or communication methods you have for sharing offender's GPS data with Law Enforcement or working with Law Enforcement to respond to alerts.
8	Can you provide us with any program documentation? Such as Concept of Operations (CONOPS), policy statements or directives, operations manuals, organization chart, etc.?
9	What are the goals/objectives for using GPS in your offender monitoring program(s)? Do you think these goals/objectives are being met? How do you know?
10	Is there a process for review and assessment of these goals/objectives? If so, describe the process.
11	Describe how the concept of using GPS to track offenders has been communicated to the community, judiciary, legislature, and law enforcement.
12	Has GPS had an impact on the local criminal justice system (e.g., led to more offenders being recommitted to jail or prison due to violating the conditions of their release)?
13	How have liability issues, if any, (i.e., associated with alert handling) impacted the structure of using GPS in your offender monitoring program(s)?
Funding/Costs	
14	What are the source(s) of funding GPS for your program(s)? If you use Active and Passive GPS, do the sources differ?
15	What was the anticipated cost per unit (or cost per day per offender) of your GPS equipment?
16	What is the actual cost per unit (or cost per day per offender) of your GPS equipment?
17	Do you lease or own the GPS equipment?
18	Is your program limited/hampered by lack of budget for additional units?
19	What is the estimated annual cost difference between monitoring versus incarceration?
20	What is the estimated cost difference between GPS monitoring and other monitoring strategies your agency uses (e.g., home detention with RF, drive-by RF, voice recognition, etc.)?
21	Do offenders pay for any costs associated with their participation in a GPS tracking program? If yes, then how do you deal with indigent offenders or offenders who can't pay the full fee? Who determines the fees?
22	If you do charge offenders for GPS, who administers and collects the fees?
23	Are there any additional costs beyond the GPS equipment/service that your agency spends to implement and operate GPS (e.g., overtime, training, additional staff, etc.)? Were these anticipated costs?
24	What percentage of GPS costs are devoted to staff training?
Training	
25	Describe the GPS training that staff is offered (e.g., vendor provided, internal, etc.).
26	How many person-hours of training did each staff member receive when your GPS product was initially deployed?

Table A-2. Interview Guide (continued)

No.	Question
27	In addition to initial training, is there any on-going or supplemental training that is offered? If so, describe.
28	Do offenders, offender's families, and/or victims also receive equipment training? If so, who provides the training?
Officers	
29	How are Officers selected to participate in using GPS to monitor offenders (e.g., volunteer, mandated, etc.)?
30	Describe an Officer's average case load for Active GPS, Passive GPS, and/or no GPS.
Offenders	
31	What types of offenders are tracked using GPS technology, and what were the criteria for choosing those types? Did you specifically use a risk assessment tool or process?
32	Have the criteria been effective in choosing offenders? If not, how would you change them?
33	Do you make any special accommodations for certain types of offenders (e.g., homeless, those without phones, etc.)?
34	What is the average length of time an offender is tracked using GPS?
35	Are offenders required to sign a GPS participation agreement? How is offender compliance with GPS monitoring rules/processes handled (e.g., what happens if it's violated)?
36	How has the use of GPS technology influenced the ways in which an offender's violations are handled?
Technology	
37	Which vendors (and which of their products) do you use?
38	If you conducted tests on the GPS equipment before implementing it, please describe.
39	If you have used other vendors in the past, please describe that experience and why you changed vendors.
40	How much feedback does your GPS equipment provide the offender (e.g., do they receive notification of all alerts, some alerts, none? Can they be contacted via phone, etc.)?
41	Do your GPS products support customization? If so, what customizations have you done? Can you do these customizations yourself, or must they be done by the vendor(s)?

Table A-2. Interview Guide (continued)

<table>
<tr><th>No.</th><th>Question</th></tr>
<tr><td>42</td><td>For the GPS product software you use, please indicate which of the following capabilities are available. If available, then indicate which ones your agency utilizes.
<table>
<tr><th>Profile Configuration</th><th>Available</th><th>Used</th></tr>
<tr><td>Inclusion Zone</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Exclusion Zones</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Offender-Specific Alert</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Priority</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Custom Alert Text/Info</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Custom Alert Recipients</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Other _____</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><th>Position Log</th><th>Available</th><th>Used</th></tr>
<tr><td>Date/Time</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Location</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Other _____</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Mapping Display</td><td>Available</td><td>Used</td></tr>
<tr><td>Movement Path</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Display of Hot Zones</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Display of local points (e.g., schools, parks)</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Other _____</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><th>Reporting</th><th>Available</th><th>Used</th></tr>
<tr><td>Alerts</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Management</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Trends</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Other _____</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><th>Alert Acknowledgement</th><th>Available</th><th>Used</th></tr>
<tr><td>Officer Receipt</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Officer Response</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Offender Receipt</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Offender Response</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Victim Receipt</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Victim Response</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Other _____</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><th>Interfaces</th><th>Available</th><th>Used</th></tr>
<tr><td>Law Enforcement (LE) Crime Incident Data</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>LE Dispatch</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Social Services</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
<tr><td>Other _____</td><td>□ Yes □ No</td><td>□ Yes □ No</td></tr>
</table></td></tr>
<tr><td>43</td><td>What is your agency's access to an offender's historical tracking data? For how long is it available, and where is that data stored? Is it considered proprietary by the vendor?</td></tr>
<tr><td>44</td><td>What is the frequency of GPS equipment failure? (Failure constituting one or more components that require replacement, excluding batteries).</td></tr>
<tr><td>45</td><td>What common types of problems do you experience with offenders trying to circumvent the GPS equipment?</td></tr>
</table>

Table A-2. Interview Guide (continued)

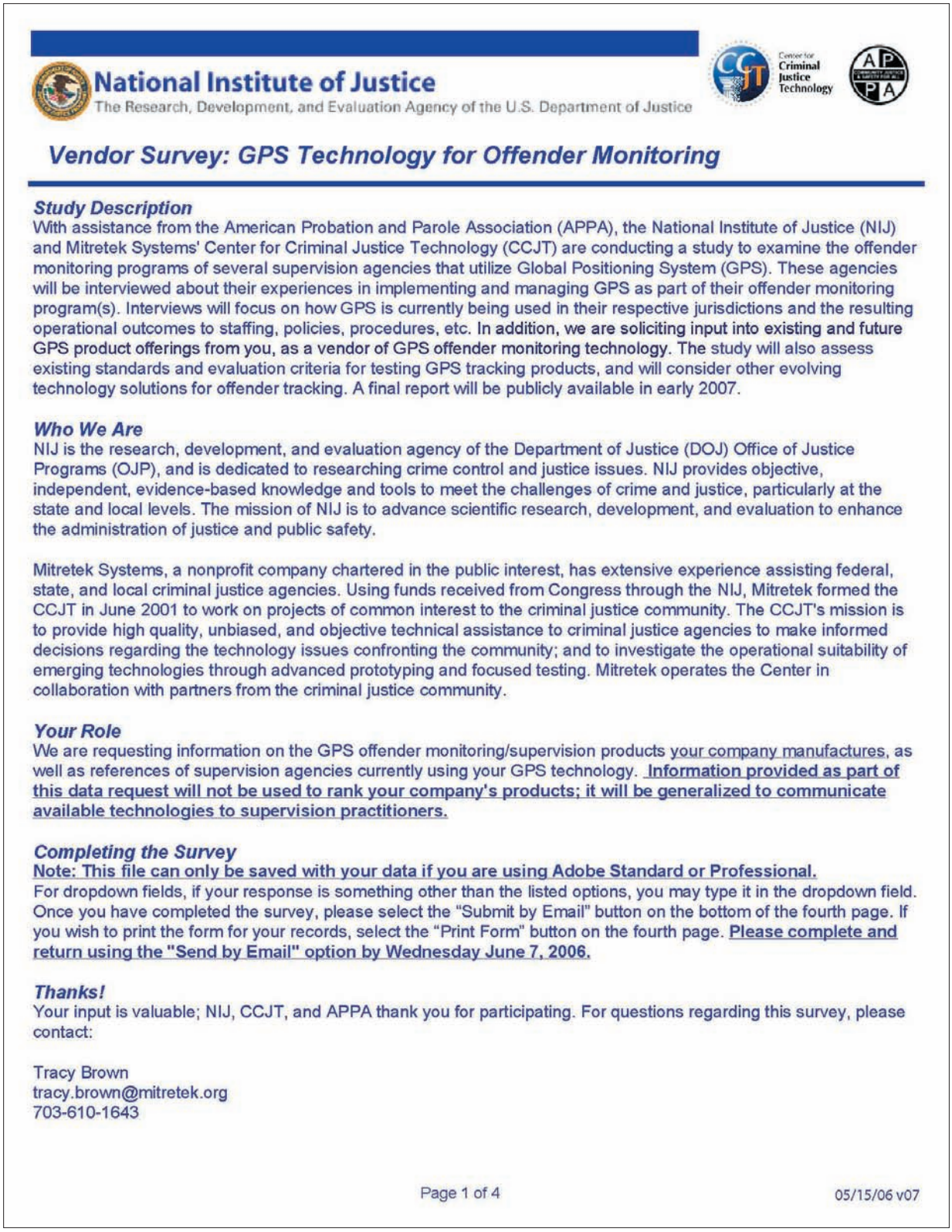
No.	Question
46	Describe your experience with vendor customer support.
47	Describe your experience with internal technical support, if provided.
48	What process do you use to incorporate emerging technology into your offender monitoring program(s)?
49	What do you wish you knew about GPS technology before you incorporated it into your offender monitoring program(s)?
50	What changes to GPS hardware and/or software would improve the effectiveness of your use of the technology?
51	What would you like to see in the future of location-based services, aside from GPS?
52	Discuss/diagram the process flow for each type of alert (e.g., exclusion/inclusion zone, low battery, etc.). Describe frequency of each type of alert.
Standards/Evaluation Criteria	
53	What was the selection process used to determine which GPS product(s) or services your program would use? What were the decision criteria?
54	Which role areas of the agency's staff had input into the product/service selection decision (e.g., monitors, technicians, officers)?
55	Would the development of objective standards and evaluation criteria be beneficial to you in making future GPS technology decisions? Are there specific standards and/or criteria that you would like to see developed?
Operations and Maintenance	
56	What is your process for managing expected equipment maintenance issues (e.g., battery replacement)?
57	What is your process for managing unexpected equipment failures?
58	What is your process for managing lost, stolen, or damaged equipment (e.g., prosecution of offenders, required to pay replacement costs, etc.)?
59	What is the frequency of hardware/software upgrades provided by your GPS technology vendor(s)?
60	What is your GPS equipment inventory management process?
61	Describe any contingency plans you have in place for minor service interruptions (e.g., local power outage).
62	Describe any contingency plans you have in place for major service interruptions (e.g., natural disaster).
63	Describe any contingency plans you have in place for staff shortages.
64	Does your vendor contract include a service agreement? If so, describe.
Legal/Judicial Issues	
65	What legal and judicial considerations have been relevant to the incorporation of GPS into your offender monitoring program(s)? This includes privacy considerations such as the physical privacy of the offender as well as the sharing of GPS data with law enforcement agencies and/or the public.
66	Are the goals/objectives of using GPS as part of your offender monitoring program(s) legislatively or judicially mandated?
67	Is your agency legislatively mandated to use GPS technology, or are the technological requirements defined in the legislation?
68	How do legislative and judicial mandates impact the administration of your program?
69	If an offender violates the terms of their monitoring program and GPS is related, who testifies in court? How is the GPS data used in court?
Impacts/Outcomes	
70	On a scale of 1-5, indicate your impression of how well vendor training prepared your staff to use GPS in their jobs
71	On a scale of 1-5, indicate your impression of how well internal training prepared your staff to use GPS in their jobs
72	On a scale of 1-5, indicate your impression of how well vendor training prepared you to use GPS in your job. (1 = very poorly, 2 = poorly, 3 = neutral, 4 = well, 5 = very well).

Table A-2. Interview Guide (concluded)

No.	Question
73	On a scale of 1-5, indicate your impression of how well internal training prepared you to use GPS in your job. (1 = very poorly, 2 = poorly, 3 = neutral, 4 = well, 5 = very well).
74	On a scale of 1-5, indicate the impact of GPS in assisting with offender supervision. (1 = very negative, 2 = negative, 3 = neutral, 4 = positive, 5 = very positive)
75	On a scale of 1-5 indicate the overall impact of GPS on your workload. (1 = very negative, 2 = negative, 3 = neutral, 4 = positive, 5 = very positive)
76	On a scale of 1-5 indicate the overall impact of GPS on the agency's workload. (1 = very negative, 2 = negative, 3 = neutral, 4 = positive, 5 = very positive)
77	On a scale of 1-5 indicate your perception of how GPS has impacted your ability to do your job. (1 = a lot harder, 2 = harder, 3 = no impact/other, 4 = easier, 5 = a lot easier). If other, please explain.
Lessons Learned	
78	Describe the benefits of GPS tracking compared with other methods your agency currently or previously used.
79	Describe the drawbacks of GPS tracking compared with other methods your agency currently or previously used.
80	What obstacles did you encounter during the implementation and operation of GPS in your offender monitoring program(s)? Which was the most difficult to overcome, and why?
81	What have been the most significant factors in making GPS successful in tracking offenders?
82	What additional information about your GPS program would you like to share with other supervision agencies?
83	Is there anything else you would like to tell us?

Attachment 2: Vendor Survey

Figure A-1, Figure A-2, Figure A-3, and Figure A-4 represent the PDF version of the vendor survey that was distributed to GPS vendors.



National Institute of Justice
The Research, Development, and Evaluation Agency of the U.S. Department of Justice

Center for Criminal Justice Technology

Vendor Survey: GPS Technology for Offender Monitoring

Study Description

With assistance from the American Probation and Parole Association (APPA), the National Institute of Justice (NIJ) and Mitretek Systems' Center for Criminal Justice Technology (CCJT) are conducting a study to examine the offender monitoring programs of several supervision agencies that utilize Global Positioning System (GPS). These agencies will be interviewed about their experiences in implementing and managing GPS as part of their offender monitoring program(s). Interviews will focus on how GPS is currently being used in their respective jurisdictions and the resulting operational outcomes to staffing, policies, procedures, etc. In addition, we are soliciting input into existing and future GPS product offerings from you, as a vendor of GPS offender monitoring technology. The study will also assess existing standards and evaluation criteria for testing GPS tracking products, and will consider other evolving technology solutions for offender tracking. A final report will be publicly available in early 2007.

Who We Are

NIJ is the research, development, and evaluation agency of the Department of Justice (DOJ) Office of Justice Programs (OJP), and is dedicated to researching crime control and justice issues. NIJ provides objective, independent, evidence-based knowledge and tools to meet the challenges of crime and justice, particularly at the state and local levels. The mission of NIJ is to advance scientific research, development, and evaluation to enhance the administration of justice and public safety.

Mitretek Systems, a nonprofit company chartered in the public interest, has extensive experience assisting federal, state, and local criminal justice agencies. Using funds received from Congress through the NIJ, Mitretek formed the CCJT in June 2001 to work on projects of common interest to the criminal justice community. The CCJT's mission is to provide high quality, unbiased, and objective technical assistance to criminal justice agencies to make informed decisions regarding the technology issues confronting the community; and to investigate the operational suitability of emerging technologies through advanced prototyping and focused testing. Mitretek operates the Center in collaboration with partners from the criminal justice community.

Your Role

We are requesting information on the GPS offender monitoring/supervision products your company manufactures, as well as references of supervision agencies currently using your GPS technology. **Information provided as part of this data request will not be used to rank your company's products; it will be generalized to communicate available technologies to supervision practitioners.**

Completing the Survey

Note: This file can only be saved with your data if you are using Adobe Standard or Professional.
For dropdown fields, if your response is something other than the listed options, you may type it in the dropdown field. Once you have completed the survey, please select the "Submit by Email" button on the bottom of the fourth page. If you wish to print the form for your records, select the "Print Form" button on the fourth page. **Please complete and return using the "Send by Email" option by Wednesday June 7, 2006.**

Thanks!

Your input is valuable; NIJ, CCJT, and APPA thank you for participating. For questions regarding this survey, please contact:

Tracy Brown
tracy.brown@mitretek.org
703-610-1643

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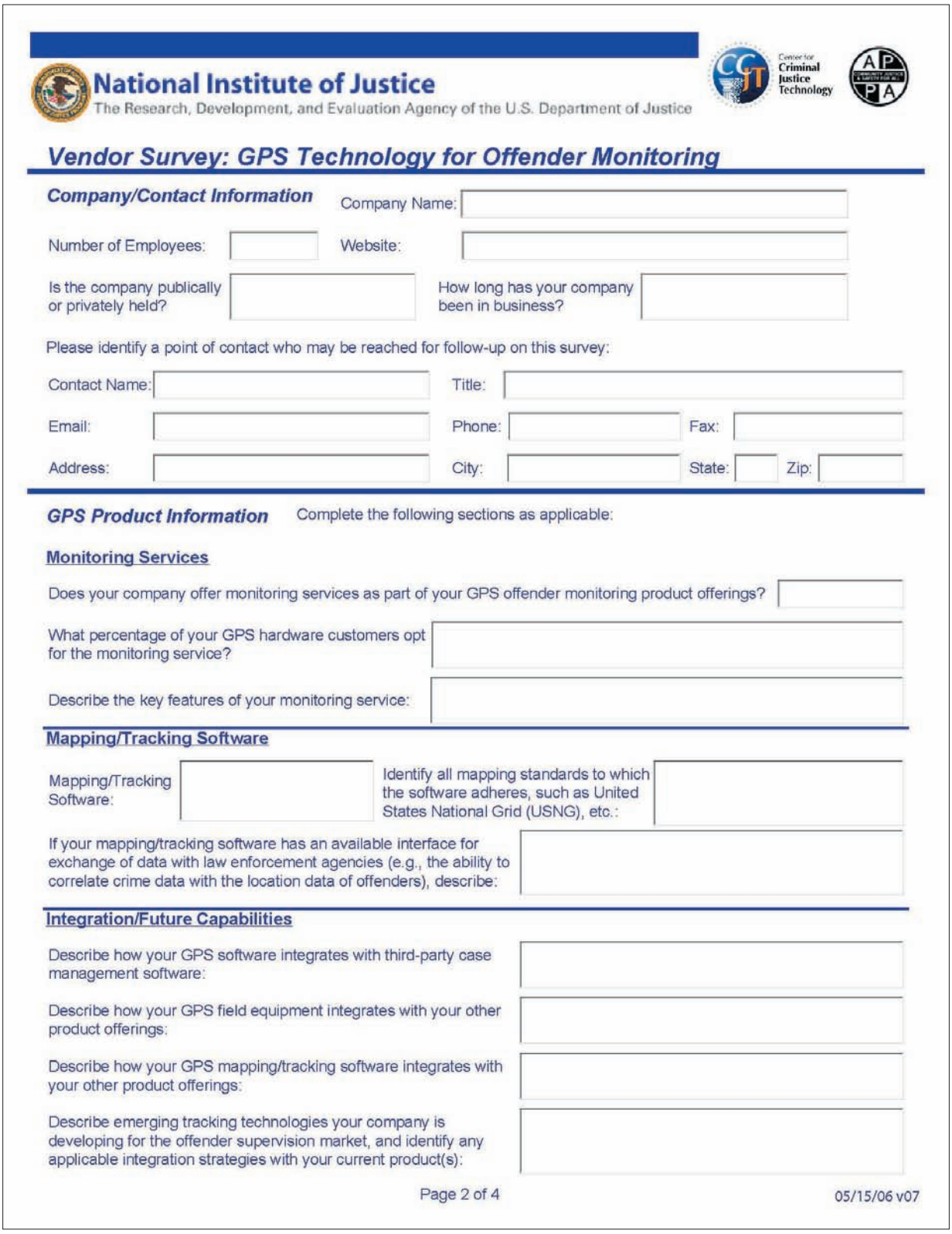
Figure A-1. Vendor Survey – Page 1



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Center for Criminal Justice Technology

Vendor Survey: GPS Technology for Offender Monitoring

Company/Contact Information

Company Name:

Number of Employees: Website:

Is the company publically or privately held? How long has your company been in business?

Please identify a point of contact who may be reached for follow-up on this survey:

Contact Name: Title:

Email: Phone: Fax:

Address: City: State: Zip:

GPS Product Information

Complete the following sections as applicable:

Monitoring Services

Does your company offer monitoring services as part of your GPS offender monitoring product offerings?

What percentage of your GPS hardware customers opt for the monitoring service?

Describe the key features of your monitoring service:

Mapping/Tracking Software

Mapping/Tracking Software:

Identify all mapping standards to which the software adheres, such as United States National Grid (USNG), etc.:

If your mapping/tracking software has an available interface for exchange of data with law enforcement agencies (e.g., the ability to correlate crime data with the location data of offenders), describe:

Integration/Future Capabilities

Describe how your GPS software integrates with third-party case management software:

Describe how your GPS field equipment integrates with your other product offerings:

Describe how your GPS mapping/tracking software integrates with your other product offerings:

Describe emerging tracking technologies your company is developing for the offender supervision market, and identify any applicable integration strategies with your current product(s):

Page 2 of 4

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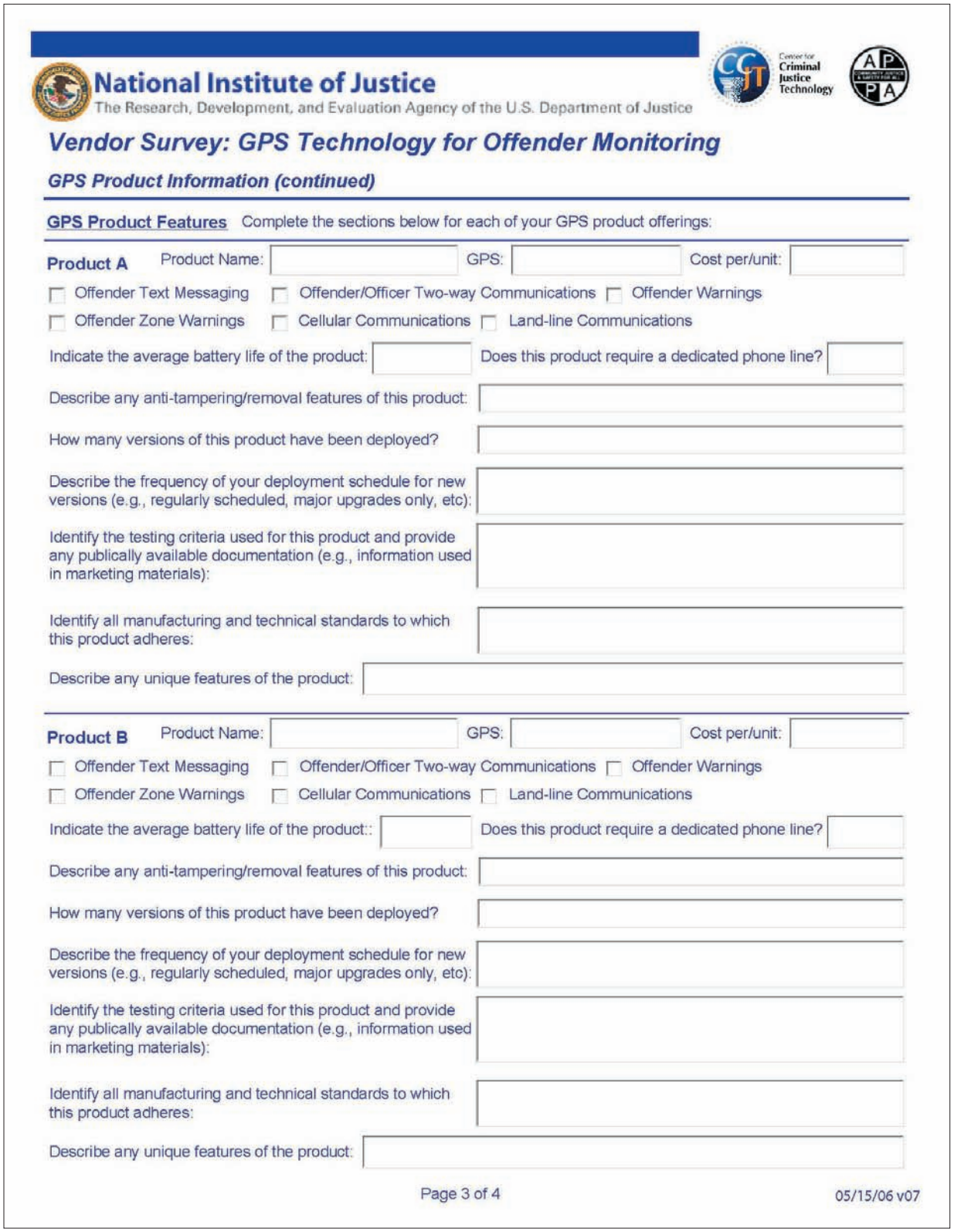
Figure A-2. Vendor Survey – Page 2



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Vendor Survey: GPS Technology for Offender Monitoring

GPS Product Information (continued)

GPS Product Features Complete the sections below for each of your GPS product offerings:

Product A Product Name: GPS: Cost per/unit:

☐ Offender Text Messaging ☐ Offender/Officer Two-way Communications ☐ Offender Warnings
☐ Offender Zone Warnings ☐ Cellular Communications ☐ Land-line Communications

Indicate the average battery life of the product: Does this product require a dedicated phone line?

Describe any anti-tampering/removal features of this product:

How many versions of this product have been deployed?

Describe the frequency of your deployment schedule for new versions (e.g., regularly scheduled, major upgrades only, etc):

Identify the testing criteria used for this product and provide any publically available documentation (e.g., information used in marketing materials):

Identify all manufacturing and technical standards to which this product adheres:

Describe any unique features of the product:

Product B Product Name: GPS: Cost per/unit:

☐ Offender Text Messaging ☐ Offender/Officer Two-way Communications ☐ Offender Warnings
☐ Offender Zone Warnings ☐ Cellular Communications ☐ Land-line Communications

Indicate the average battery life of the product:: Does this product require a dedicated phone line?

Describe any anti-tampering/removal features of this product:

How many versions of this product have been deployed?

Describe the frequency of your deployment schedule for new versions (e.g., regularly scheduled, major upgrades only, etc):

Identify the testing criteria used for this product and provide any publically available documentation (e.g., information used in marketing materials):

Identify all manufacturing and technical standards to which this product adheres:

Describe any unique features of the product:

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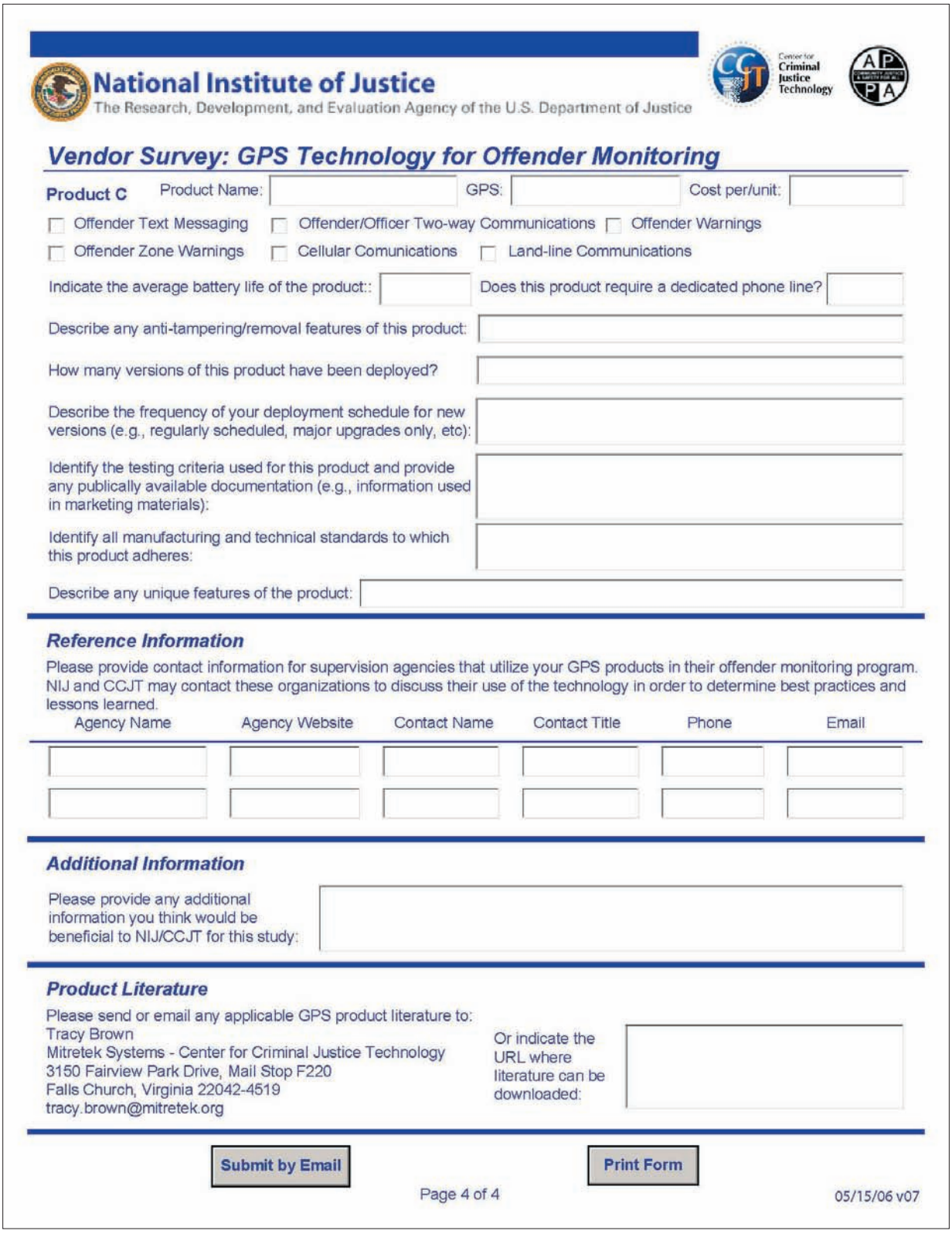
Figure A-3. Vendor Survey – Page 3



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Center for Criminal Justice Technology

Vendor Survey: GPS Technology for Offender Monitoring

Product C Product Name: GPS: Cost per/unit:

☐ Offender Text Messaging ☐ Offender/Officer Two-way Communications ☐ Offender Warnings
☐ Offender Zone Warnings ☐ Cellular Comunications ☐ Land-line Communications

Indicate the average battery life of the product:: Does this product require a dedicated phone line?

Describe any anti-tampering/removal features of this product:

How many versions of this product have been deployed?

Describe the frequency of your deployment schedule for new versions (e.g., regularly scheduled, major upgrades only, etc):

Identify the testing criteria used for this product and provide any publically available documentation (e.g., information used in marketing materials):

Identify all manufacturing and technical standards to which this product adheres:

Describe any unique features of the product:

Reference Information

Please provide contact information for supervision agencies that utilize your GPS products in their offender monitoring program. NIJ and CCJT may contact these organizations to discuss their use of the technology in order to determine best practices and lessons learned.

Agency Name	Agency Website	Contact Name	Contact Title	Phone	Email

Additional Information

Please provide any additional information you think would be beneficial to NIJ/CCJT for this study:

Product Literature

Please send or email any applicable GPS product literature to:
Tracy Brown
Mitretek Systems - Center for Criminal Justice Technology
3150 Fairview Park Drive, Mail Stop F220
Falls Church, Virginia 22042-4519
tracy.brown@mitretek.org

Or indicate the URL where literature can be downloaded:

Submit by Email Print Form

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Figure A-4. Vendor Survey – Page 4

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APPENDIX B: PARTICIPATING AGENCIES' SUMMARIES

Appendix A: Project Methodology describes in detail the methodology used to identify agencies for inclusion in the project study. Of the eight agencies invited for inclusion in the study, seven agreed to participate; Figure B-1 identifies the participating agencies.

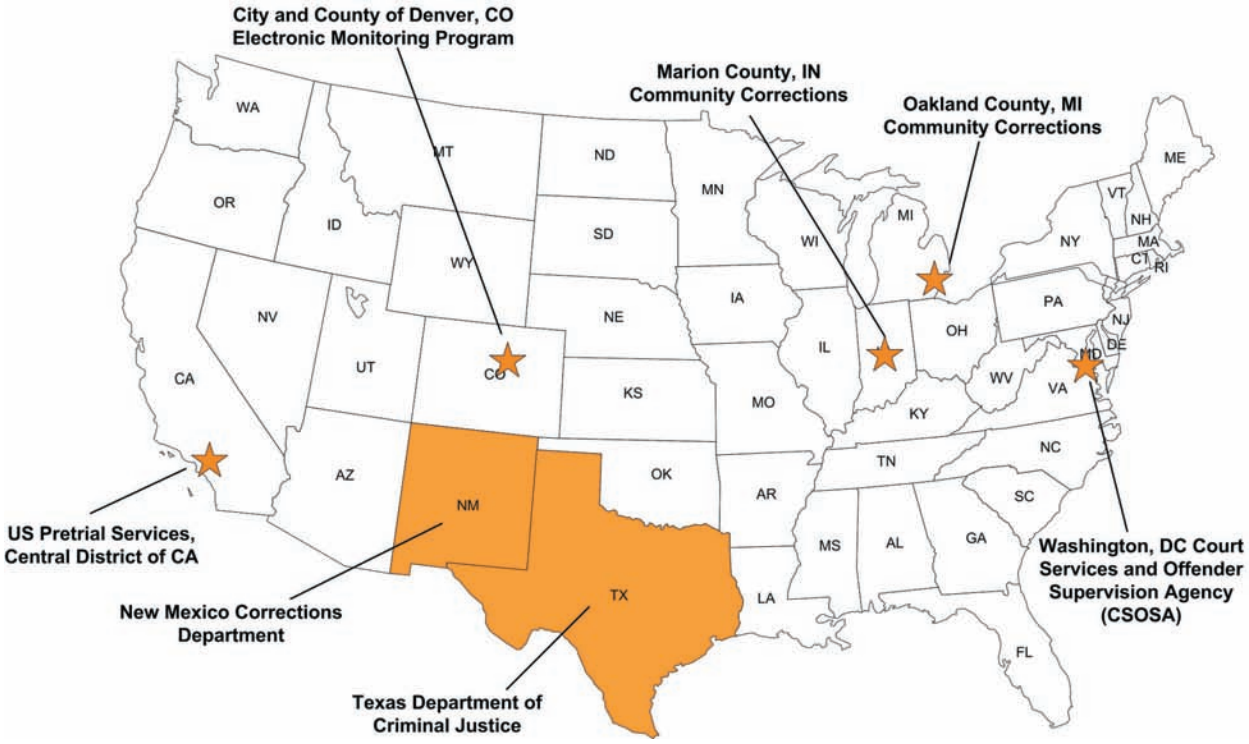


Figure B-1. Participating Agencies

Table B-1 contains summary level information on each agency that participated in the study. The information provides an overview of each agency's use of GPS.

Table B-1. Agency Summaries

Agency	Years	Clients Per Day	GPS Type	Program Type	Type of Clients	Vendor(s)
City/County of Denver Electronic Monitoring Program	5	54	63% Active 37% Passive	10-20% of clients are pretrial defendants who are generally placed on Active GPS. Remaining percentage of clients are post-conviction (generally probationers or as an alternative to a jail sentence) and are usually placed on Passive GPS.	Pretrial defendants typically have victims (sexual assault, murder, etc.). Post-conviction is a variety based on judges discretion.	iSECUREtrac – Active BI – Active and Passive

Table B-1. Agency Summaries (continued)

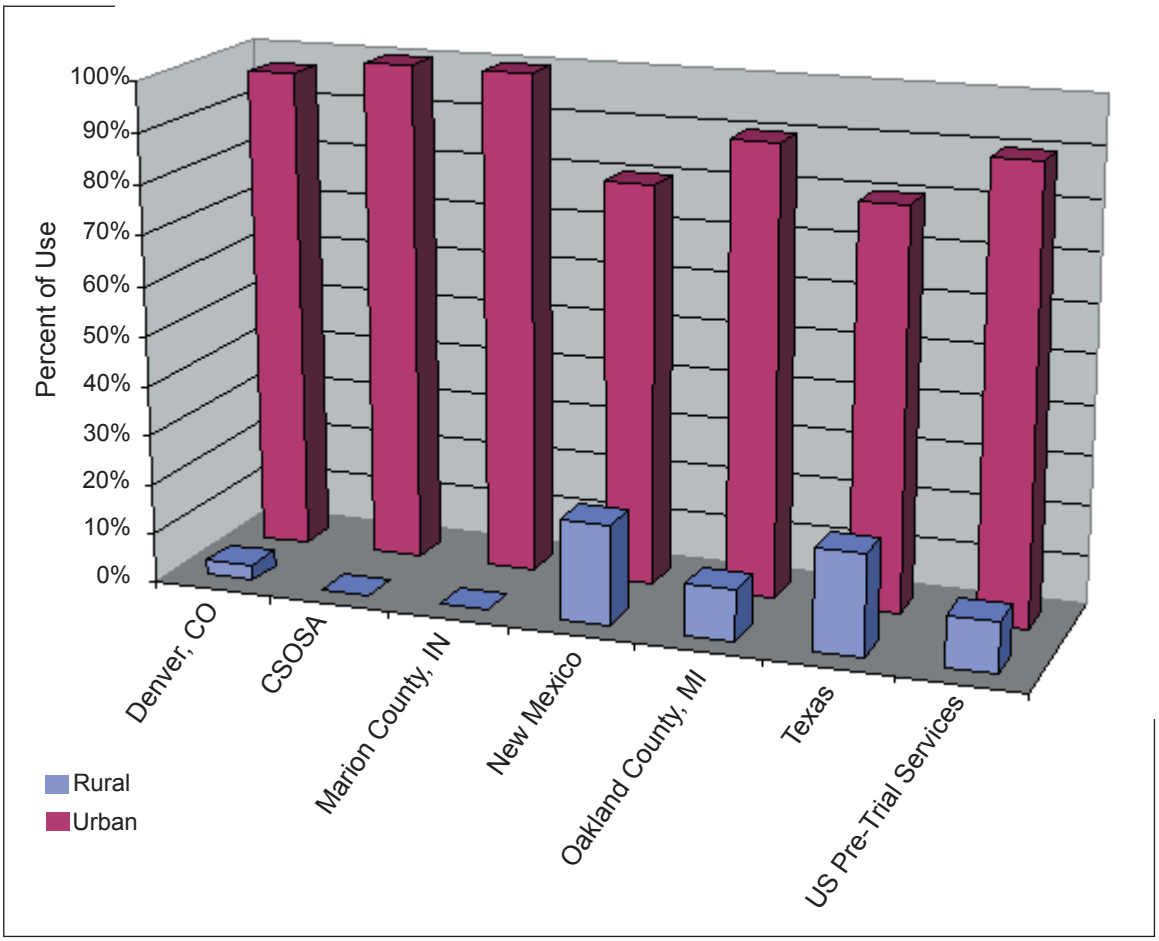
Agency	Years	Clients Per Day	GPS Type	Program Type	Type of Clients	Vendor(s)
Court Services and Offender Supervision Agency (CSOSA) for the District of Columbia (Washington, DC)	3	100	100% Active	Probation and Parole Considering using GPS for pretrial in future.	Primarily sex offenders, but also domestic violence, substance abusers, mental health clients, and other violent offenders.	STOP-LLC
Marion County, Indiana Community Corrections	7	222	90% Active 10% Passive	72% are pretrial defendants placed on Active GPS. 28% are post-sentence and Probation. Post-sentence refers to someone whose sentence is GPS monitoring.	Violent offenders are legislatively mandated to be tracked with GPS. These are "1806s", people convicted of armed robbery, burglary, and other violent offenses. Also track domestic violence, and other violent offenders. GPS is used in conjunction with Radio Frequency (RF) as a reward for good behavior.	Pro Tech
New Mexico Corrections Department	7	350-400	2% Active 98% Passive	Probation and Parole	72% are sex offenders and 28% are high-risk repeat offenders (part of the Intensive Supervision Program (ISP)).	Pro Tech
Oakland County, Michigan Community Corrections	10	50-60	90% Active 10% Passive	Pretrial	Domestic violence, some drug defendants.	Outsource complete operations of GPS to external vendors. These vendors use Pro Tech and iSECUREtrac.
Texas Department of Criminal Justice	6 for Active 2 for Passive	1538	2% Active 98% Passive	Parole	Approximately 50% are sex offenders, the rest are violent offenders.	Current vendor is Group 4 Securicor (G4S) and Pro Tech is the supplier of equipment.

Table B-1. Agency Summaries (concluded)

Agency	Years	Clients Per Day	GPS Type	Program Type	Type of Clients	Vendor(s)
United States (US) Pretrial Services – Central District of California	5	180-190	20% Active 80% Passive	Federal Prison	Gang members, drug dealers, sex offenders, computer fraud, identity theft, white collar crimes.	Sentinel

Figure B-2 depicts each agency's use of GPS in rural and urban environments in terms of the total percentage of GPS use.

Figure B-2. Geographic Distribution of GPS Use



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APPENDIX C: GPS VENDORS

Summary

This appendix contains the GPS vendor survey responses obtained from vendor surveys received in the summer of 2006[13]. Although the information has been formatted for inclusion in this report, the actual content is unedited and represents exactly the responses the vendors provided.

Table C-1. Participating GPS Vendors and Products

Vendor Name & Web Site	Products
BI Incorporated *www.bi.com*	ExacuTrack AT ExacuTrack On-Demand ExacuTrack Passive
iSECUREtrac Corporation *www.isecuretrac.com*	Cellular Passive Personal Tracking Unit Passive Personal Tracking Unit Active Personal Tracking Unit
Omnilink Systems, Inc. *www.omnilinksystems.com*	Omnilink i
Pro Tech Monitoring, Inc. *www.ptm.com*	MTD ActivePTD
Satellite Tracking of People LLC *www.stopllc.com*	CellTag BluTag
StreeTime Technologies *www.streetimetechnologies.com*	StreeTime Tracker

[13]Information obtained from the vendor surveys is intended to reflect the state of the vendor's products at the time of the survey in the summer of 2006.

BI Incorporated

BI Incorporated Overview		
Information Category		**Vendor Response**
Business Years		36 Years
Employees		500+
Public/Private		Private
Monitoring Services		Providing corrections officers with assistance regarding client case load, alert management and response.
Product Integration	GPS Software to 3rd-Party Case Management	BI utilizes Microsoft SQL that can be configured to export the critical data to an agency's crime database for analysis.
	GPS Software to your other products	BI offers a single monitoring platform for an agency's needs, enabling officers to monitor a variety of case loads - including RF, Passive, On-Demand and Active.
	GPS Hardware to your other products	One transmitter can serve to monitor as an RF only, Passive, On-Demand or Active tracking device.
Mapping Software	Mapping Technology	Microsoft MapPoint
	Grid Standard	Please contact Microsoft
	Correlation with Crime Data	BI utilizes Microsoft SQL that can be configured to export the critical data to an agency's crime database for analysis.
Emerging Technologies		Proprietary Information

BI Incorporated Products		ExacuTrack AT	ExacuTrack OnDemand	ExacuTrack Passive
Product Feature Category				
Description		Further information about the products features can be found at *www.bi.com/* Click on products/services for details.		
GPS Type		Active	Active/Passive Hybrid	Passive
Communications	Cellular	Yes	Yes	No
	Land Line	Yes	Yes	Yes
	Dedicated Phone Required	No	No	Yes
	Two-Way	No	No	No
	Text Messages	Yes	Yes	No
	Zone Warnings	Yes	No	No
	Other Warnings	Yes	No	Yes
Cost Per Unit		Contact Vendor		
Average Battery Life		1+ Years	1+ Years	1+ Years
Anti-Tamper Features		Dual tamper technology in the transmitter and multiple layers of tampers in the handheld devices.		

iSECUREtrac Corporation

iSECUREtrac Corporation Overview	
Information Category	**Vendor Response**
Business Years	10 Years
Employees	70
Public/Private	Public
Monitoring Services	We offer three levels of Monitoring Center intervention as well as local support services that an agency may choose from to meet their specific needs. 1st Tier Monitoring – iSECUREtrac will be the first responder to violations after hours and on weekends and holidays. Monitoring Center staff will evaluate violations according to each agency's specific protocol. Minimum data entry will also be included. This level will allow for the Monitoring Center staff to contact the offender to evaluate the status of the violation and report to agency officers based on specific policies and procedures set in place by the agency. 2nd Tier Monitoring – iSECUREtrac will be the first responder to select violations 24 hours a day, 7 days a week. Monitoring Center staff will provide all Tier 1 services 24/7. Additionally, Monitoring Center staff will be available to perform data entry for new offender set-up, entry of approved schedule changes, as well as telephone communication with the offenders relating to program instructions, schedule changes, movement violation troubleshooting and communications with corrections and law enforcement officials on noncompliance. 3rd Tier Monitoring – iSECUREtrac will fulfill all duties that fall under Tiers 1 and 2.Tier 3 Monitoring also allows for the Monitoring Center staff to impose sanctions for the client based on very specific criteria that the agency and iSECUREtrac will work together to develop. This will give the officers the knowledge that offenders that are not being compliant will have their conditions altered. Install/De-install Services – iSECUREtrac provides onsite services for managing the complete installation and de-installation of monitoring equipment. This service may include the computer entry of offender information, implementation of curfew and 24/7 location requirements, the actual installation and troubleshooting of the monitoring system hardware, the field management of the hardware, the removal of the hardware from the offender after the completion of his electronic monitoring sentence, the management of shelf hardware, and shipping and receiving of equipment to and from the agency's location. Offender Billing Services - iSECUREtrac offers to our agencies an Offender Billing Program under which iSECUREtrac will directly bill designated offenders identified by the agency on a monthly basis and manage payment receipts for the agency. This program allows the agency to assign a unique daily billing rate to each offender they are monitoring. iSECUREtrac will generate monthly statements to be sent to the offenders. These statements will identify the monthly balance due and instruct the offender to remit payment directly to iSECUREtrac in the form of a money order or cashier's check. Any payments received from offenders during any given month will be shown as a credit on the agency's invoice for the current billing cycle. iSECUREtrac will provide a monthly statement to the agency which reflects all offender billings to date and offender receipts to date to aid in the collection efforts of the agency. Case Management Services – iSECUREtrac offers case management services depending on the individual agency needs, with onsite personnel and private local office facilities. These services are identified and priced on a "per customer need" basis and will usually include install and de-install services as well as 1st 2nd, or 3rd tier monitoring.

iSECURETrac Corporation (continued)

iSECURETrac Corporation Overview		
Information Category		**Vendor Response**
Product Integration	GPS Software to 3rd-Party Case Management	Our system has integrated Web services that allow agencies to pull violations and tracking data to or from our server in any required format. This allows for the seamless movement of caseload information between our system and compatible case management software.
	GPS Software to your other products	iSECURETrac is the only company to offer a comprehensive Web-based host software and user interface application, known as tracNET24, to manage passive GPS, active GPS, and House Arrest/RF monitoring hardware all in the same user interface without ANY other intervention or monitoring center.
	GPS Hardware to your other products	iSECURETrac provides a single hardware platform that can be used for House Arrest/RF, passive GPS, and active GPS monitoring. This system does not need changing of equipment in the field; instead, modifications to monitoring efforts are changed in our integrated, Web-based software system.
Mapping Software	Mapping Technology	AltaMap
	Grid Standard	AccuGlobe
	Correlation with Crime Data	Yes, our software allows for the exchange of data with law enforcement agencies and the ability to correlate crime data with the location data of offenders.
Emerging Technologies		We continually incorporate new technology advances in areas such as enhanced GPS systems, wireless communications and alcohol sensing. We will be introducing the most advanced GPS monitoring solutions at the July APPA meeting.

iSECURETrac Corporation Products		Cellular Passive Personal Tracking Unit (2150C)	Passive Personal Tracking Unit (2150L)	Active Personal Tracking Unit (2250L)
Product Feature Category				
Description		1) The active device provides the fastest response time of anything on the market, 2) Utilizes on-board processing to record data, regardless of wireless availability, 3) Records tracking points at an industry-best once every 10 seconds, and 4) Is the only true Web-based platform for handling active GPS, passive GPS, and house arrest/RF under a single interface. The latest Passive Cellular GPS, Passive GPS, and Active GPS units feature an LCD screen display and have programmable features on what information can be displayed. These new units offer the ability to provide direct officer feedback pertaining to installations/de-installations, the ability to provide direct offender feedback to the offender during violations, and the ability to send text messages to the offender. The amount of information provided is selectable and can be customized based upon an agency's needs and desires.		
GPS Type		Active/Passive Hybrid	Passive	Active
Communications	Cellular	Yes	No	Yes
	Land Line	No	Yes	Yes
	Dedicated Phone Required	No	Yes	No
	Two-Way	No	No	No
	Text Messages	Yes	Yes	Yes

iSECURETrac Corporation (concluded)

iSECURETrac Corporation Products Product Feature Category		Cellular Passive Personal Tracking Unit (2150C)	Passive Personal Tracking Unit (2150L)	Active Personal Tracking Unit (2250L)
Communications	Zone Warnings	Yes	Yes	Yes
	Other Warnings	Yes	Yes	Yes
Cost Per Unit		Contact Vendor		
Average Battery Life		16-30	16-30	16-30
Anti-Tamper Features		iSECURETrac's products feature the best tamper detection available. The PTU is equipped with a tamper notification system that alerts the monitoring personnel by choices of fax, e-mail, page, or text message, of any attempts to open the unit or alter the routine operation of the unit. This includes opening the case and the removal of the battery. Transmitter straps have visual, electrical, and fiber optic tamper detection features.		

Omnilink Systems, Inc.

Omnilink Systems, Inc., Overview		
Information Category		**Vendor Response**
Business Years		Since 2003
Employees		25
Public/Private		Privately Held
Monitoring Services		Yes
Product Integration	GPS Software to 3rd-Party Case Management	None at present. Evaluating for future integration.
	GPS Software to your other products	Omnilink's Focalpoint software not only integrates with the Omnilink i offender monitoring device, but will also integrate with cell phones that are GPS enabled for tracking/mapping applications.
	GPS Hardware to your other products	Omnilink's offender monitoring device may be integrated with existing cell phone technologies for victim and witness notifications. The Omnilink solution allows for mobile exclusion or inclusion zones.
Mapping Software	Mapping Technology	ESRI Mapping Software
	Grid Standard	ESRI Standards
	Correlation with Crime Data	Not at present. Evaluating for future integration.
Emerging Technologies		Omnilink is the only company to develop a product for the offender supervision market using AFLT technology, which is a combination of GPS, AGPS and cellular technology, that allows the device to obtain location data inside impaired environments. (such as buildings, trains, buses, etc.).

Omnilink Systems, Inc., Products		Omnilink i
Product Feature Category		
Description		Product Obtains Location Data in Impaired Environments, Single Ankle Worn Device (eliminates transmitter away alerts), Mobile Zone Capabilities, Can be integrated with GPS enabled cell phones.
GPS Type		Active
Communications	Cellular	Yes
	Land Line	No
	Dedicated Phone Required	No
	Two-Way	No
	Text Messages	No
	Zone Warnings	No
	Other Warnings	No
Cost Per Unit		Contact Vendor
Average Battery Life		2-3
Anti-Tamper Features		Device Tamper (device opened), Strap Tamper (strap compromised)

Pro Tech Monitoring, Inc.

Pro Tech Monitoring, Inc., Overview		
Information Category		**Vendor Response**
Business Years		11 Years
Employees		60
Public/Private		Private
Monitoring Services		Internet based software access to enroll, schedule, and update offender information. 24x7 Call Center. Many Reports some sent automatically and some interactive over the internet. Rule violations automatically sent (in real-time) via email, SMS, Pager network, or Fax.
Product Integration	GPS Software to 3rd-Party Case Management	PCE provides simple integrated case management capability. We also provide custom extracts for customers.
	GPS Software to your other products	We are capable of accepting Lan/Lon from other products and integrating these points for crime scene correlation.
	GPS Hardware to your other products	We provide custom Lat/Lon extracts for customers to use with their own GPS software.
Mapping Software	Mapping Technology	Custom Developed: Pro Tech using a variety of map data sources. Interactive maps allow animating offender points on the map displaying many status features with each Lat / Lon point.
	Grid Standard	Data conforms to WGS84.
	Correlation with Crime Data	Yes. Custom but simple data dictionary for Law Enforcement to send in crime scene data. Correlation results in automatic emails linking 'Hits' to interactive mapping Web site.
Emerging Technologies		We are constantly improving our Active and Passive product lines and continue to develop interfaces to other mapping engines. We recently upgraded our primary database servers using one of the most advanced database products available today.

Pro Tech Monitoring, Inc., Products		MTD	ActivePTD
Product Feature Category			
Description			
GPS Type		Active/Passive Hybrid	Active
Communications	Cellular	Yes	Yes
	Land Line	Yes	Yes
	Dedicated Phone Required	No	No
	Two-Way	Yes	Yes
	Text Messages	Yes	Yes
	Zone Warnings	Yes	Yes
	Other Warnings	Yes	Yes
Cost Per Unit		Contact Vendor	
Average Battery Life		48 Hrs.	18 Hrs.
Anti-Tamper Features		Tamper Detection, Motion Detection, Strap Detection.	Tamper Detection, Motion Detection, Strap Detection, Unable To Connect Detection.

Satellite Tracking of People LLC (STOP-LLC)

STOP-LLC Overview		
Information Category		**Vendor Response**
Business Years		2 years
Employees		28
Public/Private		Privately Held
Monitoring Services		Violation follow-up and confirmation, victim notification
Product Integration	GPS Software to 3rd-Party Case Management	None available at this time, but working with case management companies on integration. Should be complete by Q4 2006.
	GPS Software to your other products	N/A
	GPS Hardware to your other products	N/A
Mapping Software	Mapping Technology	Custom designed and developed.
	Grid Standard	Latitude/longitude, use tools to convert to USNG and other state grids.
	Correlation with Crime Data	Exclusive Licensee under US Patent No 6,405,213 and US Patent No 5,867,103 which, among other areas, provides patent protection to provide automated crime scene correlation (ACSC). ACSC relates to a system which automatically extracts crime data from law enforcements' RMS system and automatically compares this crime data to the time and date of offenders monitored under GPS, resulting in an automatic reporting to law enforcement of any "crime hits" which result from this comparison and correlation.
Emerging Technologies		Confidential

STOP-LLC Products		CellTag	BluTag
Product Feature Category			
Description		Utilizes Sprint Nextel's walkie-talkie feature to communicate with offenders.	Only commercially proven one-piece active tracking device.
GPS Type		Active	Active
Communications	Cellular	Yes	Yes
	Land Line	No	No
	Dedicated Phone Required	No	No
	Two-Way	Yes	Yes
	Text Messages	Yes	No
	Zone Warnings	Yes	Yes
	Other Warnings	Yes	Yes
Cost Per Unit		Contact Vendor	
Average Battery Life		16 Hours	30 Hours
Anti-Tamper Features		Fiber Optic tamper evident strap, tamper alarm on unit.	

StreeTime Technologies

StreeTime Technologies, Overview		
Information Category		**Vendor Response**
Business Years		6 years
Employees		7
Public/Private		Private
Monitoring Services		Automatic monitoring report with links to prior day activity.
Product Integration	GPS Software to 3rd-Party Case Management	Information can be exported from our Website to an agency database.
	GPS Software to your other products	Our GPS software integrates with our drug and alcohol software.
	GPS Hardware to your other products	We offer a combined GPS and drug and alcohol monitoring program.
Mapping Software	Mapping Technology	MapPoint
	Grid Standard	Microsoft MapPoint
	Correlation with Crime Data	
Emerging Technologies		We are working on an all in one GPS drug and alcohol monitoring unit.

StreeTime Technologies Products		StreeTime Tracker
Product Feature Category		
Description		Automatic PDF and voice capabilities
GPS Type		Active
Communications	Cellular	Yes
	Land Line	No
	Dedicated Phone Required	No
	Two-Way	Yes
	Text Messages	No
	Zone Warnings	No
	Other Warnings	Yes
Cost Per Unit		Contact Vendor
Average Battery Life		12 Hours
Anti-Tamper Features		Tamper proof leash; an email is sent when leash is tampered with.

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APPENDIX D: APPLICABLE RESOURCES

This section identifies resources of interest to practitioners for implementing and managing a community supervision program using GPS. The online resources were identified during the research phases of this project. The personnel resources are primarily study participants who have agreed to provide their contact information in an effort to aid other practitioners. Please use consideration in contacting these personnel.

Online Resources

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Personnel Resources

Organization	Name	Title	Email	Phone Number
City/County of Denver, Colorado Electronic Monitoring Program	Marilyn Rosenberg	Director EM Program	marilyn.rosenberg@ci.denver.co.us	720-913-8901
National Law Enforcement Corrections Technology Center (NLECTC)	Joe Russo	Program Manager – Corrections	joseph.russo@du.edu	800-416-8086
Noblis	Tracy Brown	GPS Study – Project Lead	tracy.brown@noblis.org	703-610-1643
Noblis	Steven McCabe	GPS Study – Senior Principal	steven.mccabe@noblis.org	703-610-2332
University of Maryland (UMD)	Dr. Charles Wellford	Director, Maryland Justice Analysis Center, UMD – GPS Study contributor	cwellford@crim.umd.edu	301-405-4701
US Pretrial Services Central District of California	Eli Goren	Supervising US Pretrial Services Officer, EM Unit Supervisor	eli_goren@cacpt.uscourts.gov	213-894-6020
US Pretrial Services Central District of California	Jamille Claiborne	Senior US Pretrial Services Officer	jamille_claiborne@cacpt.uscourts.gov	213-894-1338

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