Strategic Vision
for Smart Cities
and the Internet of Things

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The challenge

The world population living in cities will **double by 2050** according to the United Nations with 90% of population growth occurring within cities, an increase of **2.5 billion people** with needs for city services and access to opportunity.

Local communities will face increasing challenges including **reducing traffic congestion**, **fighting crime**, **fostering economic growth**, managing the effects of a **changing climate** and improving the delivery of **city services**.

Cities are driving the vast majority of US job growth and wealth creation with metro economies responsible for **94% of new jobs** created in 2015 according to the 2016 United State Conference of Mayors *Metro Economies* report and **80% of wealth** creation in the 21st century according to MIT's Beyond Smart Cities program.

The San Francisco Bay Area is growing dramatically, adding 440,000 jobs in the past decade along with 367,000 new residents and 234,000 housing units, leading to increases in transportation congestion, public safety challenges and increased demands on city services.

This growth is **intensifying society's economic, social, health and environmental problems** at a time when the impacts of climate change will continue to grow. The solutions cannot be limited to building new infrastructure -- cities including San Francisco must make smarter use of the infrastructure we already have.

The opportunity: harnessing technology and innovation

"Smart Cities" and the "Internet of Things" (IoT) are a set of modern digital technologies, civic innovations and social changes that have come together to create the opportunity to drive fundamental changes in government, business and society to **enhance the Quality of Life for all residents**, in disadvantaged as well as more affluent areas, making cities more **effective**, **efficient**, **equitable** and **responsive**.

"Smart Cities" are cities that use data, technology, connectivity and collaboration to improve the lives of people in their local community.

In the digital era, consumers have increasingly high expectations of a **high quality customer experience**, including from government services. City services should be **easy to use** and residents and users of city services including businesses and other organizations should **be the focus** of every service the city provides.

City agencies have the opportunity to put these innovations to use to **increase access** to services, to **increase empowerment** to shape those services based on community needs and values, and to **increase inclusion** in community decisions and actions that impact residents' lives.

Meaningful use of data will drive **evidence-based policymaking** and radically alter our cities. Ubiquitous sensors, widespread connectivity, Big Data and advances in data analytics including Artificial Intelligence are continuously improving collection, aggregation and use of data. The knowledge generated from these technology innovations and disruptors will lead to real and significant improvements in the lives of residents and will provide government opportunities to improve policies, procedures and facilitate **data-driven decisions and actions**. All of this will be done with **security** and **data protection** and **privacy** at the forefront. Everyone in our community should feel comfortable with the **ethical**, **privacy** and **security** considerations of our processes and systems.

Finally, there is a tremendous opportunity for job creation and economic development. **San Francisco leads the world** in technology innovation and the demand for new products, new companies and new skilled jobs will create **tremendous opportunities for Bay Area businesses**, including service delivery and technology exports. The market for smart and connected cities is expected to reach **$1 Trillion+** in the next decade, according to IDC, MarketsandMarkets and other analysts. McKinsey estimates that cities will be the second largest setting for the impact of IoT, where IoT applications have the potential for an impact of as much as $1.7 trillion per year in 2025. Many of these technology solutions will involve manufacturing, distribution, installation and maintenance of new hardware systems, supporting the **growth of middle class jobs**.

Smart Cities and IoT: a global movement, locally-defined

Cities and countries around the world are investing in Smart Cities solutions and Internet of Things technologies to improve their communities. International examples abound including European initiatives such as the European Innovation Partnership on Smart Cities and Communities with $350M+ in associated funding annually, India's Smart Cities Mission aiming to improve the quality of life in 109 of India's fast-growing urban centers and China's smart cities efforts funding 193 pilots.

In the U.S., the **White House** launched the **Smart Cities Initiative** in September of 2015, calling upon Federal agencies including the Department of Commerce, the Department of Transportation, Housing and Urban Development, the Department of Energy and others to support the local efforts of cities in their work. The President's Council of Advisors on Science and Technology released its first-ever report on cities, *Technology and the Future of Cities*, advocating for cities to put technology to use in serving residents.

Cities themselves are taking the lead in Smart Cities solutions. San Francisco Mayor Ed Lee in collaboration with Austin Mayor Steve Adler and with support from eight other mayors, authored a resolution *In Support of Guiding Principles for 21st Century Smart Cities* that was formally adopted by the U.S. Conference of Mayors in June 2016.

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Smart Cities are **fundamentally locally-defined** based on the needs and priorities of each community.

Our **working definition** is that "Smart Cities" is a framework for using data, digital technology, civic and policy innovation in order to enhance the quality of life for all residents, making cities more effective, efficient, equitable and responsive.

The **Internet of Things (IoT)** is a set of products and services, often called "connected devices", enabled by a new generation of abundant sensors, the data they create, the analysis done on that data, the communications systems they use, and the actions taken, in some cases by actuators and robotics that act in the world directly. When we talk about IoT here, we are talking about these technologies as they are put to use to make our cities better: IoT for Cities.

"Smart Cities" is an approach cities can take to use data, connectivity and collaboration to improve the lives of people in their local communities.

> *Every community is different, with different needs and different approaches. But communities that are making the most progress on these issues have some things in common. They don't look for a single silver bullet; instead they **bring together local government and nonprofits and businesses and teachers and parents around a shared goal**.*
>
> -- President Obama, quoted at the Smart Cities Initiative Launch in September 2015.

> ***Smart Cities are locally-defined** with common features including resident-centric services, a focus on problems based on community needs and priorities, data-driven processes, and sensors and connectivity.*
>
> -- *In Support of Guiding Principles for 21st Century Smart Cities*, U.S. Conference of Mayors.

Guiding Principles for 21st Century Smart Cities

San Francisco's Mayor Lee, with support from ten other mayors, authored a resolution *In Support of Guiding Principles for 21st Century Smart Cities* that was formally adopted by the United States Conference of Mayors in June 2016. The four guiding principles are:

1) **Urban Mobility and Smart City Framework**

   Cities across the country must improve the way people and goods move. Smart Cities are expected to provide safety improvements, enhance mobility, increase ladders of opportunity by incentivizing reinvestment in underserved communities, reduce energy usage, and address climate change. Smart Cities are locally-defined

with common features including resident-centric services, a focus on problems based on community needs and priorities, data-driven processes, and sensors and connectivity.

2) **Bridging the Digital Divide with Connectivity**

Internet access is a prerequisite for participating in every aspect of society—finding work, quickly accessing health information, entertainment and consumer services, and staying connected with family and friends as well as what is happening in the local community.

3) **Government Modernization**

In the 21st century, meeting our community's needs and high-quality customer experience means providing digital access to public services. Building modern digital services is a chance to rethink an entire business process, improve the public's experience of government, and include our residents and clients in the design and development process.

4) Digital Literacy for **Inclusive Communities**

It is critical that all people, businesses, and institutions have access to digital content and technologies that enable them to create and support healthy, prosperous, and cohesive 21st century communities. Residents need the language and literacy skills to effectively use the Internet. Digital inclusion reduces social disadvantage and increases economic equity and is necessary for education, access to healthcare information, applying for jobs, communications, and competing for 21st century jobs.

Social and Technical Enablers

*"**Smart cities are about people** and just building the technology won't get you where you want to go."* -- Paul Wilson, Managing Director of smart city program "Bristol is Open"

*"[Smart Cities] are about **technology that enhances quality of life**.*" -- Shaun Abrahamson, Founder of investment group Urban.us

Smart Cities are focused on providing solutions for their residents and businesses, not on technology and innovation. However, information and communication technologies are key enablers of more efficient, effective and responsive government.

The foundation of smart cities is a **focus on residents** through **connectivity**, **data** and **collaboration**. Connectivity (e.g. SFWiFi or IoT network) as the enabler, access to data to

make better decisions and collaboration across agencies, departments and private sector to innovate and improve processes, services and outcomes.

Enablers
- Smartphones, **Sensors**, IoT, connected devices
- **Connectivity**
- **Data**, the cloud and data analytics including Artificial Intelligence/Machine Learning
- Actuators and robotics
- Social innovation and paradigm shifts:
  - Open Data/Open Gov/Open Source
  - Peer-to-peer sharing economy/On-demand economy
  - Civic innovation/Civic tech/Civic engagement
  - **High quality customer experience**, privacy, security

San Francisco's approach to Smart Cities and the Internet of Things

These tools and their use **must reflect San Francisco's values and priorities.**

The vision is to make San Francisco a Smart City and the IoT Capital of the World for two primary reasons: (1) enable more equitable, efficient, effective and responsive government; and (2) create the next generation of middle class jobs by helping Smart Cities/IoT companies grow in San Francisco.

The defining values and vision that guide San Francisco's approach to Smart Cities and the Internet of Things follow from the values and vision articulated in San Francisco's current *Proposed Five-Year Financial Plan: Fiscal Years 2017-2018 through 2021-22*:

Values

Our city values define what we stand for and reflect our deeply held convictions and priorities. These values shape our attitudes and behaviors and guide how we operate and conduct our service to the public.

1. **Equity**. Our services reflect the value that each person deserves an opportunity to thrive in a diverse and inclusive city.
2. **Collaboration**. We are stronger when we work together. We serve through consensus building and cooperation across all sectors.
3. **Community**. The needs of an engaged and empowered community drive our service and we support participation and democracy for all.
4. **Compassion**. Our service is grounded in respect, dignity, embracing diversity, care, empathy and inclusion.
5. **Service Excellence**. We work to continuously improve services that are high quality, innovative, and informed by what works.

6. **Responsibility & Integrity**. We are stewards of the public's dollars. We make responsible decisions to ensure the long term success for our city and residents.
7. **Accountability and Transparency**. We hold ourselves accountable based on outcomes and believe that transparency fosters public trust.

Vision

The vision below represents our desired future for San Francisco. Our vision unifies our diverse work and is a call to action for departments to ensure there is clear direction of the City we want to be and the services we want to provide to the public:

1. Residents and families that thrive
2. Clean, safe and livable communities
3. A diverse, equitable and inclusive city
4. Excellent city services
5. A city and region prepared for the future

San Francisco's priorities areas and needs include:

- Vision Zero and Transportation/Mobility
- Homelessness
- Affordable Housing
- Public Safety and Emergency Preparedness
- Quality of Life
- Equity
- Good Government
- Economic Development

We have the opportunity to meet key challenges including:

- Improving infrastructure and services that are critical for public safety and resilience to climate change and disasters
- Reducing traffic congestion and transportation challenges
- Fighting crime and ensuring fair law enforcement
- Fostering economic growth and entrepreneurship
- Improving the delivery of city services including improving operational effectiveness and reducing costs
- Enabling data-driven decisions and actions
- Catalyzing collaboration across departments, sectors and organizations

Strategic Vision for Smart Cities and the Internet of Things

The Mayor's Office of Civic Innovation (MOCI) and the Department of Technology have worked closely with key internal and external stakeholders to create this *Strategic Vision for*

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Smart Cities and the Internet of Things and presented it to the Sub-Committee on Budget and Performance of the Committee on Information Technology (COIT).

The Strategic Vision is point six of MOCI's IoT Roadmap and this first iteration of it has been developed through a deliberative and inclusive process that incorporates best practices from industry and government.

The purpose of the Strategic Vision is to establish policy goals and objectives, identify needs, develop strategies and recommended actions, and establish roles and responsibilities for taking action.

Achieving our goals through a Smart City framework will require leadership, governance, public private partnerships and a long-term commitment. We do not anticipate any new costs and may generate significant revenues as New York City and others are doing. Additionally, the Federal Government will be investing billions into smart cities over the next several years -- investments that our City is well positioned to receive.

SF is a leader with a number of Smart Cities efforts

San Francisco is consistently ranked among leading Smart Cities globally and we are already making significant progress in applying Smart Cities/IoT solutions. While not a comprehensive inventory, here are some examples of current Smart Cities/IoT efforts the city is working on:

- We were selected as a finalist in the **U.S. Department of Transportation's** $40M Smart City Challenge and while not selected as the principal winner, we were **awarded an $11M** DOT grant to harness emerging technological innovations to make mobility smarter and more equitable.
- We launched **SFPark**, a large-scale controlled parking pricing experiment to managing the availability of on-street parking, utilizing smart parking meters that change their prices according to location, time of day, and day of the week, with the goal of keeping about 20% of spaces vacant on any given block.
- We partnered with **Sigfox** to deploy a new generation of IoT communications network wireless platform, engaging **entrepreneurs** and catalyzing startups to experiment with long-range, low-power, inexpensive connectivity. We are also using the platform to engage **intrapreneurs** within City Hall, with **IDEO** leading a workshop with over 100 city employees generating use cases that could be deployed on the network for earthquake preparedness and emergency response.
- We created an indoor navigation system for the blind and visually impaired at **SFO airport** through a collaboration between SFO, a startup called **Indoo.rs**, and a local nonprofit, the **LightHouse for the Blind and Visually Impaired**. The map leveraged audio-based beacons within Terminal 2 to show the locations of restrooms, restaurants and power outlets, enabling visually impaired passengers to walk through the venue independently for the first time.

- **STIR (Startup in Residence)** is a program that connects government agencies with startups to develop technology products that address civic challenges. Over 16 weeks, startups and government work together to co-develop solutions that creates real impact. Startups work with government partners to get to the root of civic challenges through user-testing, skills-sharing, data analysis, and prototyping a technology product or service. The program has led to innovations in the way the city enters into procurement relationships with startups who often have a difficult time working with governments and more broadly has helped spur a culture of innovation within participating agencies. The program has also expanded to include several neighboring cities to increase collaboration across traditional municipal boundaries.
- We are partnering with **Google Waze** through the Connected Citizen partnership program, a no-cost, two-way data exchange to improve service for the public and operations and planning for agencies. Waze provides real-time, anonymous, proprietary incident and slow-down information directly from drivers and the city provides real-time and advanced information about government-reported construction, crash and road closure data.
- **SF Public Utilities Commission** has piloted an advanced sewage monitoring system using an IoT communications network in partnership with **Sigfox** and a startup called **Ayyeka**. Goals included obtaining near real-time information on speed and flow levels as well as saltwater intrusion. This is important because saltwater is harmful to many of the organisms essential to the treatment process. Additionally, the pilot was aimed at reducing maintenance costs.
- We established #**SFWiFi**, providing free and fast wireless connectivity to a growing number of public locations, including 33 parks, segments of Market Street and numerous government buildings and public spaces across the city.
- We announced the creation of the **San Francisco Smart City Institute**, a public-private partnership housed at the **University of California, Berkeley**, that raised over **$150M** in private sector commitments.
- We established a first-of-its-kind innovation lab **SuperPublic** to engage the public, private, nonprofit, and academic sectors in solving our transportation and other challenges. SuperPublic, in partnership with corporate partners including Cubic, Lyft, Mastercard, Microsoft, Siemens and Zipcar, developed the **Mobility Collider**, an initiative that allows participants to shape policy by framing problems, identifying use cases, exploring private sector solutions and using empirical data.
- We established a general research partnership with the **University of California, Berkeley** to facilitate research, development and implementation of smart city solutions.

Policy and Infrastructure Recommendations

With this momentum, San Francisco has the opportunity to establish a vision and direction for becoming a Smart City and to institutionalize a Smart City/IoT framework to support our goals to improve the lives of San Franciscans: equity, safety, sustainability, and Quality of Life.

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We therefore recommend, in addition to adopting this initial *Strategic Vision for Smart Cities and the Internet of Things,* that our City:

- **Establish a Smart Cities Leadership Position** to lead this work
  - Reports to the Mayor's Office
  - Interdisciplinary and interdepartmental
  - Works closely with City CIO, Chief Innovation Officer, Chief Data Officer and other Department Innovation Officers
- **Establish a Smart Cities Working Group** to bring together key decision makers across departments
  - Catalyze collaboration across departments, sectors and organizations
  - Emphasize equity and community engagement
  - Focus on privacy, ethics, security and standards
  - Drive towards evidence-based policy and procedures
  - Inventory current and planned projects San Francisco is engaged in
  - Identify high potential opportunities, resources and collaborations
  - Work with all municipal utilities to incorporate Smart Cities thinking into their planning processes
  - Establish bi-directional processes for the Smart Cities Working Group to engage with departments on projects that can benefit from technology and innovation
    - Engage Major Service Areas to understand pain points and opportunities where technology and innovation could potentially provide a solution
    - Help develop use cases that solve high priority problems
    - Catalyze pilots with department partners
    - Learn and share success stories and failures; find sustainable business models
  - Continue outreach and engagement both internally externally
    - Continue to build internal support from key stakeholders, including the MSAs listed above
    - Engage external stakeholders, including those listed above
  - Develop an implementation plan and revise strategic plan as appropriate
- **Change governance to incorporate technology lens into planning for all major infrastructure projects**: Similar to Sustainability, introduce a Smart City lens to Capital Planning and long-range urban planning at the Planning Department.
  - Embed some of the implementation responsibilities within organizationally sustainable homes including Capital Planning, Planning Department, Department of Technology and SFMTA
- **Encourage partnerships with external partners** to share knowledge, expertise, methodologies, technologies and solutions:
  - Academic partners including UC Berkeley, Stanford, MIT and others
  - Industry partners
  - Nonprofit and city, state and federal partners such as MetroLab Network, Superpublic, Council of Global City CIOs, NIST, and others.
- **Leverage related City efforts**
  - Mayor's Office of Civic Innovation

- ○ Connectivity Plan
- ○ IoT Communications Networks
- ○ Free WiFi
- ○ Dig Once
- ○ Open Data
- ○ San Francisco's new Digital Services Strategy
- ○ Data-Driven Policymaking

Additional References:

- *City of San Francisco Smart Cities and IoT Roadmap*
- *Mayor's Five Point Local Manufacturing Plan*
- U.S. Conference of Mayors *In Support of Guiding Principles for 21st Century Smart Cities*
- White House Smart Cities Initiative launch and Fact Sheet
- DOT Smart City Challenge materials including San Francisco proposal
- President's Council of Advisors on Science and Technology (PCAST) report *Technology and the Future of Cities*
- New York City's *Guidelines for the Internet of Things*
- San Jose's *Smart Cities Vision*