An example of planimetric mapping created using remote sensing and utilizing aerial lidar and imagery.

# Demystifying Smart Cities:

## How Base Mapping Will Help Navigate Your Future

Technological advances seem to take place in leaps and bounds, as news breaks about innovations like the debut of autonomous vehicles or the availability of statewide base mapping or the concept/application of a smart city.

These innovative solutions are most often based upon the merging of incremental advances, many of which take place over years and through a variety of technological disciplines. The concept and application of a smart city is a great example of how multiple advances coming together to produce a unified, constructive leap forward in technology—both in generation and application.

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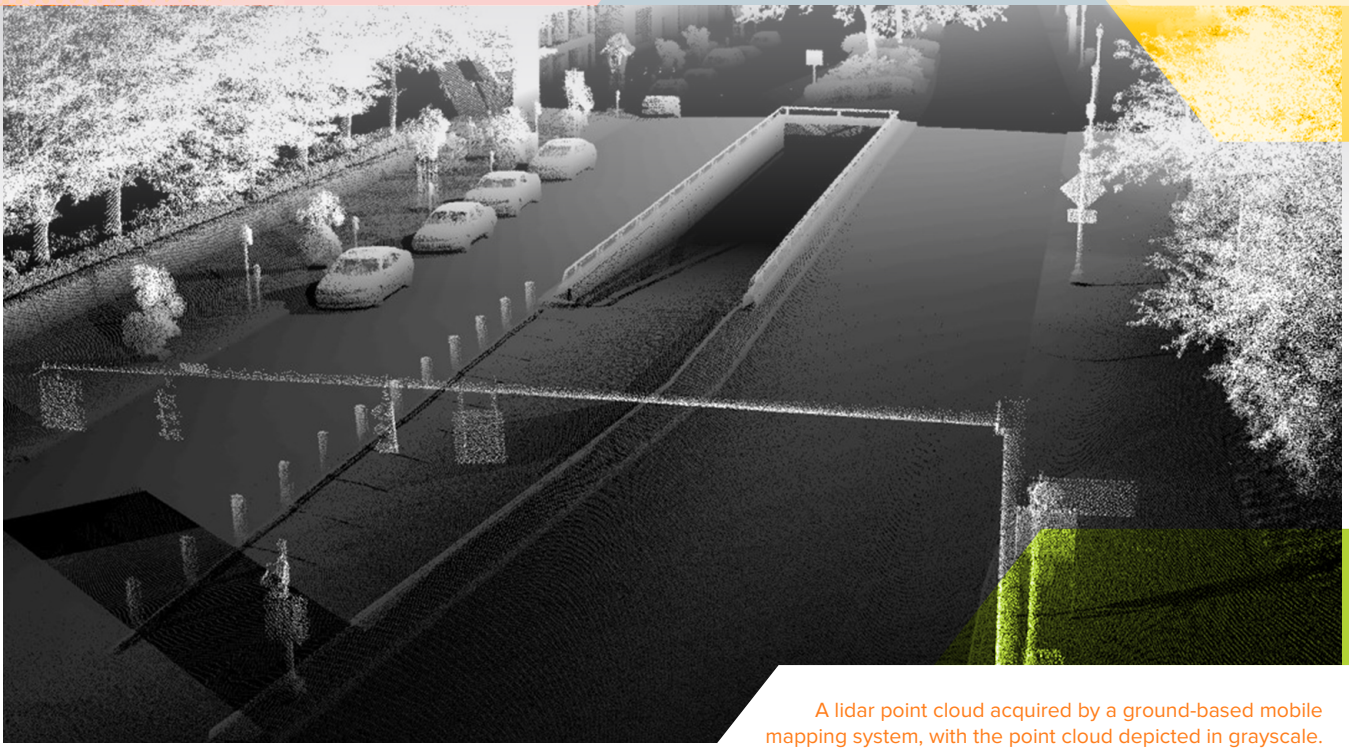
By pulling together components that support autonomous vehicle transportation, asset management, 3D technologies and more, a foundation can be created that will ultimately shape the experience and functionality for the sensory-enhanced metropolitan areas of the future.

Base mapping is essential for the accessibility and organization of these components, and the connectivity it provides forms the template needed for the smart city.

### Connectivy Provides Baseline

The Smart Cities Council acknowledges that there isn't a strict definition of what makes a smart city, but notes on its website that one consistently agreed upon characteristic is that it has "digital technology embedded across all city functions."

This connected technology is what forms the requirement for base mapping and subsequent operation of a smart city. It can be likened to planting a garden: When you plan what you're



A lidar point cloud acquired by a ground-based mobile mapping system, with the point cloud depicted in grayscale.

going to plant, it's important to view the garden as a whole and make sure everything works together from the start. And it's the work done below the soil, at the root level, that makes the difference in how well the garden grows.

For a smart city to work, you have to standardize the technology used across all city departments and accurately connect each data field.

To do this, a city must coordinate and think ahead. A city's information technology (IT) department is at the heart of this crucial planning stage because it has the holistic view of the city. Unlike utilities, which initially were a focus of the smart city movement, IT departments cross the lines of every city department. They work with utilities, transportation, city planners, etc., to not only see the potential of what you can do with this information, but also understand the chaos that will ensue if you don't coordinate.

The connectivity concept needed for smart cities has been recognized by multiple geospatial companies that leverage location-based services to generate geographic insights. These companies work with connected workplaces to automate, monitor and control products and services, while engaging and linking customers and the marketplace.

In other words, they analyze collected data to form citywide base mapping.

## CREATING BASE MAPPING

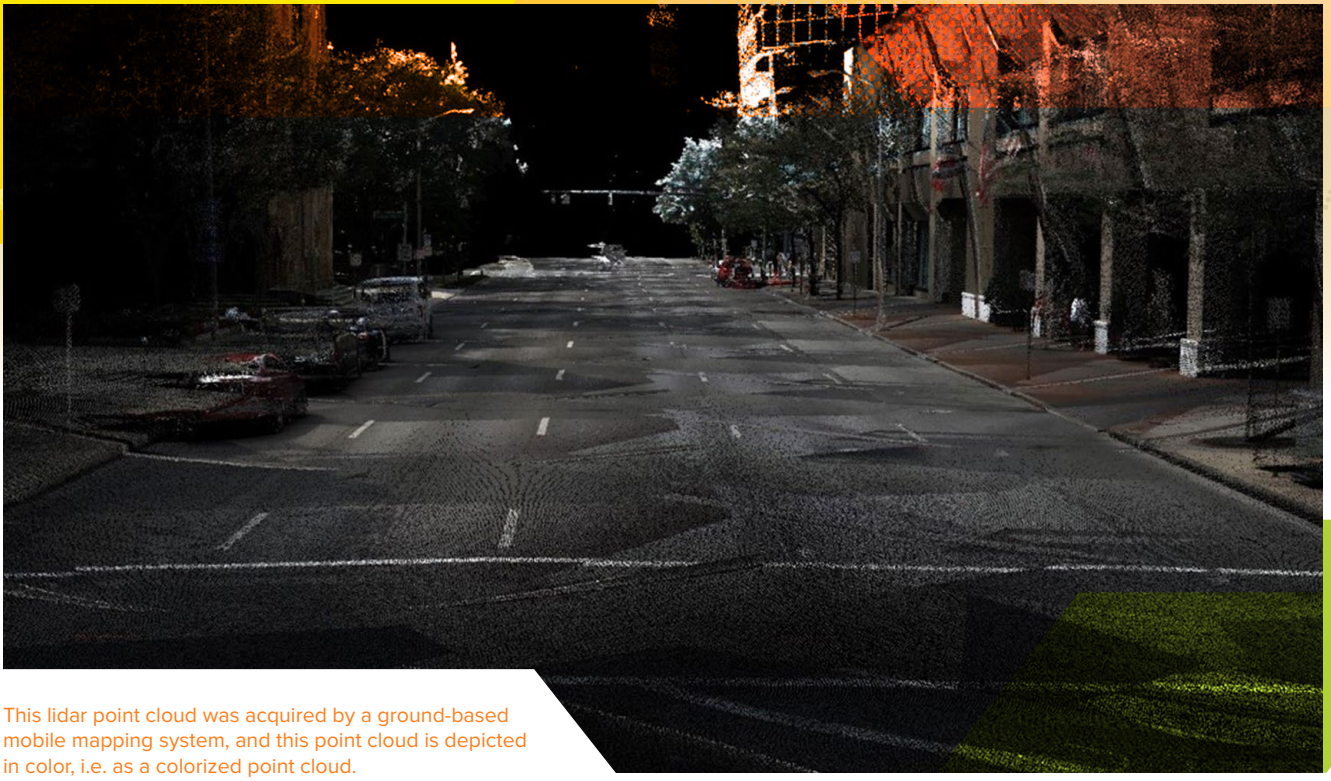
Geography has become the new alphabet for the organization of data; it gives people a literal place to start and a relevance to and investment in that information.

Cities have to decipher what level of accuracy is sufficient enough to fulfill these connectivity needs. They will want to address the varying data needs across a municipality, while maintaining the ability to standardize that data across the municipality's departments. This requires the kind of accuracy provided by 3D technology.

Generated from underground, indoor, street level, aerial and satellite imagery, 3D data creates a foundation for an asset registry. Through this registry, assets can be managed as part of an integrated GIS data framework within whatever scope is relevant—from a nationwide perspective down to a specific property.

The plan for managing assets within the framework of the smart city initiative is to create an architecture of network, policies and procedures with no default settings to create an auditing structure to know what exists and what needs to work together.

Asset management, traditionally maintained in a paper and/or CAD-based system, is progressing toward the use of high-accuracy base mapping in a GIS environment, which is a recent way of thinking that applies to every municipality. By identifying and accurately locating the assets (light poles, roadway paint, signage, etc.) across the municipality, cities can better manage



This lidar point cloud was acquired by a ground-based mobile mapping system, and this point cloud is depicted in color, i.e. as a colorized point cloud.

and budget maintenance accordingly across all departments.

By focusing on the life cycle pervasively throughout an organization, information systems are integrated and employed. Some of those include GIS, Computerized Maintenance Management Systems (CMMS), enterprise asset management (EAM) systems, computer-aided facility management (CAFM) systems and risk-informed critical infrastructure protection (CIP) strategies.

At the heart of this framework is GIS base mapping and topology, which is a product of infrastructure inventory from planning to design, from inventory to assessment, and from implementation to maintaining.

## Examples Of What Connectivity Can Produce

There have been precedents set for the kind of collaborative connectivity that will be needed to lay the groundwork for smart cities.

Houston is the fourth largest U.S. city, with a population of more than 2 million. Like thousands of other cities, content was at one time managed by people standing in lines at a city building filling out thousands of forms. Woolpert is helping Houston implement a modern permitting portal to streamline the permitting process and more efficient connect the city with its citizens. The new Houston Permitting Portal will allow customers to quickly navigate the process online.

The introduction of high-performance computing, online forms, assistance and payment makes the city function better and centralizes information for record-keeping and accountability.

Houston is one example of this kind of data implementation, which benefits both the city and its citizens. Many municipalities are compiling available data to make information consistent, accessible and applicable to multiple city functions, which also lays the groundwork for future connected functions.

Statewide base mapping programs are examples of how public collaboration between federal, state and local governments can benefit from the smart city initiative by providing base mapping, an integral dataset needed to support the foundation of any geospatially referenced initiative. Statewide base mapping programs typically include the collection/processing of high-resolution imagery and lidar, which provides consistent geographic data that is made available to a wide range of users, including public agencies, private industries, private citizens and educational institutions.

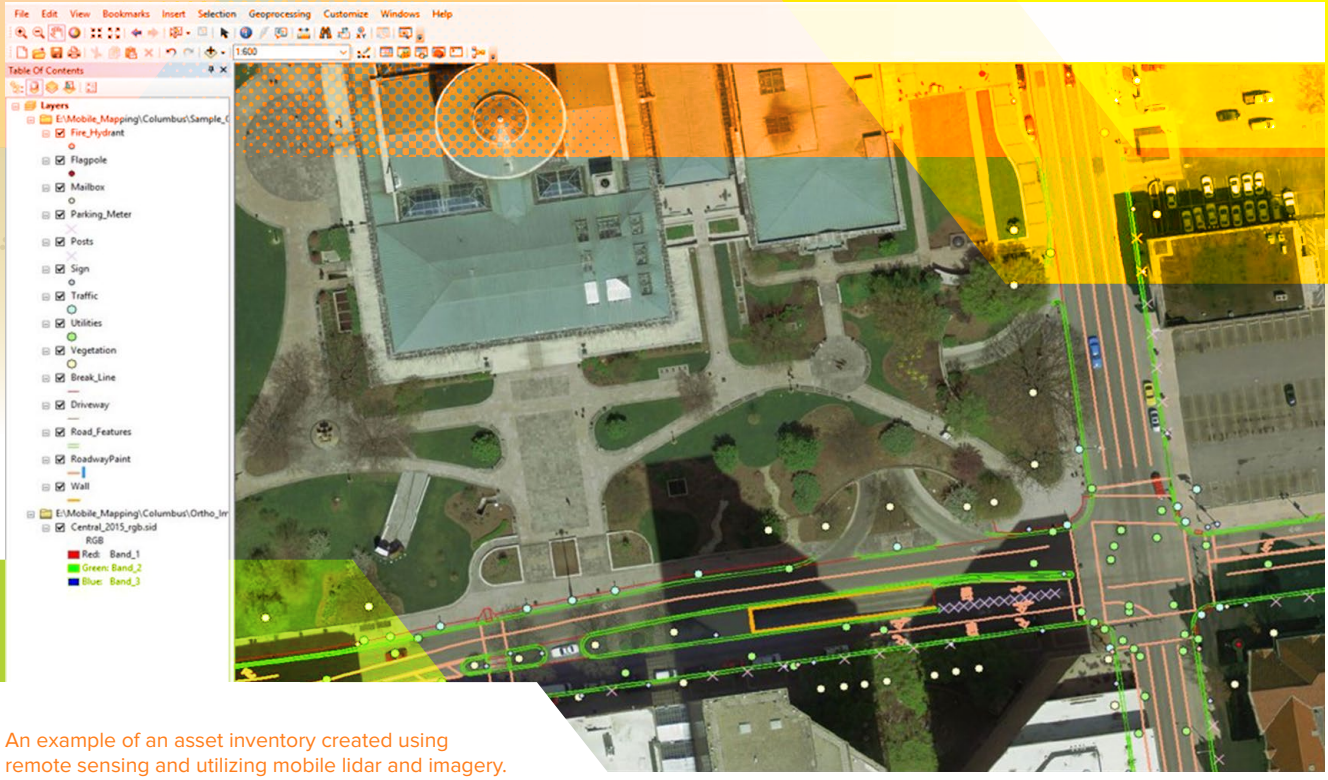
The smart city concept has the same framework as state base mapping programs; by collecting data, performing data analytics and making it accessible across the board, it connects all those who stand to benefit from it.

When there is consistent, applicable information made accessible at multiple levels, better decisions can be made.

## Columbus Selected To Lead The Way

In 2016, Columbus, Ohio, beat 77 other midsize cities nationwide to win the U.S. Department of Transportation's (USDOT) Smart City Challenge.

Columbus, dubbed the fastest growing city in the Midwest, was awarded




An example of an asset inventory created using remote sensing and utilizing mobile lidar and imagery.

$40 million from the USDOT and $10 million from Vulcan Inc. to develop ideas "for an integrated, first-of-its-kind smart transportation system that would use data, applications and technology to help people and goods move more quickly, economically and efficiently."

In an editorial published by the local newspaper, former USDOT secretary Anthony Foxx wrote about how Columbus was chosen because the city took the challenge a step further by connecting its deployment of technology and its larger challenges.

"We were impressed not only by Columbus' grasp of the technological possibilities, but also by how it knitted together those possibilities within its present-day challenges and longer-term aspirations," Foxx wrote. "Make no mistake: Columbus will do some cool things with technology. It will install street-side mobility kiosks, a new bus-rapid transit system and smart lighting to increase safety for pedestrians. It also will install traffic signals that communicate with vehicles so that the signals can adjust in real-time to the flow, rhythm and demands of traffic."

Since that designation, Smart Columbus was an organization formed to provide the vision for this reinvention of mobility.

## Conclusion

We all work and live in a three-dimensional world, which makes us all geospatially dependent when traversing through life. Base mapping, which is a foundation and lies at the heart of any geospatially referenced initiative (i.e. autonomous vehicles), provides a means to travel intelligently and establishes a "base" from which a smart city can grow.

When people are trying to work together, it is suggested often that they "get on the same page." Connected technology operates on the same premise. For smart cities to succeed, it will be necessary for the multiple technological elements involved to be able to communicate and work together effectively.

At the heart of the communication is base mapping, which provides all entities involved an accurate starting point to tie and bring together all aspects of integrating a successful program.

Fortunately, the technology required to create base mapping for these cites of the future already exists and has an established track record. The "trick" is to understand how base mapping integrates and complements with other technologies. The next step is simply a matter of connecting them to achieve a city's fullest potential.

If and when the people and departments creating these smart cities "get on the same page," we'll be able to work intelligently and leverage our resources to create an efficient, effective and highly advanced system that is well positioned for the technology of the future.

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