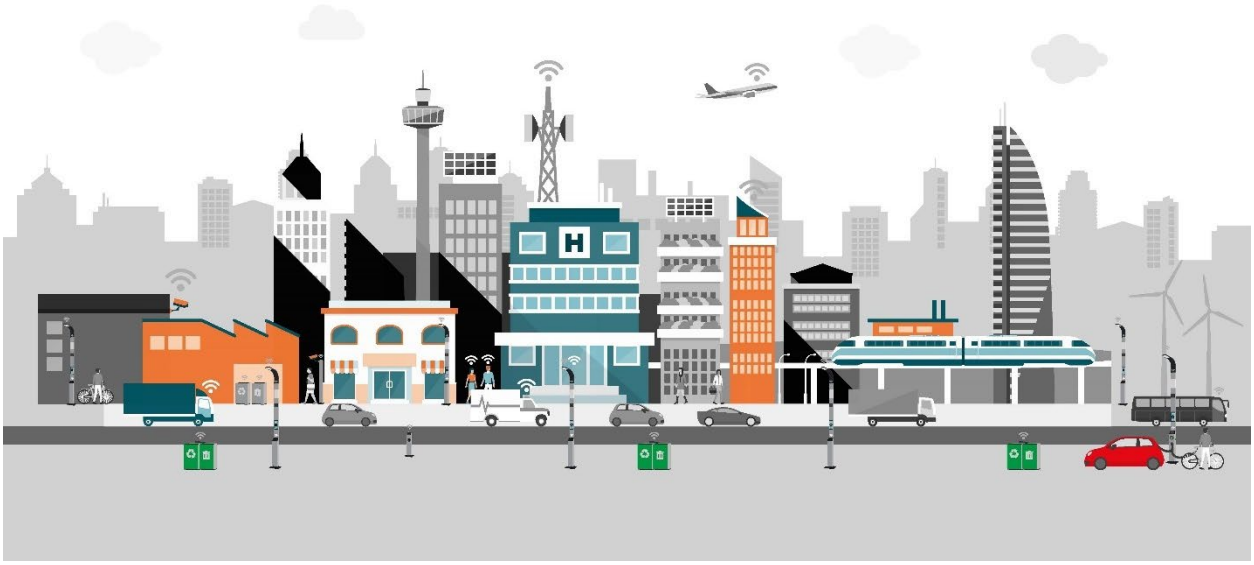


Recommendations for Digital City Communications Initiative

Prepared for the City and County of San Francisco

Revised May 2020 | Non-responsive

1 Recommendations for an Implementation Strategy

This section of the report surveys potential business strategies; recommends a potential procurement and business model framework for this initiative; discusses how these frameworks have been considered by a range of public entities regarding broadband initiatives of this sort; and discusses the importance of a technical proof of concept.

This framework suggests ways that the City can support and expand connectivity and Digital City services, including through a public-private partnership structured specifically to enable private opportunity while satisfying public policy objectives. Generally, the opportunity for private revenue models enable the City to support private investment and to engage in public works-type roles while the private sector has the opportunity to offer competitive services.

The model we recommend reflects the reality that broadband, like any other type of infrastructure, requires significant upfront capital for deployment of networks and services. The models are based on strategies to improve the economics of broadband deployment in areas where investment has been insufficient, including underserved urban areas and low-income neighborhoods. These efforts seek to create private sector opportunity in neglected areas.

The potential procurement and business model would enable the City to make private broadband investment more attractive by leveraging (1) the City's fiber assets, poles and street furniture; (2) the City's own buying power as a user of connectivity services; and (3) the City's ability to reduce the capital costs of the initial deployment.

The model mitigates risk by enabling shared efforts and obligations—but also shared opportunities. To that end, it utilizes:

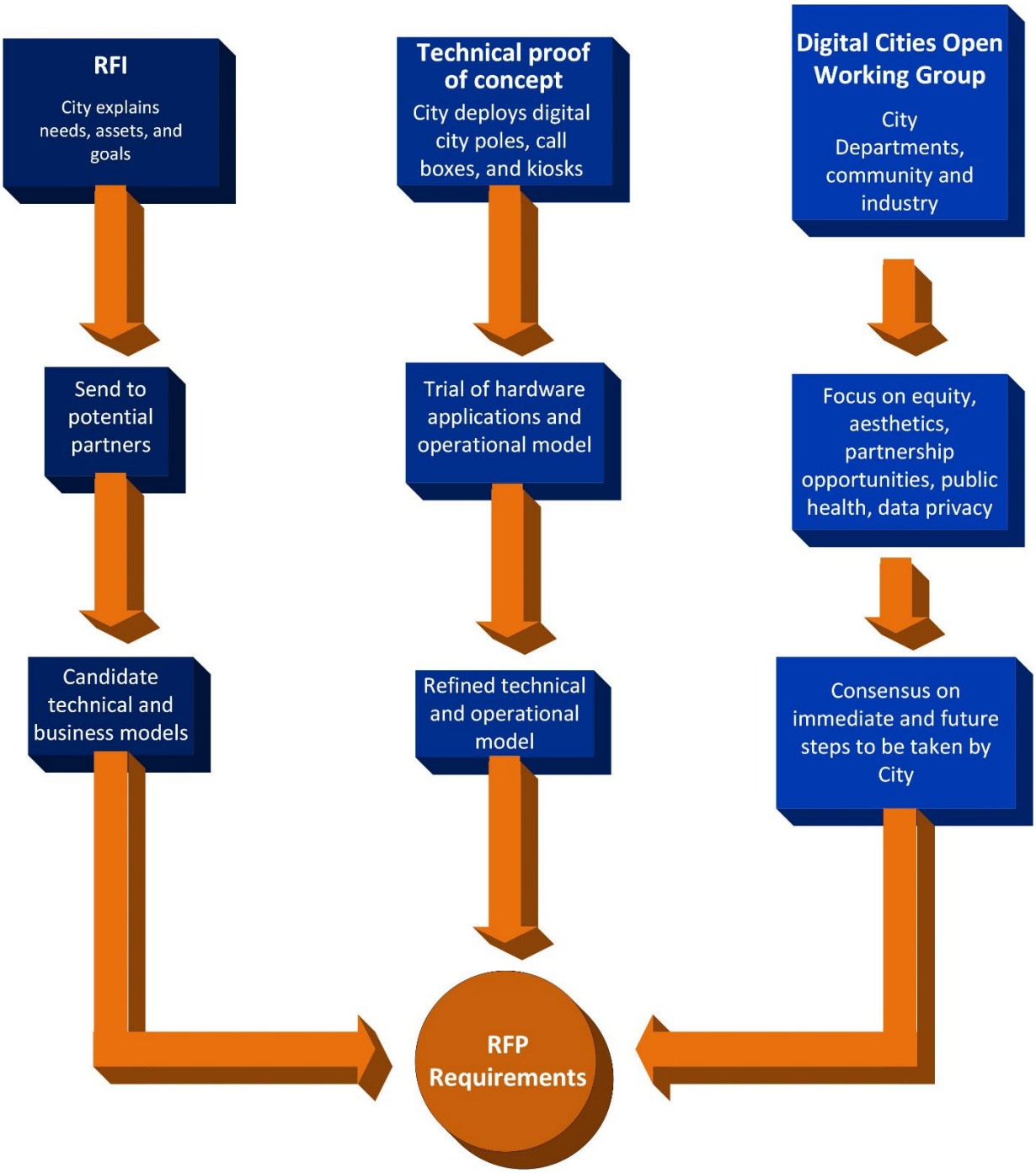
- **Close collaboration with industry.** Public-private arrangements take many forms; at their best, they involve true sharing of risk. Successful public strategies require early consultation, careful business plan design, and win-win outcomes.

- **Competitive procurement processes.** Following best practices, successful public efforts seek to shift risk to industry partners and investors and to secure the benefits that competition offers.

At a high level, the model leverages City needs, buying power, and assets (including fiber, call boxes, and rights-of-way) and builds these considerations into a strategy that will enable construction and operations of communications infrastructure to serve both public policy and private commercial needs.

To proceed, we recommend a yearlong process comprising a competitive RFI, technical proof of concept, and Digital Cities Open Working Group—collectively leading to an RFP.

Recommended Next Steps – RFI, Proof-of-Concept, Open Working Group



1.1 Business Strategy/Procurement Recommendation

In light of the comparable efforts undertaken to date and the City's own goals and requirements, we recommend that the City consider, as a next step, issuing an RFI for technical and business approaches for access to fiber, poles and street furniture that lets companies compete on price and to meet specified City connectivity and Digital City needs.

The RFI would be issued in parallel with a technical proof of concept. Based on the responses, the City would understand the potential range of business approaches and the range of costs it would pay, or the revenue it would receive. Depending on the response, the City could then proceed to issue an RFP with detailed specifications, requesting a firm price from a potential partner. Depending on procurement requirements, it might also be possible to issue an RFQ for a firm bid for a very specific approach or enter into direct negotiations with preferred partners.

We also recommend the formation of a Digital Cities Open Working Group, consisting of stakeholders invited to participate in a series of workshops open to the public. The Working Group would invite participation from community groups, wireless carriers, and other interested parties. This Working Group would include City departments with a stake in the outcome—including the Department of Emergency Management, the Department of Public Health, Public Works, the Municipal Transportation Agency, the Public Utilities Commission, the Digital Equity Initiative, the Chief Privacy Officer, the Arts Commission, the Mayor's Office on Disability, and the Planning Department.

We recommend the Digital Cities Open Working Group focus on critical issues that ideally require input and consensus from the stakeholders and the public: equity, neighborhood aesthetics, partnership opportunities, advancing public health and safety, and data privacy.

The Working Group would hold a series of meetings to listen to the community, industry, and expert advice and concerns; identify needs; and define potential solutions. The purpose would be to obtain input from the stakeholders and the public and find consensus on the immediate steps the City can take to address their concerns.

The procurement process, in parallel with the proof of concept, could be completed in one year.

We make this recommendation because it offers a simple means to test the market through an RFI and potential financial parameters for access to the call box locations and available fiber. The RFP would be designed to enable carriers, infrastructure companies, and investors to compete with each other to secure access to these key locations and the City's fiber.

This strategy could also be piloted in a narrow geographic area aligned with the technical recommendations in this report and then undertaken on a broader basis after the pilot data are evaluated.

Ideally, this kind of procurement would be structured with very clear specifications and requirements so that bidders would be providing only one key piece of data that could then be compared: financial commitment. The bids would consist of the dollar figure at which each bidder would pay for long-term access to City assets on a citywide basis or smaller geographic area—or what the bidder would require from the City in anchor tenant payments.

One feasible variation on this model is for the City to ask for bids on long-term revenue sharing among the winning bidder and the City, or for a mix of revenue sharing and payments.

The RFI and RFP could also include, among the specifications for the assets to be built, the physical assets the City will require for its own Digital City and public internet efforts. In this way, the City would use the competitive process to determine how much (if any) of the cost of deployment the industry would require the City to bear in return for (1) coverage specified by the City, geographically and otherwise; and (2) functionality for the City's own use.

The RFI and RFP would include clear parameters for how the City assets could be used, including technical specifications and standards, aesthetic standards, and other protective mechanisms.

We expect multiple private entities would be interested in this type of opportunity, so long as the business relationship includes the opportunity to use vertical assets that can support wireless service. Ideally, AT&T, Verizon Wireless, T-Mobile, and even potentially infrastructure companies like Crown Castle and Extenet would bid for these opportunities.

In this model, the City could potentially also negotiate industry guarantees on issues such as:

- Pricing for services for lower-income users
- Target economic development/investment goals
- Open access/neutral host (on both the fiber and wireless assets) to enable competition

We note however that guarantees of this sort from bidders may impact their financial bids.

1.2 Framework Business Model Considerations

Most business models contemplated by localities and states seek to efficiently allocate risk among the partner entities—the hallmark of a true partnership. Roles are assigned based in part on which partner can most effectively mitigate a given risk.

But risk management is not the only guiding factor. The business models also seek to reflect the partners' capabilities (e.g., infrastructure construction, network operations, customer service, sales and marketing), capacity (e.g., internal resources and ability to scale to support a long-term effort), and efficiencies (e.g., building on existing processes and operations).

All of the models share some core similarities:

- All seek to improve the economics of a significant connectivity and Digital City investment, regardless of ownership structure

- Aggregated department spending is a core component of the business case for fiber, wireless, and Digital City construction

- Departments will coordinate efforts around governance and competitive procurement
- Industry partners will act as service providers
- Departments will bring value or considerations to a collaboration with industry
- Department contributions will vary based on capabilities, needs, and assets (e.g., long-term purchase commitments, rights-of-way, mounting assets, and legal opportunities and constraints)

The candidate business models also all seek to catalyze new last-mile investment, which in turn will create opportunities for competitive service provision among industry partners.

That said, the models we discuss and summarize below have notable differences in terms of infrastructure ownership and governance. In a private industry ownership model, the City serves as an anchor tenant and customer (with the potential to negotiate policy concessions). In a public ownership model, the City owns the assets, and the industry partner or partners are long-term lessees or contractors.

The following is a summary of key business model mechanisms that are being used in other areas. Appendix C comprises a series of case studies describing each model in more detail.

1.2.1 Model 1: Industry Ownership with City Anchor Tenancy

In this model, an industry partner owns and operates the fiber infrastructure. The City directs the spending it would otherwise have spent on separate, stovepiped Digital City and connectivity initiatives on data connections to fund some or all of the construction of a unified digital infrastructure, but the City's aggregated buying power does not pay directly for construction; rather, the promise of ongoing purchasing (i.e., anchor tenancy) serves as the basis for a competitive procurement in which an industry partner(s) would invest in construction.

In this model, the City could potentially negotiate industry guarantees on issues such as:

- Pricing on lit and/or dark fiber services
- Pricing on wireless services and devices
- Target economic development/investment goals
- Open access to enable competition
- Long-term opportunity for revenue sharing

1.2.2 Model 2: Ownership by City with Industry Lease of Asset for Operations

In this model, the City directs the money it would otherwise have spent on separate, stovepiped Digital City and connectivity initiatives to fund (in whole or part) the construction of infrastructure that would be owned by the City and leased to industry partners. A City governance

entity is responsible for financing, designing, building, and maintaining the network, and for contracting with industry operators to deliver services to users. Excess capacity on the network is reserved for investment and economic development purposes. And the industry lessees are allowed (within negotiated parameters) to use and monetize their leased fiber as they choose.

1.2.3 Model 3: Ownership by City with Long-Term Industry Concession for Execution

In this model—which is a traditional transportation-sector P3 approach that has been adapted for broadband infrastructure deployment—the City negotiates a formal public–private partnership that resemble transit and toll-road construction projects, with public funding and private execution. This approach is also known as the concessionaire model, because the public sector entity grants a long-term concession to one partner.

As in the first two models, this approach is premised on the City directing the spending it would otherwise have spent on separate, stovepiped Digital City and connectivity initiatives to fund the construction of some or all of the planned infrastructure. It involves a substantial amount of public investment.

In this scenario, the broadband network is owned by a City agency but operated by an industry partner. An industry partner or concessionaire takes responsibility for financing, designing, building, and maintaining the network, and, as in the first model, for delivering services to users.

In this scenario, the City would have an ongoing financial commitment, and would have access to excess capacity on the network to direct toward economic development efforts. The industry partner would be free (within negotiated parameters) to use and monetize the assets. This model would also present a long-term opportunity for revenue sharing among the City and industry, assuming that revenues were to reach a certain level.

While this P3 structure is new in connectivity, it is used in Europe and increasingly in the United States for traditional infrastructure projects such as buildings, prisons, museums, water systems, toll roads, and bridges. The model seeks to leverage the strengths of the private sector to deliver turnkey services and solutions over an extended time.

Unlike transportation or utility infrastructure, however, connectivity represents a somewhat competitive marketplace. Thus, applying the model to connectivity in the United States creates political and financial risk for the public sector because public funding is used to fund an infrastructure that some residents may not want or choose to use. Indeed, if the broadband network is unsuccessful at generating revenue to cover all public sector costs, the public sector often remains on the hook for those payments. Depending on how the relationship is structured, this model can involve the public sector essentially becoming a guarantor in the event that the partnership does not secure sufficient revenue to cover all costs, including the profit margins

required by the private partners. (Experience by state departments of transportation nationally suggests that the private sector partner will seek a variation on this type of arrangement.)

This model might offer considerable benefits if the City prefers not to undertake the significant logistical effort of a large-scale public connectivity project and would prefer to rely on private expertise and execution. An additional, consequential benefit is that this model can offer a comprehensive solution for the entire City or can be targeted to particular geographic priority areas.

1.3 Recommendations for Technical Proof of Concept

For San Francisco, the Digital City transformation must meet needs that the City's current communications fabric does not fully address. These include, at a high level:

- A way to communicate in an emergency if networks and power fail
- A way for City staff to reliably and cost-effectively connect
- A way to reach and serve people who need to be better connected to the public health system
- A way to address equity problems of current services

Digital City infrastructure needs to be a robust, visible, and accessible way to address the City's needs. Infrastructure should leverage the City's real estate and fixtures (potentially in collaboration with wireless service providers) to create connectivity and support new types of sensors and applications to address the needs in Section 6.1, including:

- Resilient communications
- Public alerting
- Emergency calling
- Broadband to City agencies
- Connectivity at shelters
- CCTV for public safety, traffic, and other purposes
- Optimizing waste removal
- People and vehicle counting
- Disease surveillance monitors
- Field devices
- Body-worn cameras
- Inspection equipment
- Flood

- Ground motion/quake sensors
- Utility monitoring
- Traffic and parking enforcement applications
- Intersection safety
- Infrastructure-to-vehicle communications
- Digital signage
- Irrigation and soil moisture management systems
- Smart parks applications

To address San Francisco's focus on applications to address equity concerns and meet immediate needs for public health and the homeless, a Digital City deployment could initially target a defined subset of applications. These might include:

- Broadband to the unserved and underserved (whether to users' devices or to kiosks), with a particular emphasis on closing the homework gap and assisting residents as they are isolated and economically impacted by the COVID-19 quarantine
- Emergency calling to alert the police or fire departments
- Home health care and self-care—both for residents suffering from COVID-19 and for residents who have to receive care by alternative means because of the quarantine
- Health monitoring (including sobering)
- Access to (and coordination of) health care providers and prescriptions

1.4 Benefits of Planning a Digital City Proof-of-Concept Deployment

A proof of concept is necessary to refine the cost estimates, timelines, and construction issues with the deployment of Digital City infrastructure in the City. A pilot program may be performed in tandem with an RFI and RFP process for a larger smart pole deployment.

Developing a proof of concept is a best practice for cities considering a large-scale Digital City transformation. Even if a potential partner were to offer a "free" initiative (or a free pilot project), it is risky to pursue a large-scale implementation without first testing the technology, without determining the type of partnership, and without determining whether department and stakeholder needs can really be addressed by the solution. Indeed, Digital City efforts globally include many visible false-starts, half-measures, and efforts that could not be sustainably built and maintained.

A proof of concept can guide the City toward the optimal approach. It will include, of course, a physical platform for exploration of hurdles and best practices. But beyond that, a proof of concept is an opportunity to develop a collaboration framework for stakeholders and

departments to work together. Within that framework, the participants can seek to identify challenges that might derail a full-scale network—as well as a means of estimating costs for different types of implementations. Similarly, the proof of concept is a means to explore operational models—and thus for the City to better understand staffing and management requirements for a full-scale Digital City deployment.

1.5 The Proof of Concept Will Address Key Questions

As the City plans a proof of concept, it should be guided by the questions it seeks to answer. For example, on a physical level, the proof of concept can address the following types of issues:

What are the advantages and disadvantages of different infrastructure classes?	• Trash cans • Kiosks • Streetlight poles • Small poletop devices
What types of sensors and devices provide valuable data?	• Motion • Climate • Video • Audio
How should the device interact with the public?	• Microphone • Camera • Screen • Loudspeaker • Wi-Fi • CBRS
How can the device be part of a broader communications fabric?	• Fiber connectivity • Wi-Fi mesh • CBRS • Commercial wireless

Digging deeper, the proof of concept can also shed light on questions related to the business model, partnership opportunities, privacy, and security. Among the questions to be consider include the following:

- Is a business model with a wireless carrier or neutral host infrastructure provider technically feasible? Under what conditions?
- How much does maintenance and staffing cost?
- What is needed for backend data and equipment management?
- How can privacy be protected?
- Which locations work best and why?

- How much bandwidth is needed for connectivity?
- Which City departments and stakeholders want to participate? How?
- How can data be made useful to the City and the public?
- What is the construction cost (including power installation) and how can it be controlled?
- How can the system be kept secure?
- Is there a connectivity model using partner (wireless provider) infrastructure?

1.6 Proof of Concept Vision

Given the City's identified needs and goals, the proof of concept vision includes the following key elements:

- At least five full-size, fiber-connected devices (including at least one smart pole, trash can, and kiosk) located in different environments but near DT fiber
- Additional poletop installations if feasible and desired—connected over fiber or commercial cellular networks and with mesh connectivity for device-to-device communications
- A deployment that leverages existing SFPUC conduit for power and fiber installation (and that may leverage small cell installation by wireless carriers, or partner fiber if feasible)

The City should select sensors and devices based on department-identified needs (and, potentially, through an approach that compares different partners and device types to each other).

1.7 Proof of Concept Cost Estimate and Timeline

Over a projected two-year period, the proof of concept would require an investment of about $1.25 million to $2.2 million.

Proof of Concept Cost Estimate

Item	Vendor	Year 1		Year 2	
		Low Estimate	High Estimate	Low Estimate	High Estimate
Smart pole or kiosk equipment & installation (5 @ $50,000 to $100,000 each)	TBD	$250,000	$500,000		
Fiber connectivity ($15,000 to $30,000 per smart pole)	DT	$75,000	$150,000		
IoT Sensors, Cameras & Modules Network technology (5 @ $20,000 to $50,000 each	TBD	$100,000	$250,000		
Proof of Concept Procurement, Operation, Documentation & Evaluation	DT & Tech Marketplace	$200,000	$300,000	$200,000	$300,000
Physical Engineering & Design (20% of item 1)	DT, SFPUC & TBD	$50,000	$100,000		
Maintenance ($10,000 plus one replacement per year @ half 1 & 3)	DT, SFPUC & TBD	$0	$0	$45,000	$85,000
Planning of Scaled-Up Deployment & Procurement Process	Tech Marketplace	$0	$0	$200,000	$300,000
Contingency (10% of total)		$67,500	$130,000	$44,500	$68,500
Estimated Total		***$742,500***	***$1,430,000***	***$489,500***	***$753,500***

The initial 24-month timeline would encompass steps from procurement through to evaluation and documentation.

Proof of Concept Timeline

Action	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Tech marketplace – quote & selection																								
Requirements gathering with departments																								
Procurement of smart pole & sensors																								
Detailed design & permitting																								
Installation & testing																								
Proof of concept trials																								
Evaluation & documentation																								

The cost estimate and timeline assume the City will design and plan proof of concept projects in at least five locations—likely replacing SFPUC or MTA poles. To seek to reduce costs, the City will partner with one or more infrastructure entities to explore the feasibility of a longer-term relationship; these may include a wireless service or infrastructure provider, a street lighting partner, a waste removal company, or a kiosk designer.

Further, while the proof of concept will test a wide range of use cases with departments & stakeholders, the budget does not include user equipment or labor from departments performing those proof of concept tests. And, while the budget includes software and management platforms, it does not include integration with additional City systems.

2 Staffing Recommendations

A successful Digital City implementation needs to be relevant and responsive to the public, needs to be reliable, and needs to be creating increasing value for the community. Making it work will need a broad set of skills. In supporting this system, DT team will need to evolve from roles supporting single-function, legacy equipment to a range of tasks spanning the whole set of information and technology disciplines.

We have identified nine areas that will require sustained, focused effort:

1. Maintenance of physical Digital City smart poles and outdoor devices (e.g., kiosks, cameras, microphones, sensors, call boxes, sirens)
2. Management and monitoring of Digital City systems
3. Fiber maintenance and outside plant coordination among pole owner (PUC, MTA, PG&E), the power company, and public works
4. Help desk (to public and departments/stakeholders using devices)
5. Analysis of large data sets, including geographic data
6. Maintaining connectivity with cloud processing and storage
7. Information security
8. Education—training users in app use, in app development, in working with data sets
9. Outreach to public, application partners

The number of team members will depend on the number of devices, as well the roles of partners. In rough terms, in a citywide implementation, fiber mileage will double and the number of poles will be comparable to the current number of call boxes. Many of the information technology roles (security, help desk, management and monitoring) would require scaling up of existing departments. The application-specific roles may be handled by specific stakeholder departments that sponsor and manage them (e.g., SFUSD, Public Health).

The proof of concept should include as a goal developing further clarity on an operational model and in how responsibilities are divided. It should also enable the City to develop a framework for adding applications and functions and managing data.

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