City of Dallas

2019 - 2020

CITY OF DALLAS
INTERNET OF THINGS (IOT)
BEST PRACTICES GUIDELINES

VERSION 2.0

2019 - 2020

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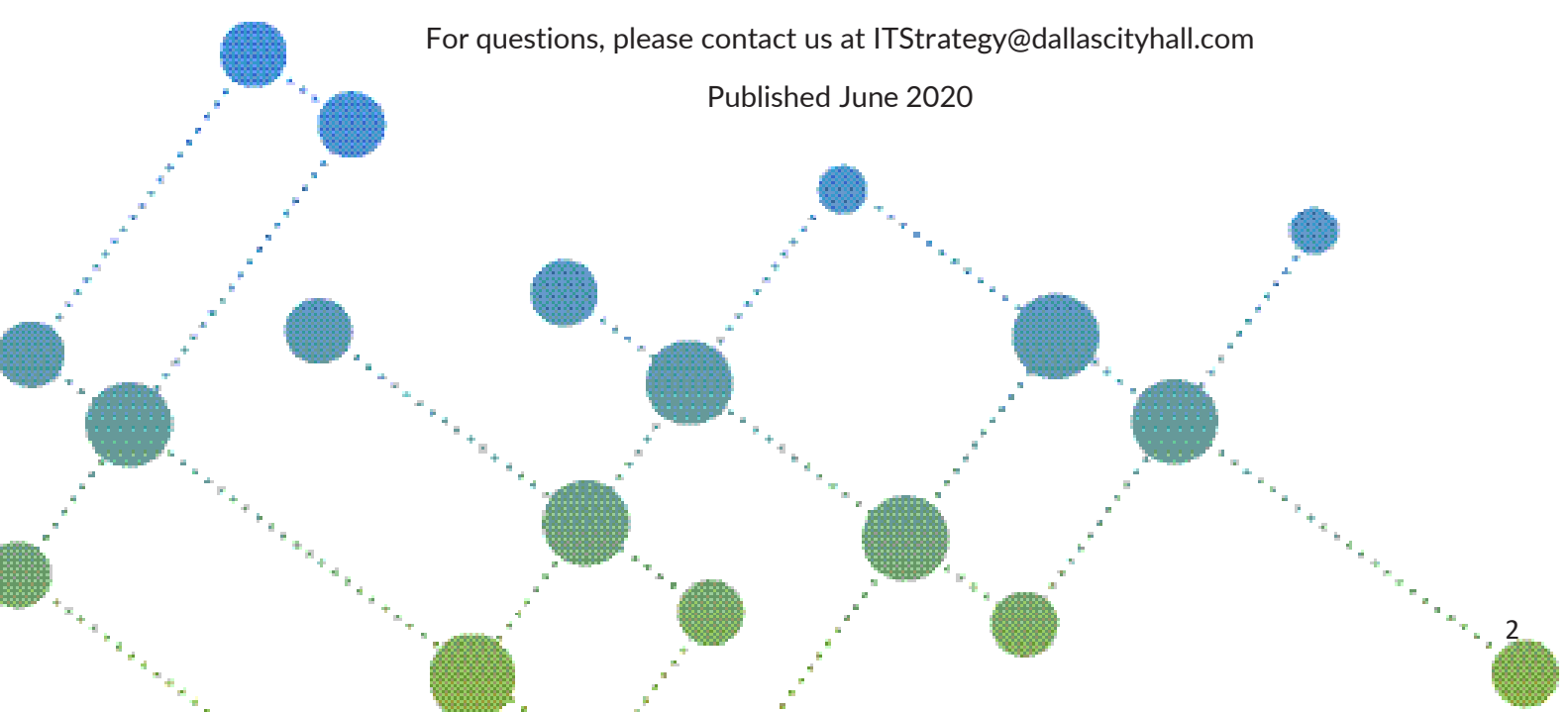
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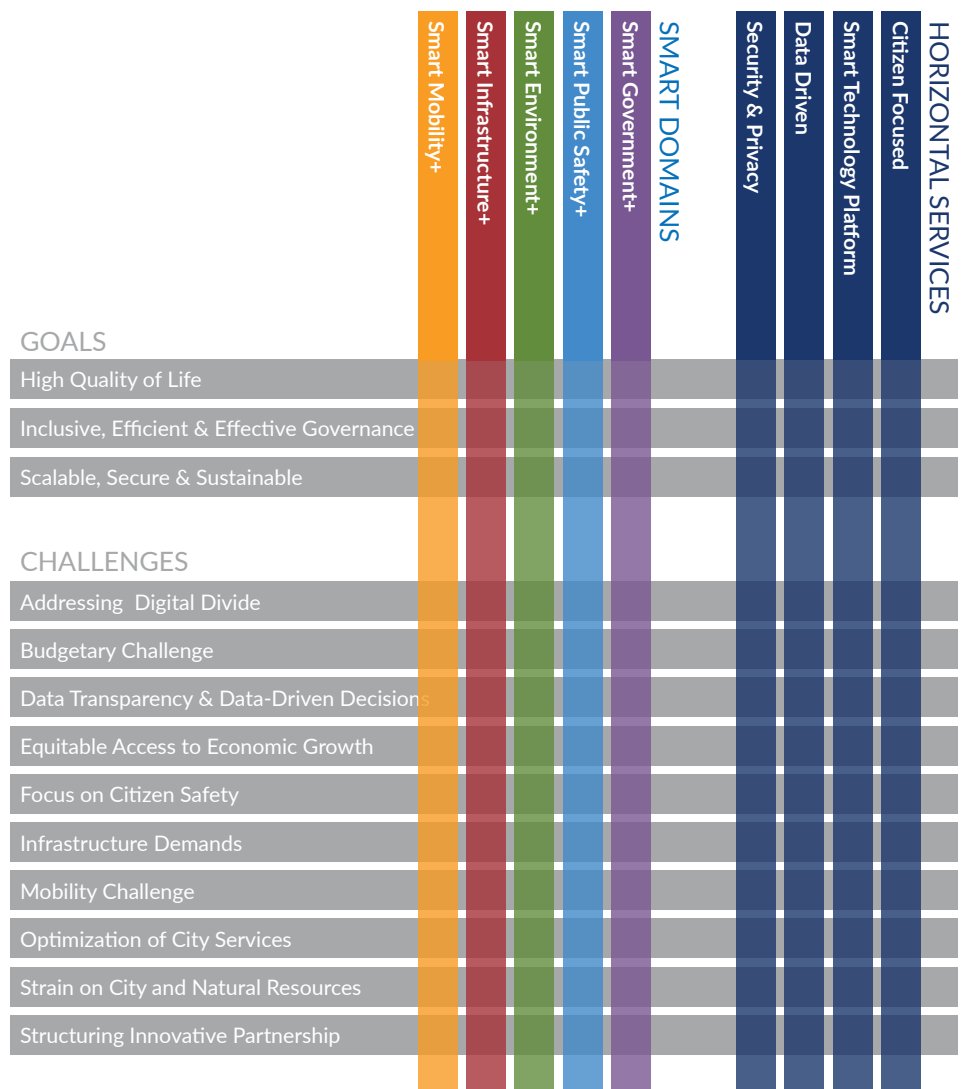
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INTRODUCTION

The purpose of this publication is to articulate the guidelines and best practices that the City of Dallas and its partners and vendors will adhere to when operating, implementing or contemplating Emerging Technology - specifically IoT solutions. This document is written from a technology perspective and does not negate the need to adhere to any and all relevant ordinances, policies, guidelines, standards or similar instructions published separately by the City of Dallas or the industry leading best practices.

CITY OF DALLAS IOT ARCHITECTURE

The City of Dallas' Technology+ Strategy encompasses a data-centric architecture and focuses on leveraging technology and data across as many use cases as possible to maximize the value citizens receive. The City has implemented Horizontal Services to meet the goals of Citizen Focused, Smart Technology Platform, Data Driven, and Security and Privacy as described in the Technology+ Strategic Plan.

In the context of this document, a Horizontal Service is defined as technology, data, intelligence and applications that are utilized to deliver value across multiple domains, use cases and departments. The City of Dallas has guiding characteristics for each category of Horizonal Service (Technology, Data, Intelligence, and Applications) that should be present in all IoT Solutions.

	Smart Mobility+	Smart Infrastructure+	Smart Environment+	Smart Public Safety+	Smart Government+ (SMART DOMAINS)	Security & Privacy	Data Driven	Smart Technology Platform	Citizen Focused (HORIZONTAL SERVICES)
GOALS									
High Quality of Life									
Inclusive, Efficient & Effective Governance									
Scalable, Secure & Sustainable									
CHALLENGES									
Addressing Digital Divide									
Budgetary Challenge									
Data Transparency & Data-Driven Decisions									
Equitable Access to Economic Growth									
Focus on Citizen Safety									
Infrastructure Demands									
Mobility Challenge									
Optimization of City Services									
Strain on City and Natural Resources									
Structuring Innovative Partnership									

1. Technology
The City of Dallas implements IoT solutions based on open and interoperable standards wherever pos-sible—enabling evolution to changing market requirements and the ability to meet the diverse needs in different communities across Dallas. This also supports leveraging the existing assets to the fullest extent possible. Leveraging existing assets to maximize the value of previous investments is key to this guide-line.

2. Data
All IoT initiatives prioritize availability and access of data to enable cross-initiative insights
and easy to implement visibility for citizens. Data should be accessible and follow the City of Dallas data management guidelines. Solutions should avoid data lock-in and ensure interoperability with other government organizations locally and globally, where possible. All IoT initiatives should include open standards based APIs for both real-time and bulk data sharing.
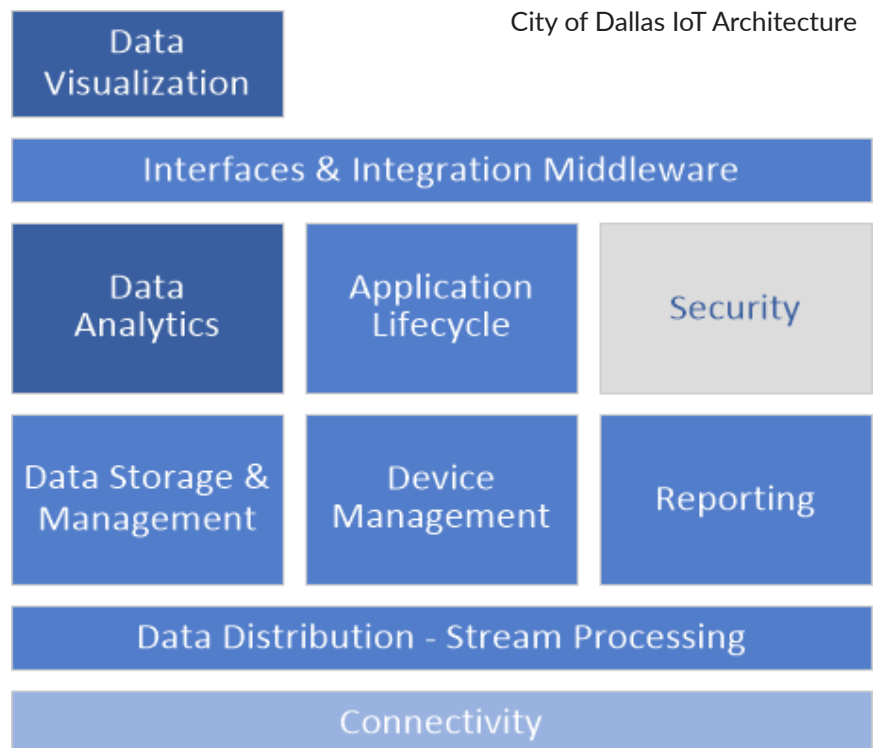
3. Intelligence
All IoT initiatives should consider availability and access of data to enable actionable insights by lever-aging data across all domains. Data-driven decision making and optimization of government operations often require the big data platform to utilize data from numerous departments—all solutions should sup-port the flexibility to share data with the big data platform in the future.

4. Application
All City of Dallas IoT initiatives are implemented with a focus on how the specific application being real-ized is beneficial for Dallas residents and visitors. One vision for the future is the City dynamically adapts to the needs of the citizens and communication with the citizens is a continuous feedback loop.   All IoT initiatives should utilize Security and Privacy Frameworks, and citizens should have visibility into how their private information is being treated.

IoT Architecture
The City of Dallas IoT Architecture is comprised of these horizontal service, pack-aged into an IoT stack as can be seen in the City of Dallas IoT Architecture graphic. All part-ners are ecouraged to leverage exisitng techology investments where it is in the best interest of the City to do so, and tailor their proposals to align with the City's technology architecture and vision.

City of Dallas IoT Architecture

Data Visualization

Interfaces & Integration Middleware

Data Analytics

Application Lifecycle

Security

Data Storage & Management

Device Management

Reporting

Data Distribution - Stream Processing

Connectivity

IoT Architecture Components

Data Visualization

The City of Dallas has a number of off-the-shelf data visualization tools that are utilized by the Data Analytics team to derive actionable insights and enable data-driven governance. In addition, the City has a team dedicated to ensuring high-quality Geographic Information System (GIS) services. Finally, to enable data transparency, data sharing and citizen engagement, the City of Dallas has created an Open Data Portal with over 100 published data sets.

Interfaces and Integration Middleware

For ingestion of data into the City of Dallas (CoD) data ecosystem, a number of off-the-shelf and open-source systems are currently leveraged. For northbound, external exposure of APIs, the necessary functions are provided by the Open Data portal and a variety of vendor solutions for other use cases.

Data Analytics

In order to realize the full value of collecting data, it is necessary to have the capability of combining data sets and mining relevant insights to enable efficient, effective, data-driven decision making. There are a wide variety of solutions available to enable analytics and big data. The cost for the City of Dallas to separately procure the necessary services for each individual use case can be cost prohibitive. Thus, the City of Dallas has invested in a complete Analytics and Big Data suite and has a team of data scientists utilizing this suite to deliver use cases across many departments.

Data Storage & Management

The City of Dallas has a data ecosystem that leverages our Hadoop database as well as RDBMS DBs and SQL Servers.

Application Lifecycle

The City of Dallas has historically trended towards utilizing off-the-shelf applications purchased from external vendors rather than building applications in house. That being said, the vision for the City of Dallas, for Citizen interaction, is to have a unified communication channel with residents or visitors across all forms and domains of interaction.

Device Management

A key aspect of the Internet of Things (IoT) is the realization of large, heterogeneous networks of devices/sensors providing data that can be used in real time or post processed to deliver situational awareness and insights. The benefits are numerous, but this phenomenon also presents challenges in how to manage a large, diverse group of devices to perform necessities such as monitoring device status, pushing necessary SW updates, troubleshooting issues and taking action remotely, etc. The City of Dallas has IoT device management technology available that utilizes the OMA DM LWM2M specification as well as IP Smart Objects guidelines. While it is not always the case that the City of Dallas would perform the device management, it is desired that vendor solutions be compliant with these specifications to enable future flexibility, if desired.

Security

The City of Dallas has a set of security guidelines, standards and best practices that all solutions must comply with, as indicated in the Request for Competitive Sealed Proposals template supporting documentation—these apply to IoT solutions, as well. In addition, for IoT solutions Device and Data Integrity functions are needed to provide a level of assurance that neither the device nor the data has been tampered with prior to the data reaching the City's servers.

Reporting

All solutions should provide logging and reporting functionality to ensure adequate visibility into system and application performance and health as well as user experience. Standard industry practices for sharing of the reports and data should be followed.

Connectivity

One of the biggest challenges for IoT deployments is connecting the IoT devices to enable data transfer—fiber is expensive to run if it does not currently exist in the desired deployment local. The City is currently evaluating the plethora of connectivity options applicable to Smart IoT use cases. Not every use case will require the same type of connectivity, so a suite of options is anticipated. The City strongly prefers non-proprietary, open-standards-based communication protocols.

BEST PRACTICES FOR USE OF CITY WI-FI NETWORKS

The use of existing City of Dallas Wi-Fi provided at many sites around the City is attractive to reduce the ongoing connectivity costs for IoT Devices. For scenarios where this is applicable (eg. City Buildings, Parks and Rec centers, Community Centers, the Innovation District, the Arts District, etc.) there are some Best Practices the IoT devices must abide by.

1. All IoT devices deployed on a City of Dallas Wi-Fi network should be certified fully compliant with the latest 802.11 standard. Certification of compliance may be requested.
2. All IoT devices deployed should support the 5GHz band.
3. All IoT devices should provide an easily accessible MAC address prior to device onboarding.
4. Default passwords much be changed or disabled.
5. Universal Plug and Plan (UPnP) must be disabled.
6. Remote management should be disabled unless an exception is granted by City of Dallas' IT Security.
7. Firmware must be kept up to date on a pre-approved schedule.
8. Encryption and certificates should be used wherever applicable.
9. Devices shoud be physically secured in a manner that prevents tampering.

STANDARDS FOR REFERENCE

The City of Dallas understands that multiple and sometimes conflicting open, non-proprietary standards exist for IoT data and technology interfaces. The City of Dallas' intent is for the most appropriate open, non-proprietary standard to be used for the IoT project at hand. This approach may encourage the highest possible level of interoperability and future flexibility without stifling innovation given the nascent nature of the IoT standards landscape. The below are some standards and framworks the City is following for reference, but is not intended as an exhaustive list and any open, non-proprietary standard is of interest.

- **IPSO Application Framework:** The City of Dallas appreciates the value of having a uniform guideline for representing IoT resources.

- **OMA LightweightM2M v1.0:** The City of Dallas appreciates the use of the LWM2M framework for interfacing with IoT devices and data in a standard way.

- **IEEE P2413:** This working group has not yet published the IEEE Smart City Framework Standard; however, the City of Dallas is anticipating this release.

- **The Open Group Architecture Framework (TOGAF), Version 9.2:** The City of Dallas currently uses TOGAF.

- **ISO/IEC 20802:** Information Technology – Open data protocol (OData) v4.0 – Part 1: Core

- **ISO/TS 37151:** 2015 Smart Community Infrastructures – Principles and requirements for performance **metrics**

- **ISO 37120:** Sustainable development of communities - Indicators for city services and quality of life.