

White Paper

Powering Digital Transformation in Smart Cities: The Role of Smart Buildings

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IN THIS WHITE PAPER

The adoption and growth of Smart Cities worldwide is accelerating the digital transformation (DX) of our urban environments. Smart Cities look to harness the data from smart devices, networks, cloud infrastructure, and applications and analytics to develop new insights as well as new products and services that support sustainable economic development. Smart buildings, whether publicly or privately owned, can serve as an important catalyst for that growth.

This white paper discusses how smart buildings can be both a microcosm of a Smart City and an integral building block for smart communities. It explores how urban policy makers, building owners, real estate developers, and technology vendors can maximize the benefits generated by smart technologies in public and private facilities in urban environments. Cooperative development of smart buildings is important because it will help attract and retain businesses, residents, and tourists to support sustainable city growth and, at the same time, help cities meet their environmental targets and build out needed communications infrastructure, significantly improving connectivity for building occupants and, if desired, people and services located near the building. Perhaps most importantly, when properly executed, it can help communities close the digital divide among citizens by boosting common access points.

The creators of Smart City technologies, along with equipment suppliers, carriers, and the commercial real estate industry, have key roles to play in the digital transformation of smart communities. This white paper concludes:

- State and local governments, private and public building owners, and technology vendors share many goals for operational efficiencies, facility cost reductions, and sustainability improvements. Stakeholder collaboration is the foundation for developing and executing strategic investment plans to develop smart buildings in the urban environment.
- State and local governments should provide the leadership to engage real estate developers, building owners, utilities, smart building technology suppliers, and communications providers in Smart City development. In many ways, it will be major communications providers that will help provide the infrastructure needed to assist with bringing smart buildings online in a powerful way. Cities that conscientiously build an issue-based ecosystem around connectivity and sustainability in buildings will most effectively promote smart building technology adoption and maximize progress toward Smart City energy and sustainability public and private development goals.

Why Are Smart Buildings an Important Part of Smart Cities?

Smart Cities are on a mission to produce outcomes-based digital transformation for their communities. For this, Smart Cities must capture new, more granular, and more timely data in order to implement solutions designed to solve environmental and business challenges. Cities need the insights from this data to improve decision making and customer service and to offer new digital services. In addition, the data from smart devices, high-speed networks, cloud infrastructure, and analytics helps cities understand the root causes of issues and the complex systems that are involved with challenges such as traffic congestion or neighborhood crime.

Cities around the world face many of the same challenges, such as rapidly growing and aging populations, global competition for talent and business investment, supporting energy sustainability, economic inequality and the digital divide, and keeping pace with technology innovations that have changed resident expectations for personalized mobile government services. These factors impact the daily lives of billions of residents, commuters, and business owners (see Figure 1).

FIGURE 1

Macro Challenges Facing Smart Communities Today



Source: IDC, 2018

City officials, real estate developers, utilities, building owners and managers, and even technology suppliers serve the needs of a common consumer – residents that are increasingly urban, concerned about environmental sustainability, and driven to live in areas that provide good economic opportunities and that offer modern conveniences, such as digital access to services. Consider the following:

- **Healthy and thriving cities are extremely important for the health of a nation and the global economy.** Cities generate more than 80% of the global GDP and are the economic engines of their host countries.¹ In the United States, commercial real estate construction contributes 3% of economic output, which means there was \$564 billion of commercial real estate construction in 2017.
- **Growth in global urban populations has significant ramifications on sustainability and the environment.** Today, cities house over half of the world's population, consume two-thirds of the world's energy, and produce over 70% of global CO₂ emissions.² According to the United Nations, 66% of the world's population will live in cities by 2050. Cities are taking charge to reduce their emissions or to be, as with Copenhagen, carbon neutral. For example, in the United States, according to a report by ICLEI, 37 cities have set emissions reduction goals at 80%+ by 2050 and 62 others have reduction goals above the targets set by the federal government.
- **Buildings also impact sustainability.** The United States Environmental Protection Agency has estimated that commercial and industrial buildings contribute 45% of the U.S. greenhouse gas (GHG) footprint. In addition, emissions from buildings are expected to grow faster than from any other source, and the fastest growth is from commercial buildings. Cities – as public building owners — have been adopting green initiatives, like LEED certification or smart building technologies, which can cut carbon emissions and reduce electricity use by as much as 30%, but have not often engaged private building owners around these initiatives beyond setting policies for energy targets.
- **Urban population growth also impacts other quality-of-life issues that Smart City solutions seek to address.** For example, the TomTom Traffic Index, 2017, which tracks the congestion of 390 cities across 48 countries, shows that traffic congestion is up 23% from 2008, and rising. Mexico City leads the world, with commuters spending an average 277 hours per year in congestion.

With a growing mobile and connected workforce, cities must work to attract business investment and the talent new companies require. Real estate developers and building owners must also differentiate their offerings to renters and home buyers; improving the urban environment is a common goal of these stakeholders and points to the need for collaboration. Also, in many major cities, landlords and building developers are realizing they need to come up with new services for tenants in order to remain competitive.

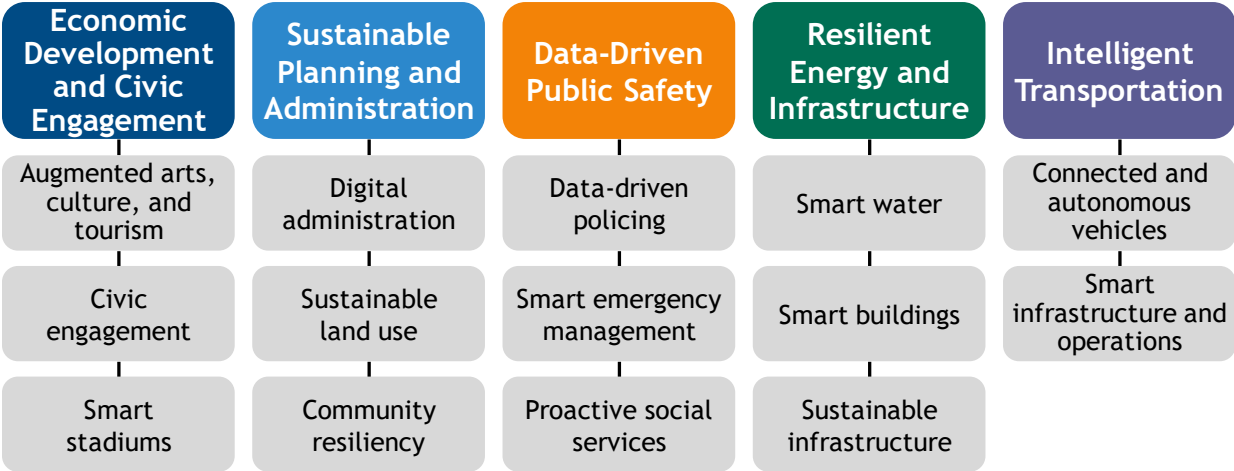
¹ www.worldbank.org/en/topic/urbandevelopment/overview

² International Energy Agency, *Cities, Towns & Renewable Energy: Yes In My Front Yard*, www.iea.org/publications/freepublications/publication/cities2009.pdf (2009)

Figure 2 shows the five key strategic priorities and the related programs that will be the most transformative and the most funded for cities over the next three years. Smart buildings could be a key component of the strategic priority of resilient energy and infrastructure, which extends also to building out the needed communications infrastructure to support Smart City solutions. For example, smart buildings could provide quick broadband hotspots for police, high access points for cell systems, platforms for traffic and security cameras, and so forth.

FIGURE 2

Smart City Strategic Priorities and Key Programs



Note: For more information, see IDC's *Worldwide Digital Transformation Use Case Taxonomy, 2017: Smart Cities* (IDC #US42992517, September 2017)

Source: IDC, 2017

IDC forecasts that the global smart buildings technology market will grow 16.1% over the next five years from a 2018 market size of \$30.5 billion (source: IDC's *Worldwide Semiannual Internet of Things Spending Guide, 1H17*). Real estate developers and building owners (from owned-occupied to leased to publicly owned buildings) are becoming increasingly aware of the benefits of smart building technologies, which include:

- Managing and reducing internal building energy costs
- Improving building and equipment maintenance
- Increasing efficiencies in business operations
- Achieving sustainability and corporate social responsibility goals
- Complying with new regulations and codes
- Attracting and retaining tenants and employees
- Serving as important infrastructure in Smart Cities and the Internet of Things (IoT)

As shown in Figure 3, 37% of state and local government decision makers report that they have smart building solutions in production or they are piloting such solutions. Many of these projects are related to energy monitoring and access control. While this represents a good base, there is clearly more growth possible for smart buildings.

FIGURE 3

Worldwide State and Local Government Smart Building Adoption Plans



Base = state and local government decision makers

Source: IDC's *Global IoT Decision Maker Survey*, 2017

What Is a Smart Building in the Context of a Smart City?

A smart building is both an internal platform capable of delivering transformational services, connectivity, and monitoring capability to its owner and tenants and a connected asset as a building block for citywide digital transformation efforts. As the Internet of Things expands, buildings will become the host for an ever-growing array of new smart devices.

This white paper is focused on two aspects related to smart buildings:

- The internal "smart" operations and building management, often mostly related to energy consumption (lighting, heat, etc.) and efficiency
- Leveraging the building as infrastructure for networking technologies to support the ubiquitous connectivity needed for Smart Cities

The Smart Building as a Microcosm of a Smart City

IDC defines a smart building as "a facility that utilizes advanced automation and integration to measure, monitor, control, and optimize facility operations and maintenance." A smart building uses a variety of automated procedures to control the building's systems and functions, such as the security, air-conditioning, heating, and lighting of the building. Installed sensors, actuators, and computer

systems help manage the functions, and the systems collect data and manage that information according to preset rules. The systems can also react to the data collected (e.g., changing a temperature setting based on data collected during the day or redirecting videocameras based on detected motion).

The rise of the Internet of Things is disrupting the building industry and has helped spark the rise of smart buildings (both new buildings and retrofitted older structures). Examples and applications of smart building technologies include:

- Smart elevators:
 - Predicting elevator traffic patterns to reduce wait times, energy use, and traveling distance for empty lifts
 - Reducing downtime of building elevator systems through remote diagnostics
 - Offering customizable solutions to suit the elevator automation needs while intelligently predicting service breakdowns and driving proactive and real-time actions
- Energy management:
 - Enabling accountability of energy consumption via smart grid tracking and dashboard analytics
 - Encouraging responsible consumption among customers
 - Managing future risks, reducing carbon footprint, and optimizing systems
 - Integrating lighting solutions to a single, converged, technology-agnostic network for centralized control of resources
- Public safety – when it comes to buildings, we often think of safety in terms of fire suppression, access control, and videocameras, but there is much more:
 - Monitors can be tied to integrated building management systems and communications systems. Essentially, if sensors read smoke, notifications are automatically sent to fire and police. Sensors show where the fire's heat signature is, and airflow to those areas can be automatically suppressed. Sprinklers are turned on, and illuminated floor guides also turn on to help people find a safe exit.
 - In case emergency services are needed, a variety of tracking mechanisms can be used, ranging from mobile phones to environment sensors and video, to help managers know exactly where people are and what the situation is.

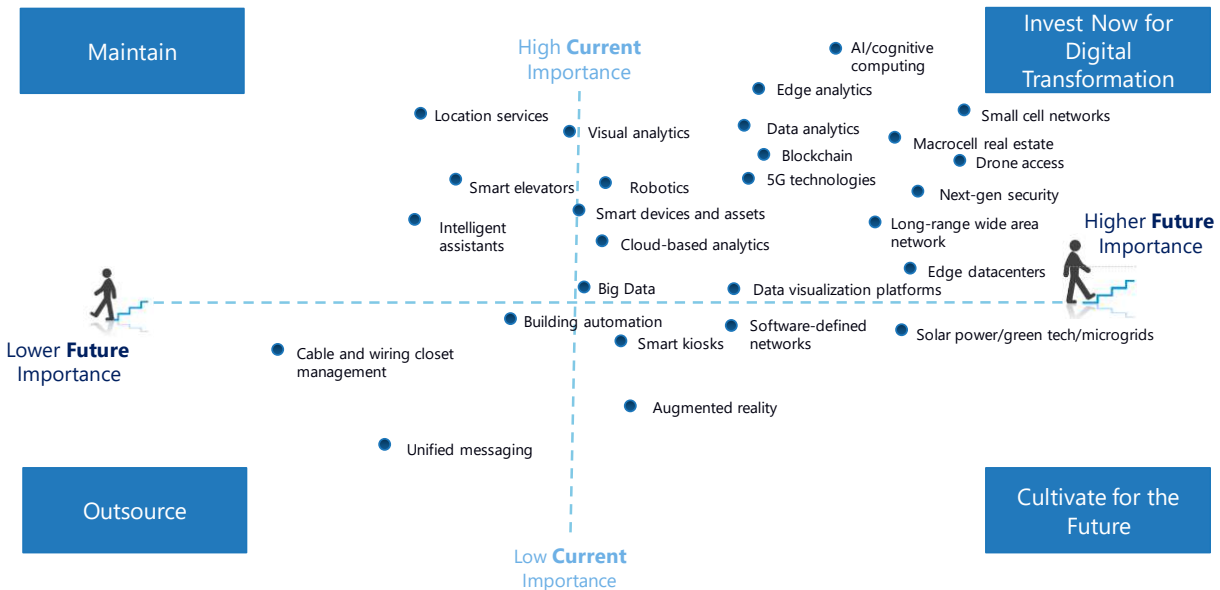
Given the variety of systems operating within a building, smart buildings must address some of the same issues as Smart Cities (e.g., ingesting data from a variety of sources and single-purpose devices and requiring a platform to pull together this data for systemwide analytics and decision-making support). To date, most consumer IoT devices have been single-purpose devices, with single-purpose applications to control them. For example, Google's Nest Thermostat is a complex device with a number of sensors built in, connectivity to the cloud, and a highly usable app to control its operation.

Smart building technologies, on the other hand, are more multipurpose and complex like Smart City technologies. Smart building control systems tend to be highly engineered, with emphasis on corporate needs like availability, redundancy, scalability, and security. With potentially thousands of monitoring nodes and control points, commercial networks are required to connect these devices together. With many devices from different manufacturers that are purchased and installed over a longer period of time, interoperability and integration can be challenging issues.

For smart buildings DX, key technologies will be more important over time, as shown in Figure 4. There are so many existing and emerging technologies that it can be hard to think strategically about investment over time. Figure 4 divides up key technologies related to smart buildings and Smart Cities by their importance over time. Technologies that are highly important now and will be highly important in the future must be invested in further, emerging technologies that will grow in importance must be cultivated, important technologies now but declining in impact in the future should be maintained but not grown, and low-impact technologies should be outsourced.

FIGURE 4

Technology Adoption for DX in Smart Buildings



Source: IDC, 2018

Managing a building can have a wider impact than just the building itself. For example, a smart building HVAC system can automatically precool a building or change when or how a rooftop unit operates. These changes are monitored and the impacts are quantified in the analytics layer of the smart solution. Good management of a building can both deliver a positive return on investment for the owner and have a wider impact on a city electric grid. In total, moving a building toward this level of digital transformation can help boost revenue, reduce costs, and provide improved services to citizens. It also can help boost the long-term value of the property.

Changes in equipment operations lead to reduced energy demand and/or a shift in energy consumption to a time when there is less demand overall on the electricity grid. The results can be quantified as cost savings first to the building, through reduced utility bills. But it also can help spur a reduction in the facility's carbon footprint, and it can help with efforts to support grid reliability through demand response. In other words, the operational changes to the HVAC system enabled by smart building technology can address the goals and motivations across the stakeholders, including real estate managers, communications professionals, utility companies, citizens, and community leaders.

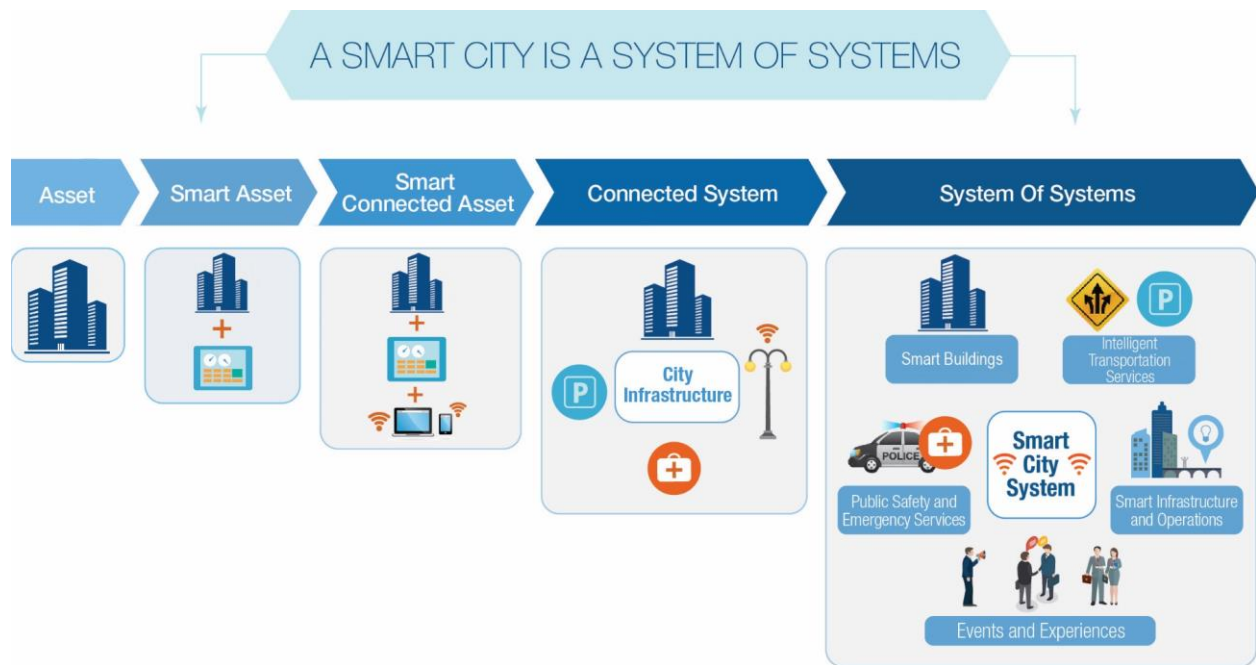
Coordination of policy development, investment strategy, and technology deployment can lead to greater use of smart building solutions by building owners to magnify the benefits generated by these energy management innovations.

Redefining the Smart Building as Part of the Smart City System

Beyond the traditional definition of a smart building, which is mostly focused on its internal operations, smart buildings can also serve as a connected asset in the larger Smart City ecosystem. Figure 5 illustrates the importance of this concept of scale and interconnectedness in Smart Cities. As physical assets, like buildings, become "smart" and digitally enabled with embedded software, they transform into "smart assets," managing their internal systems more efficiently. However, these smart assets now can also be connected to other smart assets and smart systems, becoming part of the larger city ecosystem. Smart buildings can be an important piece of this systemic view as they can be used to provide a variety of network connectivity options while serving as a platform for other sensors and devices that can capture, share, and communicate with each other. For example, smart buildings can be linked to police departments via IP-connected video and to on-street parking via sensors, as well as to smart outdoor lighting systems, and all of these can function together to provide a responsive and safer environment for residents, business, and visitors.

FIGURE 5

Systems Must Be Connected to Derive Maximum Value



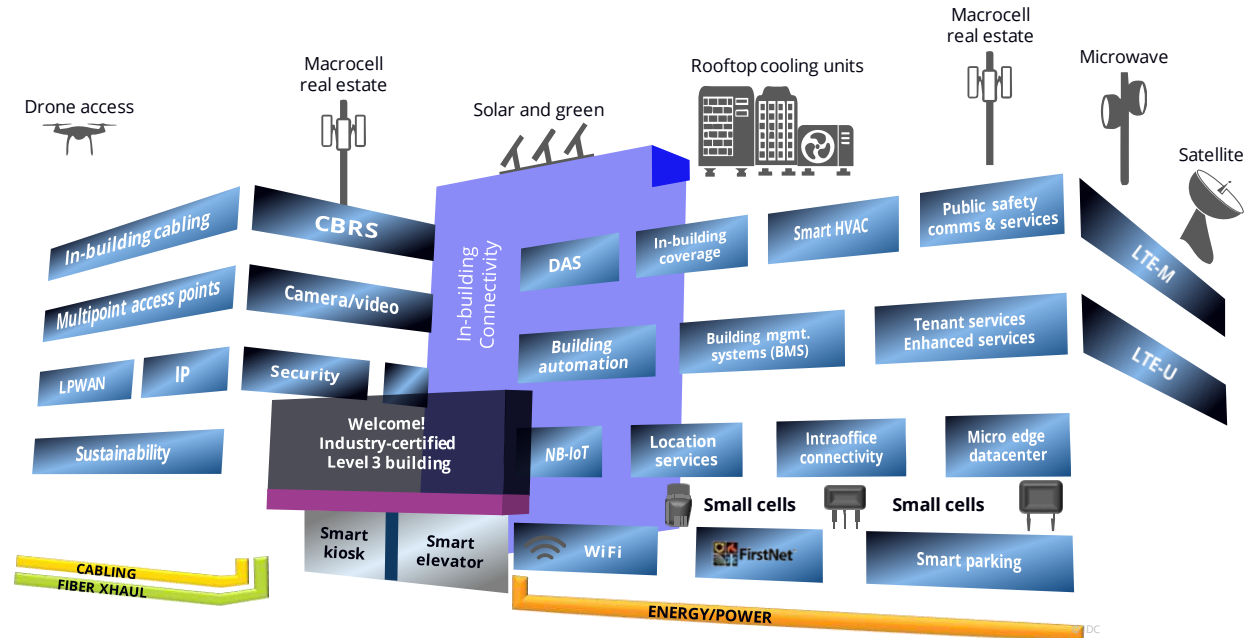
Note: This figure is adapted from *Harvard Business Review*, "How Smart, Connected Products Are Transforming Competition," Michael E. Porter and James E. Heppelmann, November 2014.

Source: IDC, 2018

In theory, multiple types of entities and communications services attach to buildings. Everything that attaches to the building can be leveraged, from gas to millimeter waves, satellites, copper, fiber, edge devices, edge datacenters within buildings, and more (see Figure 6). Piggybacking on this connectivity can also be a way of leveraging existing municipal permits while avoiding new investments of points of presence.

FIGURE 6

Smart Building as a Connected Asset



Source: TIA, 2018

By monitoring and streamlining everything (e.g., power consumption for security perimeters), by serving as a platform for cell system antennas and other communication devices, and by participating in a wide range of other smart initiatives, smart buildings serve as fulcrums and help a city achieve its broader digital transformation goals.

Spotlight Example: Buildings as a Platform for Small Cell Networks

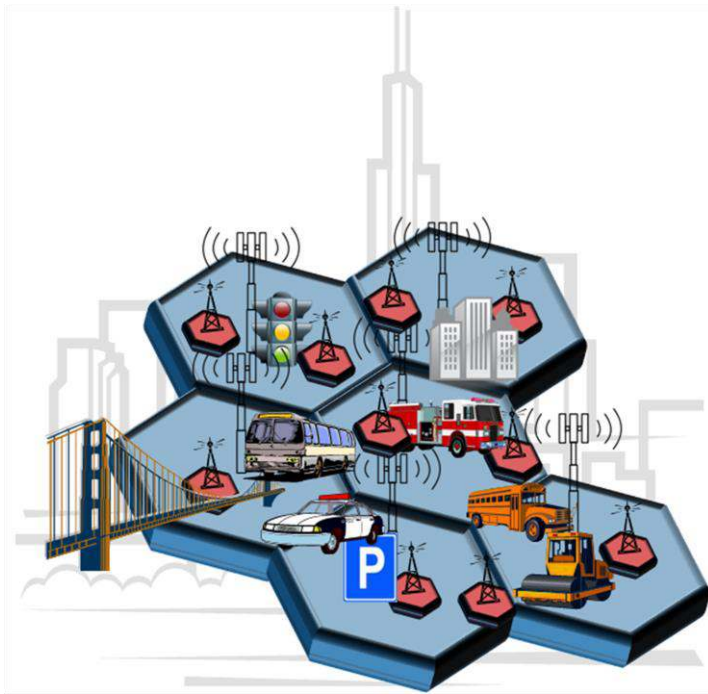
Much of the data collected "in the field" in cities today is a starting point for what we will call government "Data in Motion." Much of this data, from road sensors, traffic lights, and parking systems, needs to immediately flow into government networks, on its way to a variety of destinations. But sensors are placed in such a wide variety of locations that they are not always located near existing government WiFi or hardwired systems.

Metro or other dedicated "small cell networks" collect data and eventually feed it into city networks. In some cases, municipalities install small cell networks on top of streetlights or other outdoor infrastructure. In some cities there is a desire to tap into the network presence that can be found within smart buildings, which may already be wired with substantial bandwidth and which can serve as various types of platforms. This could include mounting areas for small cell network points of presence, placement points for videocameras, roof-mounted microwave relay systems, and more. Figure 7 shows a stylized view of how this fits together.

IDC predicts rapid growth of these so-called small cell networks in some areas, especially as they relate to 5G buildout. We can think of small cell points of presence as low-powered radio nodes. They may have a range of 12 yards to as much as a mile. In contrast, a larger mobile macrocell tower may have a range of 8mi+. A small cell solution tends to have a small radio footprint. IEEE 802.16, wireless LTE, and several other protocols may be supported (including some new technologies that are vying for 5G recognition). These small cell solutions may be used to provide wireless services within buildings or, more interestingly, to specific outdoor areas. Some commercial providers of mobile connectivity use small cells to extend their service coverage and/or increase network capacity in very specific areas, such as conventions, sporting events, outdoor gatherings, or mobile hotspots along highways.

FIGURE 7

MASC Networks in an Urban Environment

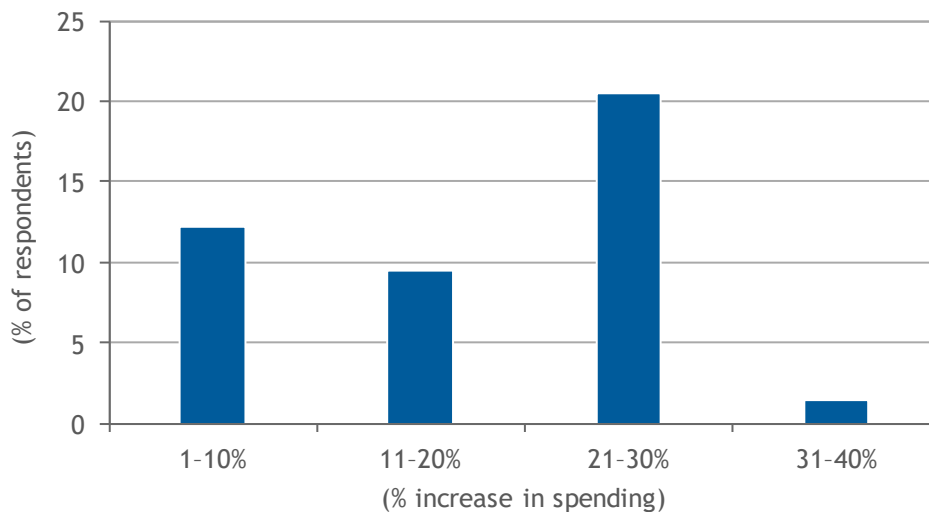


Source: IDC, 2018

Smart buildings also have an important role to play in the densification and ubiquity of networks. Network densification means adding more cell sites to increase network capacity; this is especially important in areas where there are a lot of mobile users, such as in urban areas. This is also a requirement for 5G networks, which will be designed to offer high capacity and high per-user data rates and as such are expected to require ultradense network configurations. Municipal governments are challenged to fund the connected infrastructure that can support 5G as well as other types of devices and network infrastructure to support a variety of different Smart City solutions. Fiber, high-speed broadband, and other wireless technologies are all needed to support IP video for safety monitoring and connected signaling for better traffic flow at intersections; however, the ubiquitous connectivity residents and businesses need in this digital economy can be beyond the budget of many cities. In IDC's February 2017 *Digital Transformation Leader Sentiment Survey*, 44% of government respondents said that telecommunications spending will increase in support of DX initiatives. Large increases in spending – of 21-30% – are expected of these respondents (see Figure 8).

FIGURE 8

Expected Telecommunications Spending Increases in Government for Digital Transformation



n = 132

Base = government respondents that said telecommunications spending will increase in support of DX initiatives

Source: IDC's *Digital Transformation Leader Sentiment Survey*, February 2017

There are more and more examples of business owners and real estate developers working with city government to address needs on both sides. For example, in cities in Europe and the United States, local business owners and property owners have paid for connected videocameras installed on streets or private property that are directly connected to city police departments for active monitoring and emergency response. In this way, the residents and private owners benefit with safer areas and the local police have an alternative way to fund infrastructure to provide needed services.

Collaboration Between Smart Cities and Smart Buildings Stakeholders

There are many ways in which smart buildings can influence the evolution of Smart Cities. Energy management is certainly a key element. This can be a great starting point for building owners who seek to transform their properties into smart buildings and environmentally sustainable operations and platforms for the evolution of Smart Cities.

As facilities evolve into smart buildings, automation and control systems in place will enable real-time, responsive energy management, plus all the other topics we have highlighted previously. This new way of operating and maintaining facilities reduces energy consumption overall and also allows operators to shift consumption as needed to support broader city goals for grid reliability and stability. In addition, energy conservation generates sustainability and corporate social responsibility benefits through smaller greenhouse gas and environmental footprints. As smart buildings are used more as connected infrastructure, Smart Cities can reduce their risk of new technology investment, as well as reduce their communications infrastructure investment costs, as they capture data from systems outside of city operations.

As more and more public and private facility owners realize the benefits of deploying smart building technologies, including broadband communications infrastructures, these benefits are amplified supporting the development of a dynamic Smart City:

- **Greenhouse gas reduction and energy conservation:** Smart technologies can play a vital role in reducing greenhouse gas emissions by building operations. GHG reduction is challenging for utilities relying on energy consumption to generate revenue and for commercial real estate because of the split incentive with their tenants. In leased commercial buildings, there is often a disconnect between the owner and the tenant in terms of energy efficiency benefits and payment of energy costs. As a result, in some portions of the private building stock, GHG reductions are challenging. GHG reduction also represents a challenge and potential risk for municipal utilities. If new regulations require GHG reductions, utilities will have to rely on less carbon-intensive generation resources or energy efficiency.
- **Energy conservation:** The perspectives on GHG reduction and energy conservation represent an opportunity for future collaboration. Smart City initiatives promoting GHG reduction can be an opportunity for utilities to engage private and public building owners in energy efficiency programs that result in energy conservation and as a result lessen the generation burden from their fossil fuel resources.
- **Grid reliability/stability:** Reliable, consistent supply of electricity is key to local businesses, city residents, building owners, and electric utilities. Demand management programs such as demand response and dynamic pricing help utilities engage building owners to support these goals. They also help conserve energy. Smart technologies enable more sophisticated and dynamic response between buildings, and the grid and the future expectation is that pricing structures will evolve toward more real-time models to reflect grid pressures.
- **Building operational efficiency:** As more building owners adopt smart technologies, operations will be more efficient through the heightened awareness of analytics and data management and the utilization of advanced automation and control. These efficient facilities are beneficial to cities by attracting and retaining businesses as well as to utilities as responsive grid assets.
- **Enhanced livability:** Smart technologies create livable workspaces and support the goals of building owners by retaining full occupancy and of cities by appealing to a sustainable workforce.

- **Sustainable economic development:** Sustainable economic development is critical to utilities for resource planning, to cities to support growth and planning, and to building owners to retain business and economic viability. Smart technologies generate more appealing work environments and represent an opportunity to engage tenants and employees for sustainable economic development.

Figure 9 illustrates six common Smart City goals (chiefly energy related in this example) from the perspective of key stakeholders in the ecosystem. The figure illustrates where there are synergies and challenges in stakeholder goals that can help guide the development of a road map for new building technology initiatives. The goals with common synergies can be the near-term opportunity for collaboration, and those goals with barriers or a mix of synergies and challenges indicate opportunities for further exploration of solutions on how to generate win-win situations for all stakeholders.

FIGURE 9

Synergies and Obstacles to Future Smart Building Assets for Smart Cities

Goal	City Government	Municipal Utilities	Public Building Owners	Private Building Owners
Greenhouse gas reduction	●	●	●	●/●
Energy conservation	●	●	●	●/●
Grid stability/reliability	●	●	●	●
Building operational efficiency	●	●	●	●
Enhanced livability	●	—	●	●
Sustainable economic development	●	●	●	●

● Synergy ● Obstacle

Source: IDC Insights, 2018

The bottom line is that city governments, private and public building owners, and technology vendors share many goals for operational efficiencies, facility cost reductions, and sustainability improvements in regard to smart building development. Stakeholder collaboration is the foundation for developing and executing strategic investment plans to develop smart buildings in the urban environment.

Going Forward: Next Steps for the Future

Scaling Out Broadband Connectivity for Municipalities and Smart Communities

More so in regions of the world where communication is private and not government owned, building out pervasive broadband has not been easy. The idea of ubiquitous connectivity is still a dream, not only for rural communities but also for swatches of cities such as undeveloped industrial areas and lower-income areas in which infrastructure investment is not seen as lucrative and may be unaffordable for individual and/or municipal customers. Given the real need for internet access for services (for local businesses, schools, and jobs; accessing government services; paying for private sector services), the issue of broadband connectivity (both fiber and wireless) for the "haves" versus

"have-nots" will reach a tipping point. It is important to note that only 14% of the world's population will have access to broadband connectivity in 2019; according to IDC, Smart Cities are showing promise in working on new types of models to move forward with broadband investments, and IDC believes that in 2018, there will be business models, supported by invested communications service providers, that will emerge with a strategy to support the growth of Smart Cities and smart communities.

There have been starts of some of the innovative relationships, such as with LinkNYC and other kiosks that fund public WiFi networks via ad-based revenue, but ad-based revenue sharing can leave out lower-income areas, smaller cities, and areas not yet developed.

A recently announced partnership between Verizon and Sacramento, the capital city of California, has provided Verizon with the ability, at no cost to the city, to put in wireless access points in the city's parks, providing free WiFi to any user (not just Verizon customers).

This investment by Verizon will significantly grow access for residents, even as the company's strategy for monetization is collaboratively developed with the city.

In Vietnam, Phú Quốc, an island off of Kiên Giang Province, is working with Vietnam Post and Telecommunications Group (VNPT) in an effort to turn Phú Quốc into a special economic zone in 2020. VNPT is working closely with the local government to create the VNPT Smart City model in Phú Quốc by building network infrastructure, datacenters, and smart services and has successfully completed a high-speed 4G network trial. The region of Halland in Sweden is testing a fiber-to-the-home model, with the municipality paying 6% of the total costs to deploy an IP-only network and an open network provider covering the remaining costs.

These examples are just the beginning and demonstrate that internet access and broadband coverage can increase significantly in a city if a strategy is codeveloped with local governments, CSPs, and other key public and private sector partners.

Business Models for Scaling Investment

One of the key roadblocks to Smart City investment is around securing sufficient funding for new and innovative technologies while mitigating the risks of these acquisitions, given the rapid pace of technology development. Many required Smart City investments, for example, involve upgrading existing physical infrastructure such as buildings or roadways and/or adding in significant network infrastructure, such as small cells, Bluetooth, WiFi, or fiber. These are costly investments, and cities and vendor partners turn to several areas in which to provide project justifications:

- Leveraging common infrastructure across multiple departments and domains for a better cost-benefit ratio
- "Monetizing" the investment via new revenue opportunities (often unformed or untested ideas for using data)
- Finding operational cost savings from the investment

These types of things can be difficult to justify and implement with siloed, department-led funding; no tested monetization models; the low risk profiles of cities to test new models; and procurement policies that often inhibit innovation. As a result, cities have begun to seriously explore and implement new types of partnerships and contracting models. In fact, IDC has observed that the traditional tender-based procurement methods are gradually evolving to include sourcing models such as public/private partnerships (PPPs) with the creation of new nonprofit organizations, co-funded innovation centers, and memorandums of understanding (MoUs) for testing conceptual ideas in pilot Smart City projects.

Developing and emerging economies such as Saudi Arabia, Vietnam, and Indonesia as well as tier 2 and tier 3 cities in China (Yinchuan, Guiyang, etc.), Indonesia (BSD City, Surabaya, etc.), and Vietnam (Da Nang, Nhat Tan-Noi Bai, etc.), for example, are looking at PPP models with global and domestic technology vendors to reduce the initial and up-front costs of investments, attain operational expertise and needed skills, and share or even outsource the risk to an entity separate from the municipality.

The nonprofit partnership model has been operating in Europe and a few leading Asia/Pacific cities for over five years, in which cities partially own or fund the organization but the organization operates outside of traditional city procurement requirements. It is a model starting to take hold more in the United States and North America. This model allows cities to test new types of working relationships as an alternative to the traditional buyer-seller model for products and services. Examples of this model include Forum Virium Helsinki, Amsterdam Smart City, TINA Vienna, Bristol Is Open, InnDEA Valencia, the Dallas OpenData initiative, Chicago's UI LABS, Singapore government's IDA Lab, Taipei City's IoT Innovation Lab, and New South Wales government's Knowledge Hub.

IDC expects these partnership models to be the preferred models and to be more prevalent in the future, with up to 50% of the Smart City projects globally to be funded via these contract models by 2019. The type of partnership model adopted will also depend on the maturity and scale of the project, with pilot projects going for MoUs and full-scale deployments for PPPs.

Actions for City Governments

- **Help build the innovation ecosystem around smart buildings.** Many cities include building energy efficiency in their sustainability programs, but fewer cities have a formalized process to involve the larger group of stakeholders in the smart building discussion. Incorporate smart buildings into larger efforts, and move beyond the focus on publicly owned buildings and sustainability to include the private sector and other use cases as well.
- **Be a role model for private building owners.** Cities that have had success in their own smart buildings should use these as proof-of-concept case studies for smart buildings in the private sector. Cities are looking to improve their management and operations for public buildings, and many have programs in place for reducing energy use in these buildings. Because these buildings are within their sphere of control, there has been more focus on these efforts than on influencing private building owners. This requires a different mode of influence; it is a higher-level discussion with more senior decision makers and involves policies and other incentives.
- **Partner with developers to promote smart buildings.** Municipalities have many safety, street, and building codes that must be followed. They often also have complex permitting and licensing requirements that vary from city to city. Cities should proactively support developers to make it easier for them to build out communication infrastructure. At its most complex, this could result in modernizing policy, but there are simpler options by offering education to developers and bringing in different stakeholders to discuss how to best deploy communications infrastructure. The Boston Redevelopment Authority, for example, brought together all stakeholders to discuss the development of an RFP for developing an industrial site in the city. The public works departments worked with the utilities, the network providers, IT companies, and private developers to think of creative ways to prepare this site for the future.
- **Provide incentives that target retrofits.** Regulations have, for the most part, targeted new construction, leaving a gap in policy for existing or older buildings. Take a balanced view of models to promote green and smart buildings in older buildings as well.

- **Consider piloting smart building programs in industrial parks, neighborhoods, or ecodistricts.** Geographically focused incremental progress in industrial parks, ecodistricts, or innovation districts can be an effective approach to developing smart buildings in cities. Ecodistricts provide a framework within which stakeholders can pilot technology deployments and test scenarios to benefit multiple stakeholders at once. A small-scale approach can allow cities to test scenarios of systemic integration. Smart building technologies can be viewed with an integrated perspective – for example, beyond the building to whole city energy demand, beyond electricity to water conservation, and beyond building operations to public safety.
- **Foster education and outreach to the community.** This recommendation represents an opportunity for city governments to take outreach to residents a step further by partnering with the communication providers or developers. Cities often budget for educational materials that promote efforts like recycling and reducing energy use or water and other resource consumption. The private sector has much larger marketing budgets and, in coordination with city governments, can target building owners and residents as key influencers for adopting smart buildings.

Actions for Building Owners and Developers

- **Proactively look for opportunities to work with city leaders.** Join Smart City pilot projects and contribute your perspective on plans for ecodistricts or other green initiatives. Use the pilots as a way of speeding up implementation of smart building technologies in collaboration with local government.
- **Take part in policy discussions.** Become familiar with city policies for network infrastructure, energy benchmarking, and greenhouse gas reduction to ensure building operations are in compliance with local regulations/policies. Be a part of these policy discussions as a member of the urban smart building ecosystem.
- **Meet tenant expectations.** Keep in mind that high-end building tenants now demand many of the smart building functions outlined in this white paper. It can have an impact on your bottom line, including revenue generation, cost reduction, and new business applications and revenue models based on smart building features.
- **Showcase smart building technologies.** Showcase smart building technologies to demonstrate commitments to local policy and the business benefits of enhanced efficiency.
- **Market to the citizen.** Citizens also care about green buildings and energy efficiency and are interested in efforts that private companies, developers, and city leaders are undertaking. Look into ways that a building can attain LEED or WELL certification. Citizen demand for sustainability also translates to employees. Businesses renting commercial real estate often acknowledge this interest and seek premium office space in green buildings. This chain of demand for sustainability can help motivate commercial building owners to invest in smart building solutions to showcase their facilities as these premium, green, and sustainable office spaces.
- **Help build the community.** Building owners should recognize their roles as pivotal members of the environment that they are connecting to and interoperating with. They are a key component of city infrastructure and communication services.

Conclusion

The potential impact of Smart City transformation, with current and projected urban populations, can touch the majority of people in the world, impact the environment in significant ways, and support most of the global economic growth. Smart City leaders must figure out how to take advantage of new technologies that enable the transformation of historically inflexibly built environments. It is up to the cities, developers, and technology suppliers to build the infrastructure that enables all parties to leverage networks, data, and other emerging technologies in innovative ways. It will be major communications providers that will help provide the infrastructure needed to bring smart buildings online as a connected asset in the Smart City ecosystem. Cities that conscientiously build an issue-based ecosystem around connectivity and sustainability in buildings will most effectively promote smart building technology adoption and maximize progress toward Smart City energy, sustainability, safety and security, and public and private development goals.

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