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# Building Our Cities Smarter

How APIs Take Smart Cities From Concept to Value

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The Internet of Things (IoT) and connectivity are transforming how we work, socialize and meet our most basic needs. Soon, technology will be so entrenched in the fabric of our lives that it will be invisible. Our homes, cars, offices, public spaces and governments will be connected, and they will look drastically different than they do today.

Innovations will spread from smart things to smart places to eventually whole cities and regions. The Internet of Things promises to transform not just things, but also the world at large—starting at the local level, with our cities.

But it takes more than just technology for this vision to be realized. And most cities today are a long way away from the utopias technologists dream of when they think "smart city." So where should concerned citizens, businesses and local governments get started in building the smart cities of tomorrow?

This is an enormous question, and one that almost all cities are still grappling with. This white paper aims to simplify the smart city opportunity by breaking it into parts and providing a framework for bringing these components into a holistic, city-wide solution built on application programming interfaces (APIs). Additionally, it presents a case study of how Cascais, Portugal, has been transformed by technology to achieve quantifiable benefits as a smart city.

Regardless of where you currently play in the smart city ecosystem, **you are only three steps away from realizing value.**

## 1. Identify opportunities for value and the enabling tech.

Determine the key challenges and pain points specific to your city. Is mobility a problem? Waste or energy management? Citizen engagement? Infrastructure? Your city will tell you where to begin.

## 2. Invest strategically in pilot programs.

Consider how one technology can provide multiple solution benefits. For example, cameras and sensors can be used to monitor traffic, manage city logistics and provide emergency responses. Innovative cities begin pilot programs at the domain level—through smart buildings, airports, campuses and other smart places—to test and refine solutions before scaling.

## 3. Integrate smart domains into city-wide solutions.

The most valuable technology is data and the decision making it enables. These insights help improve city operations, delivery of services and quality of life. The most advanced smart cities are integrating investments across domains into centralized, comprehensive solutions that provide a correlated and single view into the city, fostering efficacy and efficiency.

## Ready to get started?

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# Identify

## What makes a city smart?

A city is smart when investments in **human and social capital, traditional infrastructure, and enabling and disruptive technologies** fuel sustainable economic growth and a high quality of life, with wise management of resources through participatory governance. How is this vision realized for the people, places and things that make up our cities?

**People:** In a smart city, citizens rethink how they engage with their government, service providers, businesses and homes. In fact, they must rethink how they will live their lives, and what quality of life will look like in these new connected environments. A smart city is of little value without engaged citizens who actively participate in decision making, namely through data generation and sharing that enable the benefits of a smart city to be realized.

**Places:** To achieve buy-in from citizens, investing stakeholders must understand key pain points that are specific to the constraints of the city, and existing infrastructure must be brought into the digital age through technology. This doesn't happen overnight. It usually begins with specific industries, places or infrastructure, such as in transportation and logistics, military and government, or healthcare. In many cases, it begins with private-sector investment. These smart places are the pilot projects that eventually come together to create smart cities.

**Things:** Only with investments in and an understanding of social capital and infrastructure can integrated technologies begin to solve challenges in the city. This connectivity layer acts as the "nervous system" that connects a smart city and that intelligently provides the adequate management of services: a city "brain."

Data in a smart city creates insights that can resolve challenges and create a better quality of life for citizens—the most important stakeholders in its transformation.

# Invest

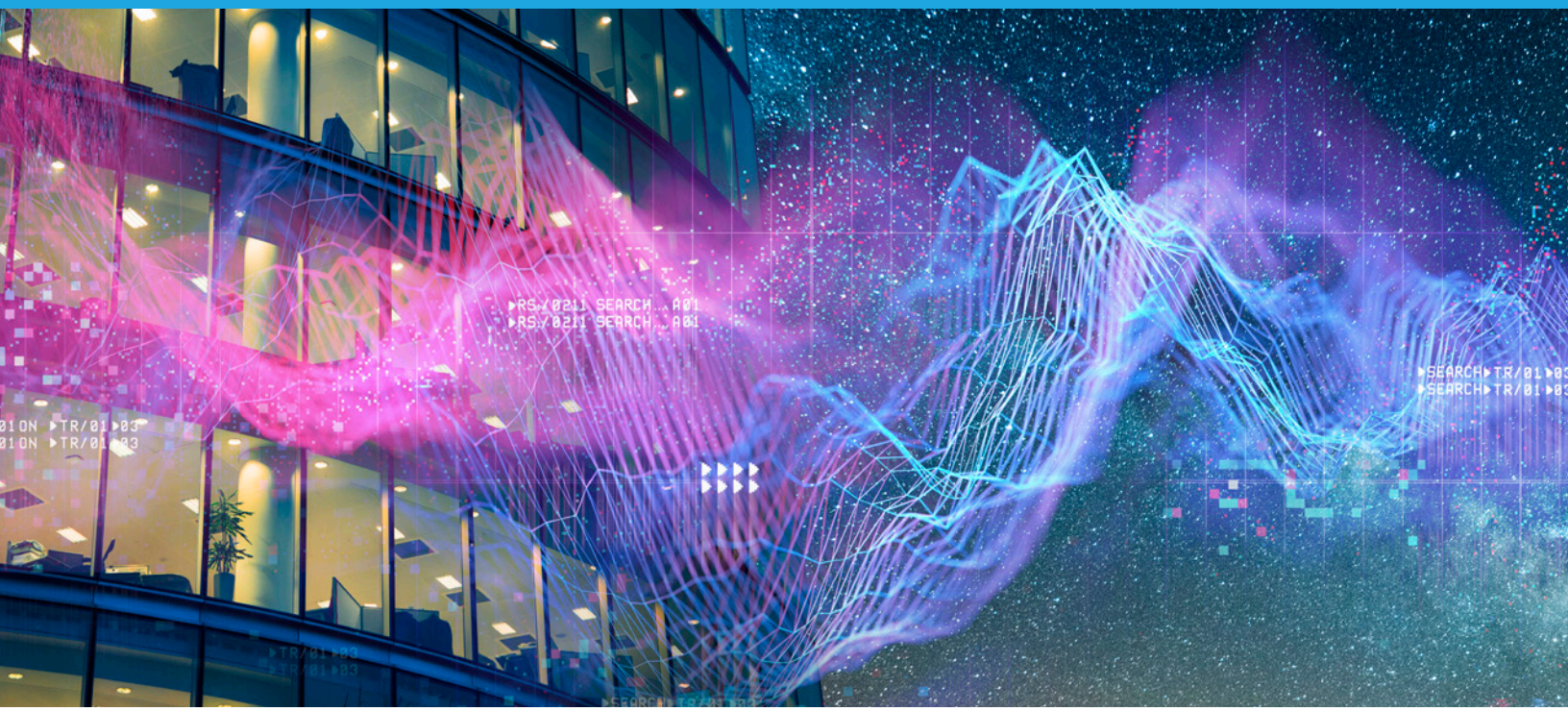
## Welcome to the cities of the future.

In a smart city, people, places and things are brought together through technology. Today, the availability of low-cost sensors and data processing, the widespread proliferation of mobile devices and networks, and innovations in the private sector have created an enormous opportunity for cities to jump-start innovation in the following areas.

**Mobility:** One of the primary goals in a smart city is to increase mobility. Mobility refers not only to traffic and public transport of people and goods, but also to accommodation for the disabled and the ability of citizens and tourists to move through the city by foot. Technologies like sensors, cameras and mobile apps engage citizens to increase mobility while providing governments with data that can be used to improve logistics and service delivery.

**Environment:** Innovations in waste management, power, water and utilities allow cities to manage and reduce consumption of scarce resources. Smart sensored lighting and power grids monitor usage and provision output based on real-time need. Existing infrastructure, such as waste collection equipment, can be made smart through sensors and connectivity. Aggregating this data with inputs from consumer products optimizes energy management and reduces environmental impact across the city.

**Government:** Smart cities are safer cities. By applying technology to public safety, local law enforcement has a better understanding of aggregated citizen behavior and can respond faster in emergency situations. Citizens are more engaged through mobile apps that allow them to report problems and participate in public services in real time. The ultimate goal is for governments to have a single, centralized view of their cities, combining logistical, infrastructural and environmental data from the public and private sectors. This helps governments to smoothly plan for emergencies and for growth based on up-to-date intelligence.



## Integrate

### A single source of truth through a city operating system.

Cities are arguably the most complex organization of resources, people and ideas ever—and no two are identical. All cities have different approaches to serving their citizens, and the same is true for smart cities. Some governments within smart cities provide technology-enabled services themselves, while others outsource these services, and some deploy a combination of both. This is why the third stage of building a smart city is the most complex and important stage of all: integration.

The ecosystem of operators, services and citizens in a smart city generates an enormous volume of data. And, by nature, it is a living body constantly transforming and adapting as citizen needs and behavior change. When cities deploy a combination of public-sector, private-sector and citizen-owned investments, it is impossible to gain a centralized view of the city without a conscious effort. Here is where we begin to draw the line between a city that has invested in smart technologies, and a truly "smart" city.

A smart city has the appropriate buy-in from citizens and businesses to collect data in aggregate. While technology provides value on its own, this coordination and management elevates investments from domain-level to integrated solutions.

Data is generated by potentially thousands of different sources within the city: assets and infrastructure, enabling technologies, government and enterprise systems, and citizens' mobile devices and smart home products. Smart cities need a way to collect, analyze and draw operational insights from this data in real time.

More-advanced smart cities around the world are implementing command centers where the various domains are integrated into a city operating system: a centralized, government-managed data store with robust analytics and service management capabilities. Through integrated systems, municipal governments act in real time, save money, deliver better services, improve logistics and increase quality of life for residents, while creating a better environment for economic growth.

In a smart city, this integration is built on APIs, which provide value by enabling the secure flow of data between systems, devices and citizens. Developers, service operators, businesses and citizens participate in this ecosystem via APIs and foster continuing innovation.

Let's look at four ways APIs take cities from a collection of smart places and things to an integrated solution.

# Four Smart City Challenges APIs Solve

## 1. Building open systems of record and systems of engagement

### The Challenge

Smart cities are all about data. Data comes from a variety of sources (infrastructure, mobile apps, business and government systems) that must be stored in a system of record. Additionally, mobile apps and IoT services are systems of engagement that provide a user interface through which IoT and smart city experiences take place.

Cities must emphasize the importance of data collection and analytics in order to realize the value of a smart city. They must invest in developing systems of record and systems of engagement that are open, accessible and intuitive to users. In doing so, cities foster a culture in which citizens trust the methods and purposes of data collection and actively participate in the smart city ecosystem through engagement with these open systems.

### The API Solution

APIs allow the free flow of data into systems of record and systems of engagement to collect and store IoT data that can be turned into insights about the smart city. Through APIs, citizens can engage with local government, services and systems through the platform on which they are most comfortable: a mobile app.

APIs provide a low-cost solution for governments to begin to invest in making components of the city—such as public transit systems and infrastructure—smarter through technology. Additionally, open APIs allow governments to build on existing investments in the private sector. As we will see later, these systems of record and engagement form the foundation of a smart city by centralizing the data generated from its inhabitants, businesses and government. Combined with self-service analytics, reporting, and management tools, these systems transform data into sources of real value for the city.

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## 2. Integrating the tools and components of a smart city

### The Challenge

Multiple devices, infrastructure components, systems of record and systems of engagement must come together in order for insights to be drawn from the data produced by a smart city.

Investments take place at different stages and often begin as pilot programs in specific industries, municipalities or problem spaces, eventually scaling to larger, interconnected solutions. A truly smart city brings together all the investments within the private and public sectors and with existing infrastructure, services and platforms (such as citizens' mobile devices) into a single, centralized management system.

Attempting to manually integrate all these systems and investments into a single platform would be an extremely time-consuming and resource-intensive task. In fact, with data coming from the public sector as well as from citizens' mobile devices, it would be near impossible to orchestrate all these dispersed elements without an integration strategy.

### The API Solution

APIs provide a means for businesses and mobile app providers that have agreed to share their data with local governments to do so seamlessly and securely,

# Four Smart City Challenges APIs Solve

without the need to build new systems or write complex, custom code. APIs enable infrastructure, devices and systems to be connected into a single source of truth for the city.

With APIs, systems can interconnect and share data without having been built with this goal in mind. This means that although data will be coming from sources as different as sensors, mobile apps and business systems, it can be integrated into a common format and central system from which insights can be drawn.

This data is seamlessly and simultaneously shared with multiple parties. For example, through APIs, driving data is sent to insurance providers to enable personalized safe-driver discounts, as well as aggregated with traffic data and feeds from connected infrastructure, sensors and cameras to provide real-time information to the city at large.

## 3. Securing access points and protecting citizen information

### The Challenge

Smart cities collect large volumes of personal data about citizens through connected technologies like sensors and cameras. Citizens typically consent to this data gathering, on the conditions that they are gaining a proportional benefit in time or monetary savings and/or quality-of-life improvements and that the data is appropriately protected and shared only with trusted officials, such as governments, healthcare providers and regulated businesses.

The intersection of smart-city investments with highly personal citizen domains such as mobile devices, homes, offices and healthcare facilities demands that there are regulations in place to protect this data. A city-level data breach could potentially expose the sensitive information of hundreds of thousands of people, or cause widespread outages.

Digital transformation does not stop at the intelligent management of domains and the connection and monitoring of "things." Cities must ensure the integrity and security of the information they collect.

### The API Solution

A smart-city architecture built on APIs enables secure access to open data, allowing the registration of programmers (citizens and the private sector) through an API portal to accelerate application development and monitor and control the flow of data. At the same time, these developers are free and encouraged to participate in the smart city through secure and regulated APIs, generating additional value.

APIs protect the flow of data both by authorizing access only to trusted third parties and by constraining which types of data these parties have access to. With APIs, security is built in by design and throughout the smart city technology stack, from app to device to infrastructure components and larger systems of record. A high degree of integration and interoperability is achieved while data is protected.

# Four Smart City Challenges APIs Solve

## 4. Making the city work for all

### The Challenge

With any city investment, a key challenge is ensuring that it does not increase disparities along economic, social or demographic lines. It can be difficult to ensure that the smart city is open to all. The barriers to entry in a smart city are high, with large upfront expenditures required to build infrastructure and systems from the ground up. For businesses, there is a risk that these high capital expenses will be prohibitive to participating in the smart city ecosystem.

Additionally, cities must consider the range of social, economic and mobility needs that exist among the various demographics of the city. While moving traditional services into the digital age may appeal to younger, tech-savvy citizens, these types of changes will require increased adaptation from certain communities.

When city governments and businesses begin to see savings from smart technology investments, it is important that these benefits are passed on to citizens through improved service delivery, monetary savings, or both. This will ensure buy-in from all stakeholders in the city—not just government officials.

### The API Solution

APIs reduce development friction by integrating existing investments in the public or private sector with new smart initiatives, reducing some of the barriers to entry for businesses and service providers. Additionally, APIs enable citizen participation in the smart city through mobile devices. In most major cities, mobile devices are ubiquitous, so most citizens can participate. The more these barriers can be reduced through data and APIs, the more the benefits of smart technologies can proliferate across enterprises, citizens and government.

APIs allow data to be shared with government and private businesses simultaneously. Thus, while the government achieves cost savings and value from the smart city, citizens can receive personalized benefits, such as health and auto insurance discounts tied to their personal data.

New technologies should be continuously introduced in the smart city to improve conditions for disadvantaged groups such as disabled, elderly or poor communities. Technologies like natural language interfaces that enable citizen engagement in intuitive and accessible ways can be integrated through APIs.


CASE STUDY

# Smart Means Real Achievements

Innovative technologies, a platform to collect and analyze data, and a foundation of secure, governed APIs enable smart-city opportunities to become a reality. Around the world, many cities are getting started in this digital transformation, and some have already seen demonstrable results.

## Let's take a look at one example of a smart city done right: **Cascais, Portugal**.

Cascais, a cosmopolitan city located within the Lisbon metropolitan area, has a population of 220,000 from approximately 123 nationalities (including 20 percent expatriates). The city attracts more than 1.2 million visitors per year. Since Cascais' motto is "the best place to live for a day or a lifetime," this volume of tourism presents unique challenges for the city in mobility, resource management and service scalability, and can have undesirable impacts on quality of life. Cascais has sought out innovative technology solutions to support and engage its existing population, such as by attracting investment from clean and high-tech companies and new universities, and to offer scale for peak tourism seasons.

Cascais implemented a number of mobile apps and smart services that have already produced measurable benefits:

**Mobi.Cascais** is a mobility-as-a-service solution that integrates public and private services to allow citizens to reserve, manage and pay for mobility through a daily, weekly, monthly or yearly fee. Services such as bike sharing, car sharing, smart parking, taxis, on-demand transport, carpooling, electric vehicle infrastructure, and bus and train transit information are available through a smart card that users can connect to through an app or Web portal. The impacts have been far-reaching.

**2,000** shared bicycles

**1,280** connected parking spaces

**12** connected bus lines

**10 to 23 percent** savings in citizen mobility costs and **100 percent** savings for students

**Smart waste management** through sensors and integration with mobility data and public infrastructure enables operational and energy savings for the city. Sensors track the fill level of more than 400 underground recycling bins, allowing the city to optimize routes for garbage collection trucks on a per-day basis. By integrating real-time data about traffic and road conditions, the city can identify the best times for garbage collection, furthering efficiency and savings.

**€900,000 savings/year** in waste management; ROI in less than one year

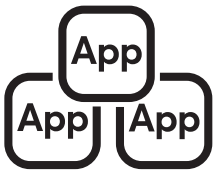
**400** underground recycling bins

**350 tons** of $CO_2$ savings

**93 percent** citizen satisfaction with the service–a 10 percent increase

**Up to 40 percent** reduction in operational costs

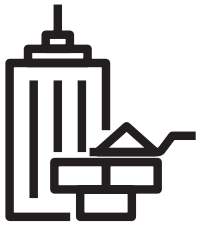
**Up to 20 percent** reduction in energy usage




**FixCascais** is an app that allows citizens to photograph and report problems in the city, enabling direct communication with appropriate municipal services.

**CityPoints** is an app that awards citizens with points for practices that benefit the city. Users can exchange these points for goods and services at participating local businesses.

## Behind the Scenes of a Smart City



Besides great governance and PPP that allows the financing of this groundbreaking project, what technologies are enabling these incredible results? A combination of smart-device and infrastructure investments, robust self-service analytics, military-grade security, and full lifecycle API management. Together, Deloitte and CA Technologies are providing solutions to the city of Cascais that have turned a collection of smart initiatives into an integrated, correlated and operational smart city.

Cascais selected five initial domains—mobility, public infrastructure management, street light management, waste management and information and communication technology (ICT)—as the initial scope for its smart city program. In the next phase, the city is scaling to support 12 vertical domains. The city's smart domains, legacy government systems and data from thousands of smart objects have been integrated into the Cascais Command Center (C3) in a pilot developed by Deloitte on top of its city operating system called CitySynergy™.

## CitySynergy™ Deloitte's IP to Foster Our Presence on Build and Run Solutions

### The integrated city operating system—an "operational brain" to support the City Command Center and a "nervous system" to provide sensing to the brain through integration and security

**CitySynergy Protect:** Thousands of managed "things" and connected citizens are thousands of eventual open security breaches. Protect is a security and compliance, up-to-date protective layer around the command center that ensures full data regulation compliance.

**CitySynergy Intelligence:** Applies BI and analytical methods to the collected data to foster process automation and continuous improvement and optimize operational efficiency and cognitive algorithms for machine learning and artificial intelligence—namely near-future prediction and support in planning for growth and scale.

**CitySynergy Command:** The core of the City operating system, centralizing the City vertical domain events, incidents and requests, and dynamic asset management—fostering event correlation and real-time collaboration on top of standard operating procedures. The result is high-quality service management, efficiency, efficacy citizen satisfaction and sustainable growth.

**CitySynergy Insights:** Provides to all stakeholders contextualized, synthetic and visual reporting information about the service and operations, relevant for decision-making and citizen input and feedback.

**CitySynergy Integrate:** Ensures the expansion of a range of functionalities of the command center through the solid integration of new modules, such as vertical service domains (through APIs), IoT, legacy systems, citizen and stakeholder contextualized communication and social login.



Simply put, CitySynergy Command, together with CitySynergy Insights and Intelligence, form the "brain" behind the smart city that delivers data visualization and analytics capabilities in the form of customizable reports, dashboards and maps. This integrated system creates operational insights that speed decision-making, enable the city to coordinate and improve operations, and fuel growth.

CA Service Management is a critical component of CitySynergy Command's orchestration of the vertical domains with integrated incident, request and asset management, providing a full picture of the domain service management for C3. A portfolio of integrated and orchestrated city services makes it easy for end-users to request services and assets, resolve issues and get answers. This is possible due to brand new City Service, city KPIs and SLA catalogs built by Deloitte based on best practices and standards.

With CA Service Management, process automation ensures consistency and efficiency of support and fulfillment processes, while risk and service disruption are minimized as incidents, problems and changes are collaboratively and proactively managed. Analytics and real-time dashboards facilitate better decision-making and overall management of services and support costs, with attention to delivering better-quality services to citizens.

In Cascais, APIs play a crucial role in integrating, securing and scaling the smart city. Data from each domain is brought together into the C3 through a comprehensive integration and security layer called CitySynergy Integrate. Built through a series of APIs, CitySynergy Integrate allows Cascais to connect scattered verticals and drive operational efficiency.


CA API Management, built into the CitySynergy Integrate platform, helps government and citizen data and city investments remain protected and secured, without prohibiting access. Open standards such as OAuth and OpenID Connect provide mobile and IoT security, and full lifecycle API management enables integration, orchestration and transformation of IoT events into insights.

CitySynergy Protect complements CitySynergy Integrate with an up-to-date security and compliance protective layer around the C3, at the same time ensuring full data regulation compliance.

Through CA API Developer Portal, developers, universities, businesses and citizens can participate in the smart city via secure, open APIs. Private-sector participation enables the city to accelerate development while monitoring and controlling the flow of its data.

Open data means providing unrestricted data to everyone. It is not just a "valuable revenue stream" for government—it is a public good. But this public good can be transformed into a "valuable revenue stream" by others. It can also create pressure on the city ITC or be hacked, so cities must ensure access control to avoid data abuses.

Sometimes shared data is restricted because it provides a revenue stream—it is only available to people who will pay for it. Or, more frequently, data is restricted because it is sensitive in some way, either because it is personal or because of security risks. The CitySynergy API Portal for Developers provides information about how to log in and integrate with CitySynergy APIs, enabling developers to build apps or perform research and development projects to further increase open participation in the smart city ecosystem, while protecting sensitive data.

Data is the "new oil," and must be adequately managed. Smart cities produce volumes of data the likes of which cities have never experienced before. A single connected vehicle can generate 1TB of data a day. APIs enable city systems and infrastructure to scale for this new connected era. Cascais plans to integrate additional domains—from air quality to health and education—in the next stage of its project.

Through technology integration, powerful analytics and a conscious understanding of the needs and behaviors of its citizens, Cascais has taken its smart city from concept to quantifiable value.

# Will your city be next?

For more information, please visit **ca.com/api**

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