Monitoring With Smartphones: A Survey of Applications

By Joe Russo and George Drake*

Introduction

Community corrections is responsible for the supervision of the vast majority of offenders under correctional control, yet only a small percent of corrections budgets are allocated to this effort. Given this reality, effective community supervision can only be accomplished if all available resources are fully leveraged. This is critically important at a time when criminal justice reforms aimed at reducing the incarcerated and detained populations are likely to increase the workload for community corrections agencies, many of which are already stretched to capacity. Agencies often look to technology to help them do more with less and many are now exploring smartphone applications as a way of providing cost-effective supervision services to large groups of offenders.

Two major factors are driving this trend. The first is technical capability of these devices. Today's smartphones are essentially powerful handheld computers that also provide cellular communications. Among other features, smartphones typically integrate a touchscreen interface, Internet access, camera, video recorder, GPS navigation and an operating system capable of running downloaded applications. Further, peripheral devices, such as remote breathalyzers and other sensors, can be linked with the smartphone to expand supervision capabilities. As smartphone technology is continuously advancing, agencies can leverage these developments into the future in ways that traditional electronic monitoring devices simply can't support. With the rapid development of applications and integrated and compatible sensors, the capabilities of smartphones are constantly evolving. These advances promise flexibility and expandability that community corrections has not yet experienced with any other tool, and it is anticipated that smartphones will play a very prominent role in community supervision moving forward.

The second factor is ubiquity as most people own and are familiar with smartphones. According to a recent Pew Research Center poll, 77 percent of U.S. adults have a smartphone, up from 35 percent in 2011.[1] Not surprisingly, ownership levels are highest among those ages 18-29 (92%). Further, smartphones are an increasingly important part of an individual's life. The same research study revealed that 46 percent of Americans "couldn't live without" their smartphone.

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The Journal invited all known companies currently offering smartphone-based supervision services to complete an extensive survey which asked questions about the functionality of the applications that they offer. Eleven companies responded to the survey and the results are organized in six groups of tables.

Readers should be aware that the information presented in the following tables was self-reported by the vendors. No attempts were made to conduct trials or otherwise evaluate the products or verify claims. Rather, the primary objective of this survey is to provide agencies with a better understanding of the marketplace as well as a starting point for research. Readers are strongly encouraged to contact the vendors directly for additional information. Further, this survey represents a point-in-time snapshot of current vendors and functionality. A number of new vendors have undoubtedly entered the market after this survey began and therefore were not included. Attempts will be made to include these and other vendors in future surveys. It is also important to note that most of the functionality is software-based, and smartphone and other technology is rapidly evolving. Therefore, while providers establish core functionality for their products, most have the ability to quickly make improvements or upgrades based on articulated customer needs.

Types of Companies Offering these Applications

As we interviewed companies offering these smartphone applications, a pattern was noticed. We found two distinctly different markets that these companies had traditionally served, but are now beginning to compete with one another on common ground.

Some of the vendors had primarily been in the business of providing offender tracking products and services. These companies are more likely to develop applications that are concerned with offender location while incorporating security to combat circumvention vulnerabilities. They tend to offer fewer case management tools. The location service feature of the smartphone appears to be the primary focus of these products.

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Table 1: Basic approach and technical requirements of smartphone applications

Vendor	Product	Primary Approach	Type Of Smartphone Required/ Provided	Technical Requirements	Offender Access To Smartphone Functionality	Harmful Software Prevention/Detection
Acivilate	Pokket	Application Accessible (Not Installed) via Offender's Smartphone[1]	Unrestricted	Must Have Front and Rear Camera, Ability to Access Internet and Internal Location-Based Services	Unrestricted	No
cFive Solutions	Catalyst	Application Installed on Offender's Smartphone	Apple IOS or Android	Must Have Front Camera	Unrestricted	No
Corrisoft	AIR Connect	Application Integrated in Locked-Down Smartphone Provided by Vendor	Android	N/A-Phone Provided by Vendor	Agency Customizes the Phone Functionality The Offender Is Permitted to Have	Detects spoofing apps such as fake GPS locations
	AIR Check-In App	Application Installed on Offender's Smartphone	Apple IOS or Android	Apple IOS 8.0 or later, Android 5.0 or later	Unrestricted	No
GTL	Guardian	Application Installed on Offender's Smartphone	Apple IOS or Android	Apple IOS 8.0 or later, Android 4.1 or later	Unrestricted	Yes. Detects location mocking apps.
OSM	Outreach Smartphone Monitoring	Application Installed on Offender's Smartphone	Apple IOS or Android	Apple IOS 8.0, Android 4.4	Unrestricted	No
SCRAM Systems	SCRAMnet client app	Application Installed on Offender's Smartphone	Apple IOS or Android	Latest Mobile Device Operating System	Unrestricted	No
ShadowTrack	Shadow Track	Application Installed on Offender's Smartphone	Apple IOS or Android	Latest Mobile Device Operating System	Unrestricted	Detects spoofing apps such as jailbreaks or fake GPS locations
SuperCom	PureTrack	Application Integrated in Locked-Down Smartphone Provided by Vendor	Android	N/A-Phone Provided by Vendor	Agency Customizes the Phone Functionality The Offender Is Permitted to Have	Proprietary security features to prevent detect attempts to mock or exploit the system
Track Group	v-TRCK	Application Installed on Offender's Smartphone[2]	Apple IOS or Android	Latest Mobile Device Operating Systems Work Best-But All Versions will Function	No[2]	No[2]
TRACKtech	TRACKtech Automated Rehabilitation & Compliance Monitoring Platform	Application Integrated in Locked-Down Smartphone Provided by Vendor	Android	N/A-Phone Provided by Vendor	Agency Customizes the Phone Functionality The Offender Is Permitted to Have	Smartphone will not allow offender to download or install any software

Notes:
1. This product is accessible via any internet enabled device, not just smartphones.
2. While not the primary approach, this vendor can provide a locked-down phone with full capability to restrict functions and detect/prevent harmful software.

The second group of vendors offering these applications had backgrounds in case management software. They are more likely to focus on making officer-offender interactions more efficient by using the smartphone as a platform for services such as remote reporting and the delivery of appointment reminders. When these contacts are made, the location of the offender can be provided by utilizing the smartphone's location services feature. To many of these companies, location data may be seen as a secondary benefit.

Over time, it is likely the offender tracking companies will become better versed at creating helpful case management tools while the caseload management companies will become more proficient with tracking and system security. In fact, most of the companies that were interviewed indicated that future versions of their software will contain many more features of both disciplines.

Basic Approach

The smartphone applications currently available for community supervision can be divided into two basic models. In the first model, the application is installed on the offender's personal, commercial smartphone or one that is provided to him/her expressly for this purpose. This model may be referenced as "bring your own

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device" (BYOD) and is the approach offered by the majority of vendors at this time. It should be noted that there are some general requirements, i.e., the offender can't use just any phone. For example, the majority of products rely on a fully functioning *smartphone,* i.e., a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, camera, Internet access, and operating system capable of running downloaded applications. Further, the smartphone must use an Android or Apple iOS operating system. Note that some applications are designed to work on both operating systems while others are limited to one or the other. Most current applications will ***not*** work with smartphones that utilize other, less popular operating systems, such as BlackberryOS or WindowsPhone. The one exception is the Pokket product which is accessible via Internet rather than a downloaded application and is, therefore, agnostic with respect to the phone's operating system.

In the second model, the application is integrated into a locked-down, customized smartphone which is available for purchase or lease from the vendor. As with any technology, there are advantages and disadvantages to each approach. The BYOD approach generally is less expensive, however there are security issues as smartphones built for the general consumer market were simply not designed to be a secure criminal justice monitoring tool. For example, commercial smartphones have an accessible power button as well as compartments that contain SIM cards and batteries that can be removed. Offenders also have access to other functionality such as WiFi settings, and Airplane mode that can allow them to intentionally be out of contact with their officer. Further, it can be difficult to control what other applications, including location spoofing or other conflicting software the offender might be downloading on the smartphone.

Services associated with vendor-provided, secure smartphones, on the other hand, are generally more costly; however they offer far greater security and are capable of monitoring phone activity and restricting the offender's access to

Table 2: Verification of offender identity and proximity to smartphone

Vendor	Product	Approach to verify offender proximity to smartphone	Method of verification	Verification frequency	Confirmation time
Acivilate	Pokket	Periodic	Human Comparison of Prompted Photo to Enrollment Photo	Defined by Officer (No Programmable Rate, Verification Occurs When Offender Voluntarily Checks-in or Upon Officer Prompt)	Near-real time
cFive Solutions	Catalyst	Periodic	ID/Password, Facial Recognition	Up to 5x per hour	Near-real time
Corrisoft	AIR Connect	Continuous via tether	AirConnect Bluetooth Tether	Continuous	N/A
	AIR Check-in App	Periodic	PIN, Selfie, Fingerprint, Signature	Defined by Officer	Near-real time
eHawk Solutions	eHawk App	Periodic	Facial Recognition, Fingerprint, Security Question	Defined by Officer	<10 seconds
GTL	Guardian	Periodic	Facial Recognition, PIN	Defined by Officer (Automatically Schedule Up to 10x per day, If Needed, Additional Checks Require Manual Prompt)	Near-real time
OSM	Outreach Smartphone Monitoring	Periodic	Human Comparison of Prompted Video to Enrollment Photo	Defined by Officer	< 10 minutes
SCRAM Systems	SCRAMnet client app	Periodic	ID/Password, Facial Recognition	Defined by Officer	< 5 seconds
ShadowTrack	Shadow Track	Periodic	Voice Verification, Facial Recognition	Defined by Officer	Near-real time
SuperCom	PureTrack	Periodic	Fingerprint, Voice Verification, Facial Recognition	Defined by Officer	Near-real time
		Continuous via tether	PureTag Tether, encrypted protocol over BLE	Continuous	N/A
Track Group	v-TRCK	Periodic	Human Comparison of Prompted Selfie to Enrollment Photo	Defined by Officer	~1 minute
TRACKtech	TRACKtech Automated Rehabilitation & Compliance Monitoring Platform	Periodic	Thumbprint, Facial Recognition	Defined by Officer. Note: All Phone Activity Requires Thumbprint	Near-real time
		Continuous via tether	TRACKband Tether	Continuous	N/A

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particular functionality as determined by the officer. For example, access to the Internet may be restricted or limited, in response to offender risk level and/or compliance with conditions of supervision. Conversely, positive behavior may be rewarded by removing restrictions. Further, the officer has the capability to limit the offender's ability to call or text certain individuals or restrict activity based on a schedule. Note that some vendors who provide locked-down smartphones intend that it replace the offender's current smartphone, which makes sense from a supervision aspect, but may be difficult to enforce in practice.

Generally speaking, the more access offenders have to the smartphone's functionality, the more challenging it can be to secure the application. On the other hand, more restrictions on functionality can inhibit the offender's access to potentially positive contacts and resources. Ultimately, as with any technology, agencies should consider the risk level of the offender and the case management objectives they are trying to achieve before deciding what approach to pursue.

Verification of Offender Identity and Proximity to the Smartphone

Smartphone applications have the potential to support the supervision process, yielding benefits for both the officer and the offender. However, in order for these benefits to be fully realized, the offender must be in possession of—and be the individual actually using—the smartphone. It is therefore important to confirm that the offender is in proximity to the smartphone. Vendors generally take three approaches to the problem of confirming offender identity and proximity to the smartphone: periodic confirmation, continuous confirmation, and a hybrid approach. The periodic confirmation approach typically employs some type of automated biometric (e.g., fingerprint, voice verification, facial recognition), however some systems require the officer to manually compare the offender's photo/video with the enrollment photos to validate identity. Note, that depending on the method employed, the process of identity validation may occur in near-real time (automated) or may take several minutes (manual) depending on officer workload and priority. Due to the nature of this approach it might be expected that the offender may intentionally or unintentionally separate from the smartphone and "lose" contact with the officer. In these cases, extended separation would be detected when the offender misses the next scheduled or random check-in or other contact. The frequency of contacts is generally defined by the officer and is typically based on offender risk level. Due to the requirement for active participation on the part of the offender, contacts during normal sleep hours are problematic. Therefore, this approach may be more suitable for lower-risk offenders who don't necessarily require "continuous" monitoring or contact.

Vendors generally take three approaches to the problem of confirming offender identity and proximity to the smartphone: periodic confirmation, continuous confirmation, and a hybrid approach.

The continuous confirmation approach generally employs a secure, body-worn tether that provides a continuous radio frequency link with the smartphone. In this configuration, the system is akin to a traditional two-piece offender tracking system which generates an alert if the two devices are separated or if the tether is removed. This provides a much higher level of confidence that the offender is with the smartphone and may be more suitable for higher risk offenders or those who have trouble keeping the smartphone within proximity.

The hybrid approach offers multiple layers of confirmation, for example a tether combined with a biometric validation to operate the smartphone. Note that some vendors offer both continuous and periodic confirmation configurations which allows the agency flexibility to modify the approach based on offender risk level, compliance, or other considerations.

General Supervision and Monitoring

Communication between Officer and Offender: One of the basic advantages of smartphone applications as a community supervision tool is the ability to efficiently facilitate direct communications between the officer and the offender. These communications can be handled in a wide variety of ways, (e.g. voice, text, email, vibration, popup display), depending on the type of transaction and officer preference. Most vendors have built in a panic button on their applications which allows the offender to contact the officer directly in case of emergency. Perhaps the most powerful functionality is the video camera. Although face-to-face meetings between offenders and supervising officers (or service providers) are extremely important, many routine visits, particularly for lower risk offenders, can be efficiently conducted by the video applications available on most of the smartphones. Video interactions provide the officer the ability to view offender body language and these meetings can be recorded to provide documentation of the conversation, including instructions given to the offender. The smartphone's camera and video capabilities offer other benefits as well. For example, offenders can participate in individual or group counseling via video, which can be critical for those who live in areas where these services are scarce. Further, the officer may conduct a virtual home visit by asking the offender to use the camera to display what is in his/her refrigerator or living area. If needed, the smartphone's video camera can be also be used to record the ingestion of medication.

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Table 3: General supervision and monitoring

Vendor	Product	Communication Between Officer And Offender	Offender Ability To Communicate Status Report To Officer	Noncompliance Alert To Officer	Automated Instructions To Noncompliant Offender	Panic Button To Contact Probation Officer	Compatible With Breathalyzer	Random Drug Test Notification Delivery	Client Payments
Acivilate	Pokket	Text, Voice	Yes	Yes	No	No	No	Yes	No
cFive Solutions	Catalyst	Text, Two-Way Messaging, Offender Calendar	Yes	Yes	Yes	No	No	No	No
Corrisoft	AIR Connect	Text, Voice, Video, Tone, Email, Selfie	Yes	Yes	Yes	Yes	No	No	No
	AIR Check-in App	Text, Voice, Video, Tone, Email, Selfie	Yes	Yes	Yes	Yes	No	No	No
eHawk Solutions	EHawk APP	Text	No	Yes	Yes	No	No	No	Yes
GTL	Guardian	Video	Yes	Yes	Yes	No	No	No	No
OSM	Outreach Smartphone Monitoring	Text, Voice, Popup Display, Video, Vibration, Tone	Yes	Yes	Yes	Yes	BACtrack Mobile	Yes	For OSM Fees Only
SCRAM Systems	SCRAMnet client app	Text, Voice, Popup Display	Yes	Yes	Yes	No	SCRAM Bluetooth Breath Tester	Yes	No
ShadowTrack	Shadow Track	Text, Voice, Popup Display, Video, Vibration, Tone, Text to Speech	Yes	Yes		No	BACtrack Mobile Pro	Yes	Yes
SuperCom	PureTrack	Text, Voice, Popup Display, Video, Vibration, Tone	No	Yes	Yes	Yes	Yes, Model Not Disclosed	No	Yes-Payment functionality via credit card is provided through proprietary Mobile Wallet
Track Group	v-TRCK	Text, Voice, Popup Display, Video, Vibration, Tone	No	Yes	Yes	Yes	BACtrack Mobile Pro	No	No
TRACKtech	TRACKtech Automated Rehabilitation & Compliance Monitoring Platform	Text, Email, Voice, In-App Messages/ Popup Display, Photos, Video, Voice	Yes	Yes	Yes	Yes	BACtrack Mobile Pro and BACtrack Go Keychain	Yes	Yes-Payment functionality via Stripe. Can collect payments from client for TRACKtech services and other charges on behalf of agency

Offenders can also transmit documents such as paystubs using the smartphone's camera.

Remote Reporting and Check-ins: Many smartphone applications allow for offender submission of monthly reports with updates of employment, living arrangements, contact information and other important data. These reports can be scheduled by the officer on a regular basis, randomly, or the officer may initiate an immediate prompt. Some vendors, particularly those who do not offer a tethered approach to confirming offender proximity to the smartphone, will also use location check-ins to periodically document the offender's location at various points in the day. Similar to the reporting function, the check-in typically can be scheduled, random, or on-demand. One limitation or consideration agencies should keep in mind is that non-tethered approaches rely on identify validation of some type which requires the offender's

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participation. Because of this, check-ins and reports are typically not scheduled during the hours the offender is sleeping, which creates a gap in monitoring capability. This may or may not be a major concern depending on the risk level of the offender.

Alcohol Monitoring: Unlike traditional electronic monitoring devices, the smartphone allows connectivity, via Bluetooth, to peripheral technologies, such as remote breathalyzers. A number of vendors are currently providing remote breathalyzers as an optional service for an additional fee. In this configuration, the officer can schedule breath tests via the smartphone application. This generates a prompt to the offender to confirm his/her identify (by one of a number of biometric methodologies) and video record themselves taking the breath test with the remote breathalyzer. Identity confirmation and test results are recorded and alerts are sent to the officer per established protocols. One caution – all remote breathalyzers do not provide the same level of accuracy. For example, some products are designed for personal use and may not be appropriate for evidentiary purposes. Agencies should determine whether the breathalyzer offered meets their objectives, e.g. screening tool or admissibility in court/parole hearings.

Drug Testing Notification: It is understood that all smartphone applications can allow an officer to notify an offender (using voice, text or other features) to report for a drug test. Some applications, however, distinguish themselves in that they are directly linked via an Application Programming Interface (API) with an entity that automatically determines drug testing schedules based on agency protocols. As opposed to traditional systems that require the offender call a hotline each day to determine if they are to be tested, these smartphone applications automatically generate a message notifying the offender that they were selected for drug testing and must report within a pre-determined number of hours. Further, some applications can document that the notification was sent and received.

Fee Collection: Smartphones are commonly used to transfer money and to pay bills. Applications known as "mobile wallets" allow users to add their credit card or debit card information to their smartphone. The smartphone then becomes the vehicle for making payments to participating merchants or payees. Some vendors have or are beginning to incorporate mobile wallet approaches into their smartphone applications and the capability exists for offenders to pay for the smartphone monitoring service directly from the smartphone application. Other vendors have incorporated broader models and as government agencies evolve and begin to accept mobile payments, offenders will be able to pay their restitution, court fees and other ordered financial obligations directly through their smartphone.

Response to Non-Compliance: Offender non-compliance can take a variety of forms. For example, an offender may miss a scheduled or on-demand check-in, may fail to take a breath test as directed or may miss curfew. The vendors all reported that their systems document the incident, provide an alert to the officer, and automatically provide instructions to the offender describing the required actions.

One of the basic advantages of smartphone applications as a community supervision tool is the ability to efficiently facilitate direct communications between the officer and the offender. The smartphone is an ideal platform to provide support to the offender. This support can be delivered remotely and in most cases in an automated manner that conserves precious resources.

Offender Support Functionality

Unlike traditional electronic monitoring technology e.g., RF and GPS, the smartphone is an ideal platform to provide support to the offender. Further, such support can be delivered remotely and in most cases in an automated manner which conserves precious resources.

Positive Reinforcement: The criminal justice system, as a whole, dispenses far more negative reinforcement than positive messaging, yet research indicated that a ratio of 4 positive reinforcements for each negative one produces optimal change in offenders. Smartphone applications are uniquely suited to helping officers provide these positive messages. The vendors surveyed support this objective to varying degrees. At the most basic level, the native communication capabilities of the smartphone allow the officer to send a voice or text message praising the offender for positive behavior. Some applications may prompt the officer, however this approach may be considered "manual" as it typically requires the officer to initiate the process and construct and send the message. Other applications are more efficient and can be programmed to deliver automated messages based on behaviors documented by other smartphone capabilities. For example, if an offender was struggling to make it to work on time, the system's location-based services can automatically monitor this situation. The officer can pre-program delivery of a positive message when the offender is on time for a pre-set number of consecutive days. Similarly, positive messages can be programmed for delivery in response to negative breathalyzer tests, curfews met, or other measurable outcomes. Other systems are structured to track important behaviors and provide the offender with an opportunity to earn points or credits for positive results. Officers establish the reward structure; however, in general these points can be redeemed for simple rewards such as bus tokens or more

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Table 4: Offender support functionality

Vendor	Product	Automated Positive Reinforcement	Automated Calendar Reminders	On Demand List Of Resources	Direct Interface With Resources (Other Than The Officer)	Type Of Resources
Acivilate	Pokket	Yes	Yes	Yes	Yes	Securely exchange medical records between justice system and community-based providers. Secure, pre-screened validated referrals to providers. Collaborative treatment planning
cFive Solutions	Catalyst	No. Officers may send ad hoc messages for positive reinforcement.	Yes	No	No	N/A
Corrisoft	AIR Connect	No. Officers may send ad hoc messages for positive reinforcement.	Yes	Yes (If Prepopulated)	Yes	Access to Career Builder, Indeed, Simply Hired, and other supportive services built into the application
	AIR Check-in App	No. Officers may send ad hoc messages for positive reinforcement.	Yes	Yes (If Prepopulated)	Yes	Direct access to local rehabilitation and support resources (if prepopulated) as well as access to any web-based resources
eHawk Solutions	eHawk App	No. Officers may send ad hoc messages for positive reinforcement.	No	No	No	N/A
GTL	Guardian	Yes	Yes	No	No	N/A
OSM	Outreach Smartphone Monitoring	Automated and Custom Messages Delivered to Offender. Integrated incentive/sanction program based on points.	Yes	Yes (If Prepopulated)	Yes	The offender has direct interface with OSM for technical support as well as materials helpful in the re-entry process
SCRAM Systems	SCRAMnet client app	Yes	Yes	No	No	N/A
ShadowTrack	Shadow Track	No. Officers may send ad hoc messages for positive reinforcement.	Yes	No	Yes, Upon Request	Direct access to live person and API integration with 3rd party assessments provider
SuperCom	PureTrack	No. Officers may send ad hoc messages for positive reinforcement.	Yes	Yes (If Prepopulated)	Yes	Direct access to live treatment providing case managers and personnel as well as other authorized applications and content
Track Group	v-TRCK	No. Officers may send ad hoc messages for positive reinforcement.	Yes	Yes (If Prepopulated)	Yes	Provision of materials, contacts for resources, direct access to live person (depending on the resource)
TRACKtech	TRACKtech Automated Rehabilitation & Compliance Monitoring Platform	Yes	Yes	Yes (If Prepopulated)	Yes	TRACKcase gives the Officer the ability to provision rehabilitation materials such as 90-Day Onboarding Program, Cognitive Behavioral Therapy (CBT), Medication Reminders, Socrates, DAST-10, PHQ-9 and more. The TRACKphone provides the Program Member with the provisioned material from the Officer as well as access to many resources that are both available on demand or with live support. Access to 24-hour crisis support, contact with their SupportCore(TM), access to Khan Academy and ability to search using location services and Google search.

meaningful rewards such as more relaxed supervision conditions. The flip side, of course, is that points are deducted for negative behaviors.

Appointment/Event Reminders: Those under supervision often lead chaotic lives and can struggle to keep up with daily activities. For example, they may forget to take their medications as prescribed or fail to keep scheduled appointments. When offenders miss important events such as a court appearance, a drug test or required programming, negative consequences can ensue for both the offender and the criminal justice system. In some cases a warrant may be issued and the offender could be jailed until a hearing can be scheduled. This is costly for the criminal justice system and further disrupts the

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Table 5: Location monitoring

Vendor	Product	Technologies Used	Maximum Location Data Point Frequency	One Point Per Minute	Storage Of Location Data Points	Establish/ Monitor Inclusion & Exclusion Zones	Creation Of Zones	Automatic Inclusion Zone Based On Calendar	Curfew Monitoring	Mapping Software	Estimated Location Accuracy
Acivilate	Pokket	GPS, Triangulation, WiFi	No maximum, no programmed colletion rate. Location points are gathered when offender voluntarily checks-in or when officer prompts (on demand) check in	No	Only Points Associated with Verification of Offender Proximity to the Smartphone	No	No	No	No	Google Maps	3 Meters
cFive Solutions	Catalyst	GPS	5 per Hour-Random-More frequency based on officer prompt or offender log in	No	Only Points Associated with Verification of Offender Proximity to the Smartphone	Yes	Yes	No	Yes	Google Maps	100 feet or ~30 meters
Corrisoft	AIR Connect	GPS, Triangulation, WiFi	Continuous	Yes	All	Yes	Variable Sized Circles and Polygons	Yes	Yes	Google Maps	3 Meters
	AIR Check-in App	GPS, Triangulation, WiFi	3600 Per Hour	Yes, but Not Recommended[1]	All	Yes, but Not Recommended[1]	Yes, but Not Recommended[1]	Yes, but Not Recommended[1]	Yes, but Not Recommended[1]	Google Maps	3 Meters
eHawk Solutions	eHawk App	GPS, Triangulation, WiFi	60 per Hour	Yes	All	Yes	Variable Sized Polygons	No	Yes	Google Maps	3 Meters
GTL	Guardian	GPS	Up to 12 per Hour-More frequency based on officer prompt or offender log in	No	All	Yes	Variable Sized Circles	No	Yes	Google Maps	3 Meters
OSM	Outreach Smartphone Monitoring	AGPS, GPS, WiFi, Cell Tower Triangulation	Continuous and Configurable. Frequency varies depending on movement and speed of smartphone.	Yes	All	Yes	Variable Sized Circles and Polygons	Yes	Yes	Google Maps	3 Meters
SCRAM Systems	SCRAMnet client app	GPS, Cell Tower Triangulation	1 per Hour	No	Yes	No	No	No	No	Google Maps	3 Meters
ShadowTrack	Shadow Track	GPS, Cell Tower Triangulation	Unlimited, Defined by Officer	Yes	Only Points Associated with Verification of Offender Proximity to the Smartphone	Yes	Variable Sized Circles and State Perimeter Polygons	Yes	Yes	Google Maps	GPS = 3-4 Meters; Cell Tower Triangulation = 300-1,000 Meters
SuperCom	PureTrack	GPS, Cell Tower Triangulation, WiFi	PureTag Tether Configurator: Continuous Non-Tether Configuration = 3600 per Hour	Yes	All	Yes	Variable Sized Circles and Polygons	Yes	Yes	Internal Mapping Feature which integrates with Google Maps or other solutions upon request	3 Meters
Track Group	v-TRCK	GPS, AGPS, Cell ID, WiFi, Bluetooth Beacons	Unlimited, Defined by Officer	Yes	All	Yes	Variable Sized Circles and Polygons	Yes	Yes	Google Maps	4.9 Meters
TRACKtech	TRACKtech Automated Rehabilitation & Compliance Monitoring Platform	GPS, AGPS, GLONASS, BDS, WiFi Hotspot and Cellular Triangulation	Continuous and Configurable. Internal location change technology does not send location unless movement occurs	Yes	All	Yes	Variable Sized Circles and Polygons	Yes	Yes	Google Maps	3 Meters

Note 1: While this product is capable of collecting data points once per minute and establishing and monitoring zones, the vendor does not recommend this approach with a periodic proximity configurations. See narrative below for explanation.

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lives of the offender and his/her family. Reminders can help avoid this situation. For example, a Minnesota study showed that a reminder service for pre-trial cases increased court appearances dramatically.[2] Most smartphone applications surveyed featured an offender calendar which an officer can populate with important events. Once on the calendar the systems can be programmed to generate a series of reminders to the offender. Others use the calendar function as a way for the offender to request permission to go to a location/activity outside the normal parameters established by the officer. The officer can then approve or deny the request and the decision is relayed to the offender. Ultimately, smartphone applications can provide some level of reminders to help the offender remain in compliance with the conditions of supervision.

On Demand List of Nearby Resources: Most vendors surveyed are using the smartphone application to provide the offender with a list of relevant resources such as Alcoholics Anonymous meetings, emergency shelters and other social services. The resources are typically pre-populated in the smartphone system platform for individual jurisdictions and some vendors limit the list to those organizations that have been pre-approved by the agency to assure the offender is receiving an acceptable quality of service.

Interface with Resources: Smartphone applications offer a platform for direct provision of services and resources in a variety of ways that can be customized based on the needs of the agency. At a minimum, the smartphone, via internet connectivity, can leverage existing resources such as sites that post job opportunities, information about addiction treatment and mental health resources, etc. Some vendors go beyond and aggregate existing content that is most relevant to particular offenders. This may include a copy of the conditions of supervision or cognitive behavioral training materials and exercises. Still other vendors go further and offer direct support to the offender, through the development of new content or creation of support groups for the offender made up of people in his/her life who can help the offender stay on the path to success. Other innovations provide a platform to securely exchange medical records between justice system and community-based providers as well as collaborative treatment planning.

Location Monitoring and Tracking

All smartphone applications leverage the location technologies built into devices which may include Global Navigational Satellite Systems, Wi-Fi mapping and cell tower trilateration. The location approach used is dependent upon the chipset chosen by the smartphone manufacturer, and to a lesser extent, the cellular network that the device used. The accuracy of smartphone location services can vary due to a number of hardware and environmental factors. The quality of the chipset along with the choice and placement of the antenna within the phone are variables that are controlled by the smartphone manufacturer. Vendors that offer software applications that can be downloaded to a variety of phones (BYOD) will therefore have less control over accuracy as opposed to vendor provided or "corporate owned" smartphones, though actual differences in accuracy may be minimal.

All smartphone applications leverage the location technologies built into devices which may include Global Navigational Satellite Systems, Wi-Fi mapping and cell tower trilateration.

Of course, the accuracy of location data is irrelevant if there is no confidence that the offender is actually with the smartphone when the location points are taken. As previously discussed, vendors take differing approaches to the problem of confirming offender identity and proximity to the smartphone: continuous or periodic confirmation. The frequency of this confirmation constitutes the distinction between continuous tracking capabilities and periodic location sampling. Some vendors emphasize the ability to continuously track offenders and will make comparisons between their products and traditional GPS devices. Others stress the smartphone application primarily as a supervision and support tool that also has location capabilities. Agencies will need to determine which approach best fits their needs.

Continuous Tracking: When location information is combined with a continuous means of validating the offender is with the phone (currently, some type of tether), much of the functionality of traditional offender tracking systems can be realized without the stigmatization that can occur with bulky ankle bracelets. In this approach, a secure, body-worn tether is connected via Bluetooth to the smartphone. The result is similar to two-piece offender tracking system that readers may be familiar with, however the components are typically much smaller than those currently offered by manufacturers. Much like traditional offender tracking systems, location points are gathered continuously and an alert is generated if the two devices (smartphone and tether) are separated indicating that the integrity of the location points has been compromised.

Periodic Location Sampling: Products that periodically (untethered) confirm offender proximity to the smartphone are generally not as comparable to traditional offender tracking systems. These products typically use some type of automated biometric (e.g., fingerprint, voice verification, facial recognition), manual comparison of the offender's photo/video with the enrollment photos, and/or login credentials. In this configuration, the offender's proximity to the device is confirmed at various intervals during the day. The offender is typically prompted via message to conduct a check-in while the device's location point is captured. These check-ins can be programmed to be random, on demand, or

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scheduled at specific times of the day to assure that the offender has arrived at work on time or are attending a counselling session, for example.

Some systems also allow offenders to initiate a location validation when they would like to document that they have arrived at a given location. Note that these applications may be gathering location data throughout the day, however only those location points associated with an identity confirmation should be considered reliable, i.e., capturing the location point of the offender and not just the smartphone. Agencies should understand the difference between continuous tracking and periodic location sampling. Although it may be expected that an offender remains in possession of the smartphone throughout the day, it may be dangerous to assume that this is always the case. Whether intentional or not, offenders can become separated from their smartphones for extended periods, and if by chance they return to their devices prior to the next validation call, their separations from the smartphone would not be documented.

Some vendors frequently collect unvalidated locations of untethered smartphones (i.e., once per minute) in addition to those location points that have been validated by identity confirmation. The validated points confirm that the offender is in close proximity to the smartphone being tracked. But what about location points that are not validated? Do they have any value? Perhaps. Points immediately before and after a validated point can be relied upon to some degree. For example, if an offender is asked to perform a validation procedure to confirm his proximity to the smartphone, and that validation process takes a little longer than expected, the location points prior to the validation request should be examined. The offender may

Table 6: Data, platform and reporting capabilities

Vendor	Product	Interoperable With Agency Cms	Where Is Data Stored	Data Retention Policy	Report Functionality
Acivilate	Pokket	Yes	Amazon Web Services (AWS) GovCloud	Data Retained Per Agreement with Agency	Administrative and Compliance Reports Available at Offender, Case Manager and Aggregate Levels
cFive Solutions	Catalyst	Yes	Amazon Web Services (AWS) GovCloud	Data Retained Per Agreement with Agency	Ad Hoc Reporting Tool Can Access All Data
Corrisoft	AIR Connect	Yes	Secure Cloud	Data Retained Per Agreement with Agency	Multiple Reports including Enrollment, Violation, Crime Scene Correlation, Supervisor Reports, Unenrollment.
	AIR Check-in App	Yes	Secure Cloud	Data Retained Per Agreement with Agency	Multiple Reports including Enrollment, Violation, Crime Scene Correlation, Supervisor Reports, Unenrollment.
eHawk Solutions	eHawk App	Yes	Secure Cloud	Data Retained Per Agreement with Agency	Multiple Reports: Offender-based, location-based, compliance-based, zone-based, and administrative check-ins. System supports ad hoc report creation.
GTL	Guardian	No	GTL Data Centers	Data Retained Per Agreement with Agency	Multiple Reports: Check-in Requests, Check-In Responses, Offender Profile/Account Information, Offender Current Status, Geofence Reports, Manifest Reports, Check-in Comments Reports, Missed Check-in Reports, Complete Check-in Reports, Voluntary Check-in Reports
OSM	Outreach Smartphone Monitoring	Yes	OSM Cloud	Data Retained Per Agreement with Agency	Compliance and Activity Reporting by Subject and/or Time Period. List of All Active Subjects for Selected Time Periods
SCRAM Systems	SCRAMnet client app	Yes	Microsoft Azure	Data Retained Per Agreement with Agency	Summary and Compliance/Non-compliance reports
Shadow Track	Shadow Track	Yes	Google Cloud	Data Retained Per Agreement with Agency	More than 100 Reports Availble to User, Plue Ability to Create Custom Reports Upon Request
SuperCom	PureTrack	Yes	Secure Cloud (Unless Agency Requests Another Approach)	Indefinitely-data not deleted unless agency makes specific request	Comprehensive Reporting Engine-Standard Canned and Customizable Reports Are Available
Track Group	v-TRCK	Yes	Secure Vendor Network	Data Retained Per Agreement with Agency	Multiple Reports-automated and customizable. E.g. Program Compliance, Location and Alert History, Behavior, Device Health and Analytics
TRACKtech	TRACKtech Automated Rehabilitation & Compliance Monitoring Platform	Yes	Secure Cloud	Data Retained Per Agreement with Agency	Multiple Reports including Caseload Report Summary, Detailed Caseload Report, Program Member Profile/ Compliance/Activity/Behavior Status/Location and Communications Log. Other Reports Can Be Customized Based on Agency Need

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have been at an unauthorized place and quickly changed locations prior to performing the verification. The un-validated location points just prior to the request may be crucial in understanding how events unfolded.

On the other hand, if an offender is highly motivated to commit a crime, he can intentionally leave his smartphone behind and then change his location to violate the law. If the offender happens to return to his smartphone prior to the next validation request, his presence at the crime scene would go undetected. It would be inappropriate for investigators to eliminate this offender as a suspect of the crime based upon the un-validated location points that show his phone was not at the crime scene. Ultimately, any location data point that does not correspond with a proximity confirmation should be considered unreliable.

Zone Monitoring: As part of the location monitoring functionality, it is possible to create and monitor inclusion and exclusion zones for each offender. Some systems automatically link the calendar function with location monitoring to make it simple to determine if the offender has actually attended the required event. In these cases, a scheduling option automatically generates an inclusion zone for the place/time of the appointment and the officer will be notified if the offender does not appear as required. All of the respondents indicated their applications can create multi-sided polygons and/or circular zones of various sizes. However, the storing of commonly used zones as templates, such as schools or parks, was not frequently offered. It should be noted that systems that use the periodic proximity verification approach appear to be much less suited to leveraging the power of zone monitoring as compared to the tether approach. This is due to two main factors. First, the untethered offender who intentionally enters a prohibited area would likely leave the phone behind to avoid detection. Second, unless the system happens to make a random or scheduled validation call while the offender is in the prohibited area, the zone infraction will be missed. Therefore, while zone or curfew monitoring is technically feasible with untethered systems, practical issues may limit the effectiveness of this approach. As a result, some vendors may not offer this capability and/or discourage agencies from relying on it.

Most applications provide automated alerts to the agency when a zone infraction occurs. Some vendors provide an option for the offender to be warned as they approach or enter a restricted area although it was commonly acknowledged that there are times when certain zones (i.e., a victim's residence) should be hidden from the offender.

In general, applications can collect location points on a continuous basis or configurable by the officer. The rate at which these systems obtain location points can impact battery life. For example, continuous collection of location points can result in more rapid discharge of the battery of the device. To counter this problem, many vendors have developed innovative power management schemes. These methods may include the use of beacons or movement sensors that limit location point collection when the device is at rest. Agencies are encouraged to evaluate the impact of frequent location monitoring or sampling on device battery life in realistic operational scenarios.

At a minimum, all applications store those location points which are associated with an offender proximity confirmation. Some applications store all points.

Agencies should carefully consider the target population and objectives they are trying to accomplish as they determine the level of location tracking required. For example, lower risk populations or those offenders who have successfully completed traditional location tracking may be well suited for the periodic or untethered approach, whereas higher-risk offenders may be more appropriate for the continuous or tethered approach.

Data, Platform and Reporting

Similar to traditional offender tracking systems, smartphone applications generate large amounts of data. These data may include location points, violations, alerts, breathalyzer results, and communications between the officer and the offender. It is important, therefore, for these smartphone applications to be interoperable with an agency's information management system. Most vendors indicated the capability to integrate, though some reported that their systems were more robust than some pre-existing information systems. In these cases, agencies may use the smartphone application platform as the primary information management system. Of course, these data must be stored and each provider reported that they leverage secure cloud services for this purpose. Each jurisdiction may have different data retention requirements with respect to offender data, therefore it is important that agencies specify these requirements in their contracts with the providers. Further, agencies should include provisions that address how the data is to be transferred or exported back to the agency in a readable format at the end of the agreement. The ability to generate reports is another consideration agencies should keep in mind when choosing a smartphone application. As expected, providers offered a wide range of options in this area from full access to all data so the agency can create ad hoc reports to a series of standard or semi-customizable reports. Agencies should identify their needs and clearly articulate them in contract language to avoid unexpected additional costs that may be incurred if requirements change in the future.

Endnotes

[1]Rainie, L. and A. Perrin, "10 Facts about Smartphones as the iPhone Turns 10", *Pew Research Center*, June, 28, 2017.

[2]Minnesota Judicial Branch, Fourth Judicial District, Court Reminder Project, September 2008.

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