

RFID – The Smart Way to Enhance the Accuracy of Infrastructure Asset Tracking and Monitoring

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SUMMARY

In 2013, a study was conducted by the Geospatial Research and Applications Center at Auburn University¹ (Wang, Y, 2015) that tested a combination of technologies, including Radio Frequency Identification (RFID) tags, magnetic locators and Global Positioning Systems (GPS) equipment to quickly locate buried infrastructure. The study concluded that devices that can read RFID tags, locate magnets and provide GPS coordinates could lead to more efficient and faster recovery of infrastructure facilities after natural disasters.

Today, these technologies have been combined into a system that also leverages the power of Geographic Information Systems (GIS) and asset management systems. This approach can be applied in many surveying activities to make locating and mapping verifiable, accurate and complete, while being accessible anywhere. Surveyors can provide extensive, field-verified information about specific field assets that can be shared through GIS and / or asset management systems – simplifying field workflows while accessing the specific physical asset record in GIS for updating in the field.

RFID is the lynch-pin that triggers a digital connection between the physical asset and a GIS and / or asset management system. Once tagged with RFID, an asset has a permanent ID number and precise, verified location coordinates. This permanent ID can be accessed and connected via a mobile app to a field data collection form where specific information about the asset, such as the maintenance schedule, images of the asset, repair records and other information is appended. This data is uploaded to a GIS and /or asset management system, often in real-time. Surveyors can then review this information and share it with other contractors or utility owners – all in an auditable, accessible workflow.

This session will explore the how RFID marking combined with GIS and / or asset management systems improves subsurface utility locating, inspection and management.

1. Background

Geographic Information Systems (GIS) and asset management systems are becoming more common in municipalities throughout the world. GIS allows the mapping of infrastructure assets. Asset management systems catalogue and manage the inspection and maintenance of those assets. Together, they provide powerful tools to efficiently manage infrastructure assets.

GIS provides precision X,Y and Z coordinates. When coupled with T (time stamp), GIS provides a unique indexed point in time at a particular location. What it *doesn't* do very well is tell you **what** asset is at that location at that point in time.

Today, that “what” information is filled in by a human in the field, usually by visual interpretation of the X,Y,Z,T index. This visual interpretation often results in errors (incorrect visual interpretation of the asset), extra time (trying to verify the right serial number), or even extra difficulty because the asset can't be easily seen (e.g. underground).

This leads to problems in the field. For example, if workers are trying to locate and excavate buried assets based on GIS X,Y,Z,T location and smartphone (GPS), accuracy is generally one to four meters. More precision in locating, identifying and verifying the buried asset is required before excavation can begin.

Further, in many cases, surveyors and excavators don't have access to GIS for locating buried assets.

According to the 2019 DIRT Report² (Lyle Macgruder, 2020) [Damage Information Reporting Tool], there were 532,000 damages *reported* in the United States. Because there is no requirement to report damages in the United States, this data is based only on organizations that choose to report excavation damages. Overall actual damages during excavation are much higher.

Further, the root cause of damages in the 2019 DIRT Report is “Notification NOT Made”, meaning that excavations were undertaken without any attempt to “know what's below”.

2. RFID Technology

This is where Radio Frequency Identification (RFID) comes in. RFID has many of the same applications as familiar bar codes – they're both a way to give items a unique serial number along and share limited additional information. However, RFID does not require a visual read of the code. RFID tags can be read (even underground) using an RFID reader, and they also automatically provide latitude and longitude.

RFID can identify and verify an asset location in the field and trigger access to metadata in GIS and / or asset management systems. RFID gives surveyors a way to quickly and accurately locate and verify buried assets – and update asset data using a mobile app tied to the GIS/Asset Management System.

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3. Benefits of RFID Technology

RFID technology has been used since World War II, when it was used to identify aircraft as friend or foe when a plane was close the base.

The first passive RFID tag was introduced in 1973 – as a method to open doors without a key. Later, high frequency RFID tags were developed for tracking assets, access control and payment systems. Finally, low-cost ultra high-frequency (UHF) tags were developed for use in the supply chain. Years of use in a range of applications have helped create a durable, reliable tool that provides the accuracy required for locating underground assets.



Benefits of UHF RFID:

- Reliable, durable and safe – RFID tags can last decades, do not emit power until pinged by a reader and are environmentally safe.
- Simple – One RFID frequency can verify and track all asset types.
- Scalable – RFID can be used for a single type of asset and can be expanded to include a full range of assets.
- Auditable – Every time a tag is read, a record is created and this data is automatically part of the asset record.
- Cost-effective – Low-cost precision locating tied to GIS/Asset management streamlines data collection and ensures accurate data, saving time and increasing accuracy.

4. Use of RFID Technology for Asset Locating and Management

RFID-enabled technology is used to enhance infrastructure asset management, including buried or above-ground assets.

RFID-based systems for asset locating and tracking consist of:

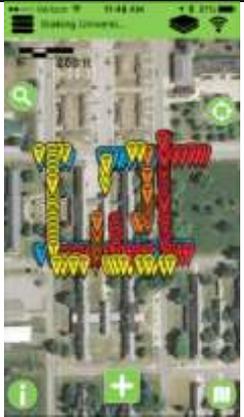
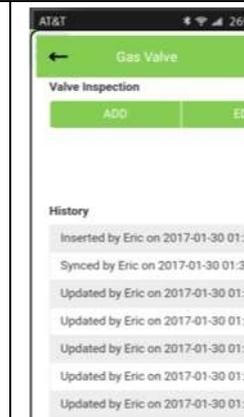
- A UHF transponder (tag/smart label) with data memory and antenna,
- RFID readers that receive and transmit UHF signals and transmit data via bluetooth
- a mobile device for gathering data in the field, and
- connected GIS and / or Asset Management Systems.

Together, this system provides precision and the data required to access the greatest benefit from GIS systems.

This system works in three steps:

4.1	Installing the RFID-enabled marker	<p>In the field, place the RFID tag on or over the asset to be marked. Data that includes asset owner, latitude and longitude and asset type is written to the tag using the RFID reader connected to smartphone software. The smartphone software features basic configurations that are designed for asset tracking. Information, such as photos of the asset, condition assessment and so on can be added to the record. This information is saved in the app for uploading to the asset management platform or uploaded immediately, depending on the configuration.</p>	 <p>Figure 1: RFID tag placed over asset</p>  <p>Figure 2: Post marked with RFID tag</p>
4.2	Identify and Verify the Asset	<p>Asset information created in the field is available in your GIS and / or an asset management system. Asset managers can see an accurate view of infrastructure assets and use this data for planning, compliance and maintenance scheduling.</p>	 <p>Figure 3: Field technician writing to RFID tag</p>
4.3	Identify and verify the asset	<p>When it's time to find the buried asset again, using the map on the mobile software, select the asset represented by a pin on the map. Or, if you know you're in the right area, just do an RFID read of the area, and the tagged assets will load. Confirm the asset location and update the record before excavation.</p>	 <p>Figure 4: Identify and verify the asset.</p>

5. Triggering Access to GIS or Asset Management System in the Field

			
<p>View of assets in the app; colors denote type of asset</p>	<p>App screen before RFID tag is read.</p>	<p>Addition of additional information is supported</p>	<p>Audit record of a single RFID tag.</p>

6. Conclusion

RFID technology has benefitted many industries and now, in conjunction with GIS, asset management systems and mobile software, RFID is the key to providing complete location intelligence to surveyors. Locating, identifying and verifying buried utilities can now be accurate, streamlined and integrated into workflows. Accurate data makes utility locating and verification faster, eliminates confusion in the field and prevents costly and dangerous excavation errors.

RFID is a proven technology that is durable, affordable and scalable to all types of infrastructure assets. Infrastructure assets tagged with RFID act as a lynchpin between the physical world and the digital world, allowing surveyors to access to a wealth of data from existing GIS and asset management systems.

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BIOGRAPHICAL NOTES

Mike Klonsinski, BSIE, MBA, is president of Berntsen International. With more than two decades of executive leadership in manufacturing and tech organizations, Klonsinski focuses the company's 50 years of boundary and infrastructure marking expertise on creating smart marking technology. Its InfraMarker® solution puts precise locating and asset management in the palm of your hand. Incorporating RFID, GPS, magnetic locating and cloud asset management, InfraMarker gives a real-time view of buried assets.

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