



# Event Parking Management (EPM) System Requirements Specifications

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for the Smart Columbus  
Demonstration Program

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Produced by City of Columbus

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# Abstract

This System Requirements Specification (SyRS) document is intended to communicate the validated set of system requirements of the Smart Columbus Event Parking Management (EPM) project to the technical community who will specify and build the system. The SyRS is a “black-box” description of what the EPM System must do, but not how it will do it. It serves as an extension of the system concepts established in the Concept of Operations and includes a description of engineering principles applied to the system and requirements definition process.



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# Executive Summary

The Event Parking Management (EPM) project is one of the eight Smart Columbus projects that aim to create transportation opportunities to connect people to better access for jobs and services while improving the overall safety and efficiency of the transportation network.

The SyRS document has been updated to reflect the as-built project changes to better allow readers to see the actual project that has been implemented while also sharing changes that took place from the concept phase to the as-built phase of the project. Major changes that are included in the concept phase of the project but are not included in the project's implementation are described in **Section 1.4**. Additionally, each system requirement listed in **Chapter 3** is verified, revised and validated to make sure all the design and system changes are captured as per the as-builts of the project.



# Chapter 1. Introduction

This Systems Requirements Specification (SyRS) is intended to communicate the requirements of the Smart Columbus Event Parking Management (EPM) project to the technical community who will specify and build the system. The SyRS is a “black-box” description of what the EPM project must do, but not how it will do it. The document contains descriptions of inputs, outputs, and required relationships between inputs and outputs.

## 1.1. DOCUMENT PURPOSE

This SyRS serves as the second in a series of engineering documents intended to describe the EPM project, building upon the Concept of Operations (ConOps) Document. The SyRS describes a set of requirements that, when realized, will satisfy the expressed needs of the EPM project. This document includes the identification, organization, presentation, and modification of the requirements for the EPM project. These requirements are derived from the user needs, constraints and interfaces that the EPM project is expected to implement. This SyRS addresses conditions for incorporating operational concepts, design constraints, and design configuration requirements as well as the necessary characteristics and qualities of individual requirements and the set of all requirements.

This document was developed based on Institute of Electrical and Electronics Engineers (IEEE) 1233-1998 Guidance for Developing System Requirements Specifications and contains the following sections:

- **Chapter 1. Introduction** provides an overview of the EPM project and key elements that guide the development of this SyRS document, including an overview of the project, the stakeholders, requirements development process, and referenced materials.
- **Chapter 2. System Description** focuses on describing and extending the EPM System concepts established in the ConOps, including system capabilities, conditions, constraints, and decomposing the system into its functional groups for establishing requirements.
- **Chapter 3. System Requirements** contains the requirements for each functional group that make up the system.
- **Chapter 4. Engineering Principles** provides a description of engineering principles applied to the system and requirements definition process.

## 1.2. PROJECT SCOPE

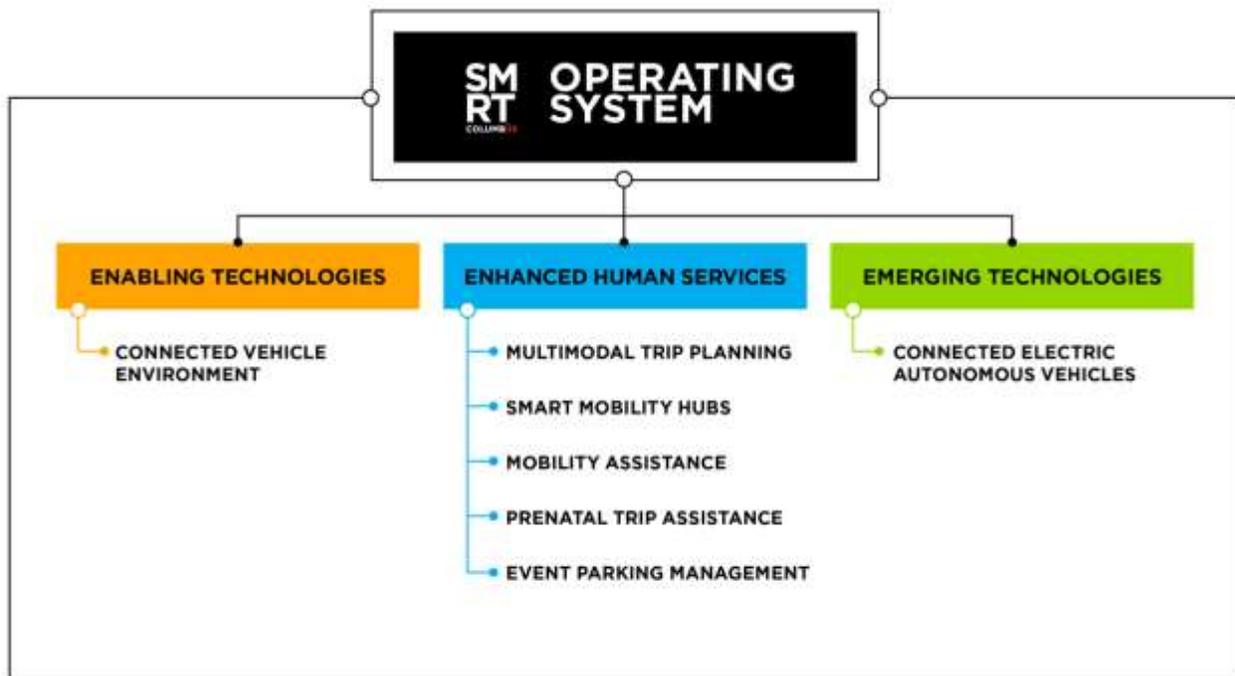
In 2016, the U.S. Department of Transportation (USDOT) awarded \$40 million to the City of Columbus, Ohio as the winner of the Smart City Challenge. With this funding, Columbus intends to address the most pressing community-centric transportation problems by integrating an ecosystem of advanced and innovative technologies, applications, and services to bridge the sociotechnical gap and meet the needs of residents of all ages and abilities. In conjunction with the Smart City Challenge, Columbus was also awarded a \$10 million grant from the Paul G. Allen Family Foundation to accelerate the transition to an electrified, low-emissions transportation system.

With the award, the City established a strategic Smart Columbus program with the following vision and mission:

- **Smart Columbus Vision:** Empower residents to live their best lives through responsive, innovative, and safe mobility solutions.

- Smart Columbus Mission:** Demonstrate how Intelligent Transportation Systems (ITS) and equitable access to transportation can have positive impacts of every day challenges faced by cities.

To enable these new capabilities, the Smart Columbus program was organized into three focus areas addressing unique user needs: enabling technologies, emerging technologies, and enhanced human services. This portfolio of technical concepts was divided into eight individual projects shown in **Figure 1**. The EPM primarily addresses needs in the enhanced human services program focus area.



**Figure 1: Smart Columbus Projects**

Source: City of Columbus

The EPM project is one of the eight projects in the Smart Columbus program and is considered the future of smart parking. Creation of the EPM System will allow users to identify currently projected parking availability near their target destination and aid in effectively reducing the additional driving required in finding suitable parking. It is envisioned that users of this system will have access to parking reservations (for garage and surface lot parking) and payment capabilities. Benefits of an EPM System include reduced emissions, reduced Traveler frustration and reduced congestion.

Parking in Columbus is classified as either public or restricted. Public parking is available to the general motoring public and can include parking at garages, surface lots, on-street parking and loading zones. Restricted parking includes city-owned parking spaces reserved for employees or permitted parking, and parking areas for students only. In special situations, such as large events, restricted parking can be temporarily designated as public by the Director of Public Service. The initial release of EPM will not provide EPM for restricted parking that has been temporarily designated as public, but this capability is a good candidate for a future release of EPM.

**Table 1** provides more details regarding the public parking facilities that are included in the EPM project.

**Table 1: Event Parking Management Project Scope**

Scope	Description
<b>Parking garage and surface lot spaces</b>	The project will capture parking availability and other parking-related data from 86% of the available parking garages and private surface lots in the project area and transmits the data to the EPM Central System and then to the Smart Columbus Operating System (Operating System).
<b>On-street parking (parking meters and kiosk zones)</b>	The project will collect parking-related data from on-street parking spaces which includes approximately 4,300 single-space parking meters and 9 kiosk payment parking zones and transmit the data back to the Operating System to project availability.
<b>Loading zones</b>	The project will collect restriction information for approximately 130 loading zones designated by the City of Columbus.
<b>EPM Central System</b>	The EPM project will consist of several new software modules working together to deliver the EPM service, including a front-end-traveler user interface and back-end central system that will connect, capture, relate, store, and respond to real-time parking data collected from various sources and equipment. EPM will interface with the Operating System to house the real-time and archived data and allow stakeholders operational and reporting access. These combined software modules make up the EPM System and will provide current, projected, and complete views of parking status and availability to help travelers plan and pay for parking and realize the City's smart parking vision and goals.

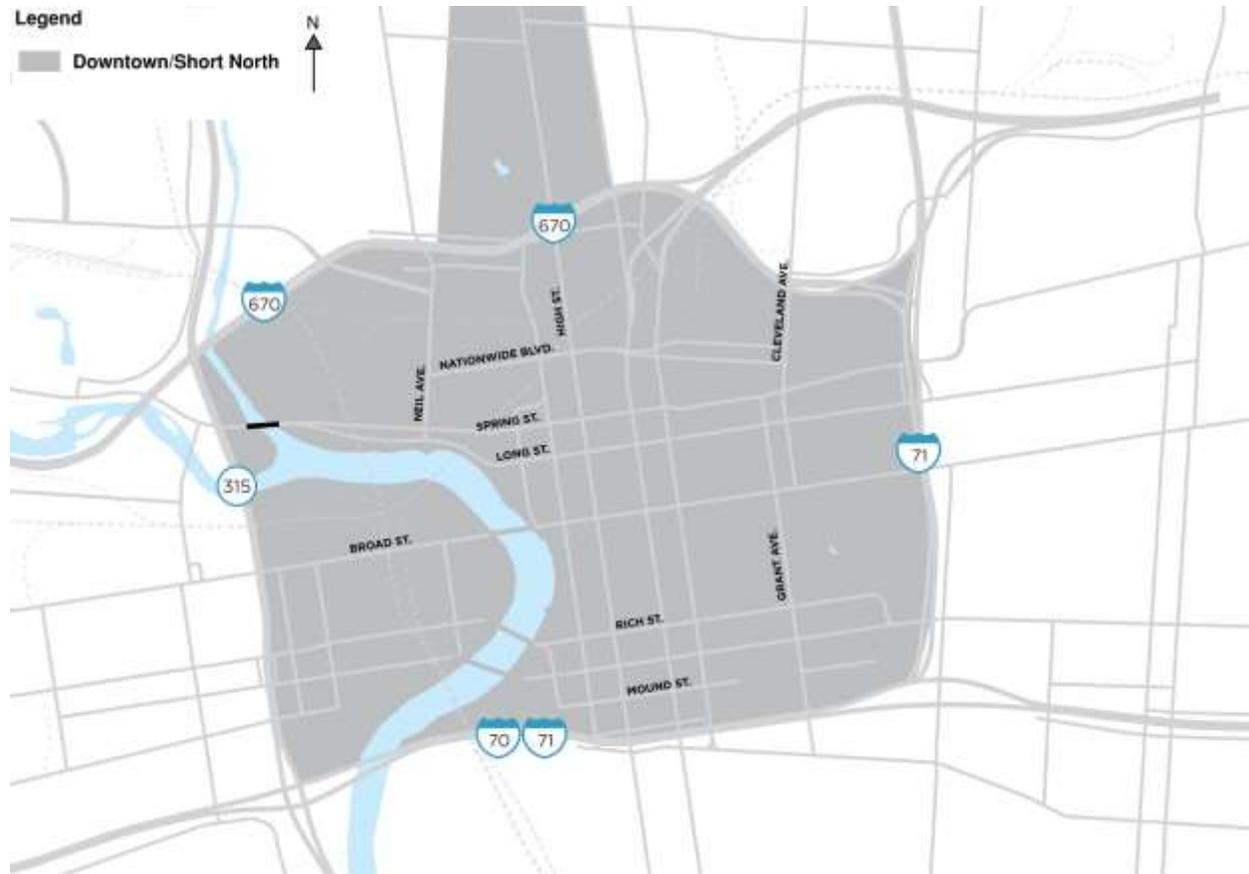
Source: City of Columbus

The EPM System will be created using parking availability information from existing garages, surface lots, and on-street parking in Downtown and the Short North. The EPM System will also house and share location and restriction information on the City's loading zones citywide. Real-time data will be augmented with historic on-street parking usage data to calculate the probability of open on-street parking. This data will be used to make availability projections to some degree of accuracy. The EPM data and the City's existing parking database and any real-time parking information available will be provided to the Operating System.

The geographic scope of the EPM project focuses on the Downtown and Short North for parking garage, surface lot, on-street parking and loading zone information. The on-street parking and loading zone information will be expanded citywide.

The Downtown boundaries are consistent with the central business district which is bounded by SR-315 on the west, I-70 on the south, I-71 on the east, and I-670 on the north. In addition, the Short North area includes the High Street corridor from I-670 on the south, approximately Dennison Avenue on the west, Third Street on the east, and Fifth Avenue on the north.

**Figure 2** depicts the boundaries of Downtown and the Short North that are relevant for this project.

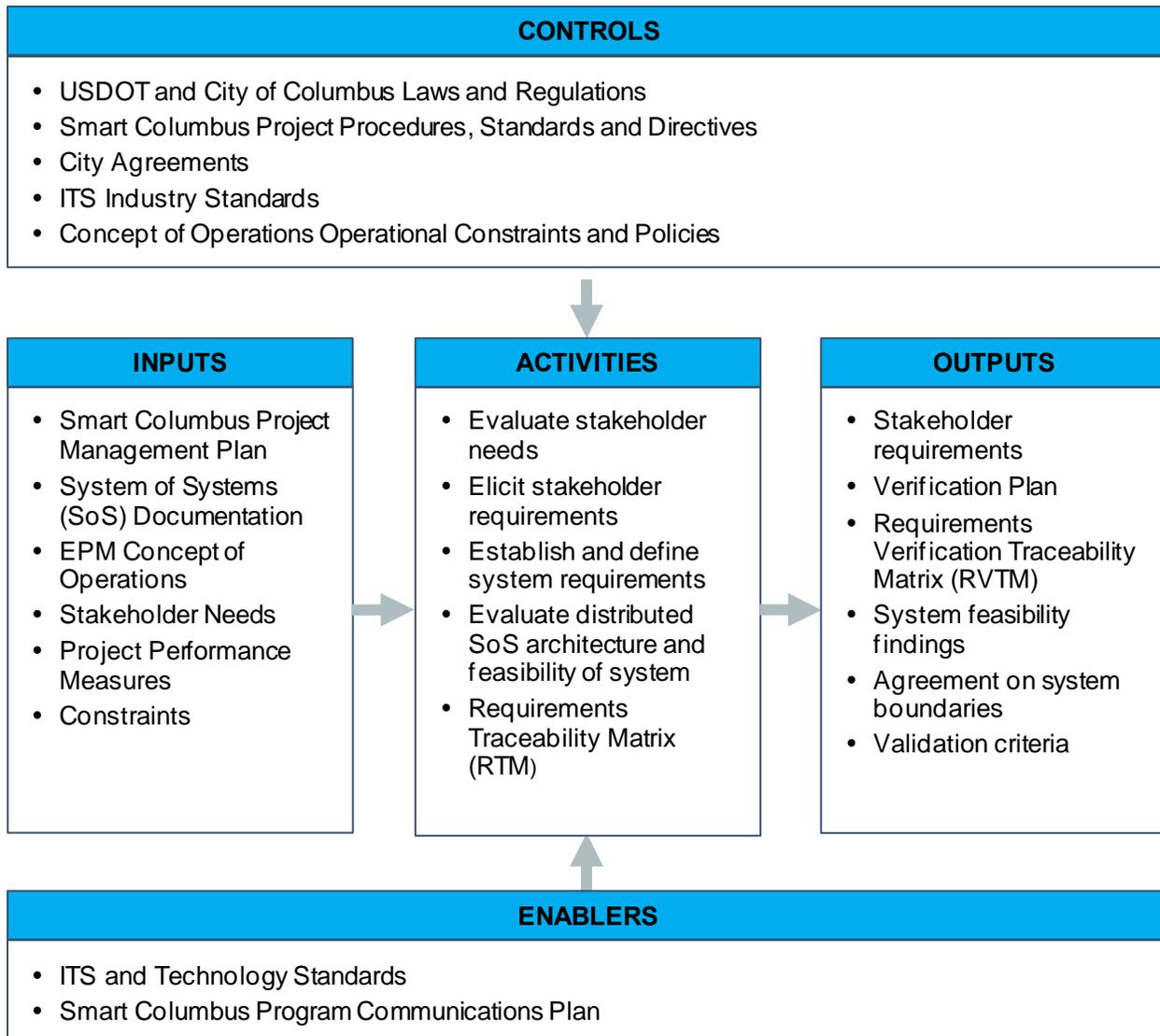


**Figure 2: Map of Downtown and the Short North**

Source: City of Columbus

### 1.3. REQUIREMENTS PROCESS

The requirements established for this project will govern the EPM System’s development cycle and are an essential factor in further defining and clarifying the scope and feasibility of development for the system. This process will also provide the basis for the technical description of deliverables in the form of a system-level specification and defined interfaces at the system boundaries. **Figure 3** provides a high-level view of the project’s stakeholder requirements definition process.



**Figure 3: Event Parking Management Stakeholder Requirements Definition Process**

Source: City of Columbus

## 1.4. PROJECT CHANGES DURING DEVELOPMENT

### 1.4.1. Parking Prediction Model

Early in project development, the Smart Columbus team spent a lot of time researching, interviewing companies, and participating in demonstrations for products to predict parking availability. From on-street sensors to cameras overhead and even data provided by probe vehicles, there were multiple technology options. The analysis for predicting availability came down to cost, time involved, the lack of the solution data being open source, and concluding that parking predictive probability only a data feed is required, not a whole suite. The team found it could be built better, faster and with open-source code to share with others if we kept the project in-house with the Operating System team.

To create the model, the Operating System team used historical data from the Division of Parking Services. This included on-street parking location and payment transaction data from both the meter head and mobile

pay. The team was also able to integrate data from a pilot program with in-ground sensor technology. The model retrains nightly based on new data.

### 1.4.2. Common Payment System

Payment functionality for EPM was original intended to take place through another Smart Columbus project, Common Payment System (CPS). CPS was envisioned to handle all payment functionality for the mobile app and web portal and the Operating System would oversee the CPS accounts and payment processing. The CPS project was removed from the Smart Columbus Program therefore any reference to CPS has been removed or updated as appropriate. Reference to the Operating System as it related to CPS have also been updated.

### 1.4.3. Removal of Probe Vehicle Data

As discussed in 1.4.1, the data used to create the parking availability model does not require probe vehicle data. When the project team reviewed options for using probe vehicle data, it became apparent that this technology was not available as a standalone data source for all on-street parking locations.

### 1.4.4. Removal of Loading Zone Availability

When probe vehicle data was removed as a viable option from the project to verify occupancy, loading zone availability was no longer feasible.

## 1.5. REFERENCES

**Table 2** contains documents and literature used to gather input for this document.

**Table 2: References**

Document Number	Title	Revision	Publication Date
2105.16	City of Columbus Municipal Code (Individual parking spaces)	<ul style="list-style-type: none"> <li>• Ord. No. 2168-76</li> <li>• Ord. No. 2120-03 § 1 (part), 12-11-2003</li> </ul>	12/11/2003
2150.04	City of Columbus Municipal Code (Parking Violations Bureau)	<ul style="list-style-type: none"> <li>• Ord. No. 32-83</li> <li>• Ord. No. 2120-03 § 1 (part)</li> <li>• Ord. No. 0867-2006 § 1 (part)</li> <li>• Ord. No. 0105-2007 § 1 (part)</li> <li>• Ord. No. 0128-2009, § 1, 2-9-2009)</li> <li>• Ord. No. 1189-2018, § 2, 3, 5-21-2018)</li> </ul>	2/9/2009

Document Number	Title	Revision	Publication Date
2151.01	City of Columbus Municipal Code (Parking prohibitions in specified places)	<ul style="list-style-type: none"> <li>• Ord. No. 1171-88</li> <li>• Ord. No. 2120-03 § 1 (part)</li> <li>• Ord. No. 0867-2006 § 1 (part)</li> <li>• Ord. No. 0128-2009, § 1, 2-9-2009</li> <li>• Ord. No. 0411-2009, § 3, 04-19-2010</li> <li>• Ord. No. 1465-2012, § 1(Attach.), 7-16-2012</li> <li>• Ord. No. 1182-2014, § 2, 06-16-2014</li> </ul>	6/16/2014
2105.16	City of Columbus Municipal Code (Individual parking spaces)	<ul style="list-style-type: none"> <li>• Ord. No. 2168-76</li> <li>• Ord No. 2120-03 § 1 (part), 12-11-2003</li> <li>• Ord. No. 1189-2018, § 2, 3, 5-21-2018)</li> </ul>	12/11/2003
FHWA-JPO-17-518	Smart Columbus Demonstration Program Systems Engineering Management Plan (SEMP) <a href="https://d2rfd3nxvhnf29.cloudfront.net/2019-08/Smart%20Columbus%20Systems%20Engineering%20Management%20Plan_0.pdf">https://d2rfd3nxvhnf29.cloudfront.net/2019-08/Smart%20Columbus%20Systems%20Engineering%20Management%20Plan_0.pdf</a>	–	01/16/2018
–	Beyond Traffic: The Smart City Challenge – Phase 2 – Volume 1: Technical Application <a href="https://www.columbus.gov/WorkArea/DownloadAsset.aspx?id=2147487896">https://www.columbus.gov/WorkArea/DownloadAsset.aspx?id=2147487896</a>	–	05/24/2016
1233-1998	IEEE Guidance for Developing System Requirements Specifications	–	1998
INCOSE-TP-2003-002-03.2.2	INCOSE Systems Engineering Handbook	3.2.2	2011
–	Systems Engineering Guidebook for Intelligent Transportation Systems	3.0	2009

Document Number	Title	Revision	Publication Date
FHWA-JPO-17-527	Concept of Operations for the Event Parking Management Project for the Smart Columbus Demonstration Program <a href="https://d2rfd3nxvhnf29.cloudfront.net/2021-05/SCC-B-EPM-ConOps-UPDATE%204.30.21.pdf">https://d2rfd3nxvhnf29.cloudfront.net/2021-05/SCC-B-EPM-ConOps-UPDATE%204.30.21.pdf</a>	2.0	04/30/2021
FHWA-JPO-17-523	Smart Columbus Demonstration Program Multimodal Trip Planning Application/Common Payment System Concept of Operations <a href="https://d3hgzplpmmz6qe4.cloudfront.net/2019-07/Multi-Modal%20Trip%20Planning%20System%20Concept%20of%20Operations.pdf">https://d3hgzplpmmz6qe4.cloudfront.net/2019-07/Multi-Modal%20Trip%20Planning%20System%20Concept%20of%20Operations.pdf</a>	2.0	08/10/2018
N/A	Smart Columbus Operating System <a href="https://www.smartcolumbusos.com">https://www.smartcolumbusos.com</a>	N/A	N/A
N/A	Smart Columbus Demonstration Program Data Privacy Plan (DPP) <a href="https://d2rfd3nxvhnf29.cloudfront.net/2020-09/SCC-D-DataPrivacyPlan-AnnualUpdate-V2.pdf">https://d2rfd3nxvhnf29.cloudfront.net/2020-09/SCC-D-DataPrivacyPlan-AnnualUpdate-V2.pdf</a>	N/A	09/24/2020
N/A	Smart Columbus Demonstration Program Data Management Plan (DMP) <a href="https://d2rfd3nxvhnf29.cloudfront.net/2020-08/SCC-E-DataManagementPlan-Update-v1_0.pdf">https://d2rfd3nxvhnf29.cloudfront.net/2020-08/SCC-E-DataManagementPlan-Update-v1_0.pdf</a>	N/A	08/06/2020
–	Web Content Accessibility Guidelines <a href="https://www.w3.org/TR/WCAG/">https://www.w3.org/TR/WCAG/</a>	2.1	06/2018

Source: City of Columbus

# Chapter 2. System Description

## 2.1. SYSTEM CONTEXT

As part of its smart parking initiative, the City wants the EPM System to be a one-stop shop for parking information in Downtown and in the Short North. In both areas, parking is in demand, even for delivery vehicles, making on-street, garages, surface lots and loading zone parking information of interest.

The City, through their contractor, IPS Group, will be adding their existing parking database to the Operating System, which includes on-street parking usage information which will help to calculate the probability of an open parking meter in an area. The City's Division of Parking Services has implemented a comprehensive parking management plan in the Short North in January 2019 and is focused on on-street parking and permit parking solutions as well as mobile payments in the Short North neighborhood.

Many parking facilities in the Downtown and Short North have a gated revenue system with availability reporting capabilities. The EPM System will seamlessly integrate with these gated revenue systems to show parking availability. Parking facilities with reservation capabilities will have the ability to allow EPM users to reserve spaces in the EPM System for special events. Garages will also be able to change the pricing on the application in near real-time.

Surface lots for public parking come in all shapes and sizes, unfortunately for this project, they don't often come with an entry and exit gate. Surface lots could be at a disadvantage when trying to use the full extent of the EPM System. For those that do not have a gate or a way to track real-time availability, a user interface will be established to allow onsite attendants to input availability data, rates, hours of operation, number of spaces and a picture of their location.

The Traveler experience will start by downloading a smartphone application (expected to be available on iOS and Android devices) or by entering through a web portal. Upon entry, without entering any personal information or creating a Traveler profile, the Traveler will enter a destination address or pull up the map feature and zoom into the desired area. The map feature will be able to automatically load their existing location if desired. Information on parking locations will be highlighted by dots on an interactive map. When a dot is pressed, a pop-up of information will be shown which will include location information, photograph of facility, hours of operation, cost, EV (Electric Vehicle) charging existence, and ADA (Americans with Disabilities Act) parking existence.

While everything described above will be done anonymously, there will be an opportunity for the Traveler to create and store a Traveler profile and notification preferences.

A context diagram for the new EPM System is shown in **Figure 4**.

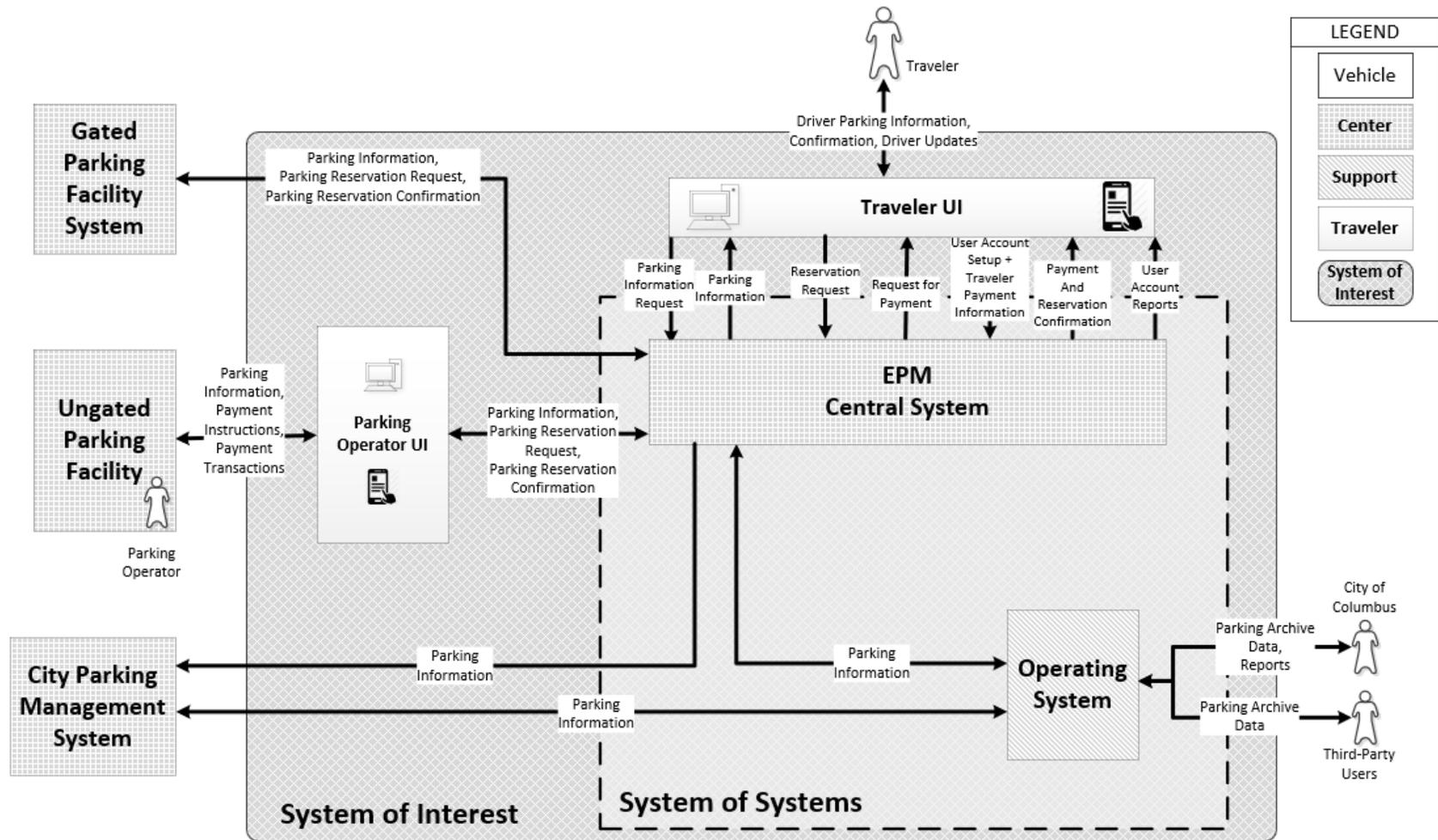


Figure 4: Event Parking Management Context Diagram

Source: City of Columbus

**Table 3** provides Functional Groups (FGs) resulting from the proposed system diagram deconstructed into its major components/functionality.

**Table 3: System Functional Groups**

Ref No.	Functional Group	High-Level Functionality
EPM Central System	EPM Central System	The EPM Central System will send and receive data with the PARKAPP and PARKWEB to schedule and reserve parking. The EPM Central System will send usage information to the Operating System. The EPM Central System will receive City on-street parking prediction data from the Operating System. The EPM Central System will receive on-street parking amenity information and loading zone location and hourly restrictions data from the Division of Parking Services.
UFAC	Ungated Parking Facility System	The UFAC will send and receive data with the EPM Central System. There is expected to be several different revenue vendor systems requiring interfaces.
GFAC	Gated Parking Facility System	The GFAC will send and receive data with the EPM Central System through OPAPP. There is expected to be several different revenue vendor systems requiring interfaces.
OPAPP	Parking Operator Application	The OPAPP will send and receive data with the EPM Central System. A web-based application will allow manual parking facilities to interface to the EPM.
CITYPMS	City Parking Management System	The CITYPMS will send on-street parking usage and general location information to the Operating System. The CITYPMS will also receive on-street parking transaction information from EPMCS.
PARKAPP	Traveler Mobile Application	The PARKAPP will send and receive parking information from the EPM Central System. The PARKAPP will send and receive payment information from the Traveler.
PARKWEB	Traveler Website	The PARKWEB will have most of the same capabilities as the PARKAPP but will not include on-street parking prediction.
Operating System	Smart Columbus Operating System	The Operating System will receive on-street parking usage and general location information from the CITYPMS. The City of Columbus and third-party users will be given access into the Operating System for research and performance evaluation.
CITY	City of Columbus Users	The CITY will configure report data in the Operating System and receive de-identified EPM data from the Operating System.
THRD	Third-Party Users	The THRD will receive de-identified EPM data from the Operating System.

Source: City of Columbus

**Table 4** provides definitions resulting from the proposed system diagram deconstructed into its major components/functionality.

**Table 4: Functional Group Subcomponent Definitions**

Ref	Subcomponent	High-Level Functionality
EPM Central System	Traveler Notifications	Notification of reservation confirmation, changes to an existing reservation, warnings of expiration of a paid parking session, and notification of expiration of paid parking session.
	Traveler Profile	The Traveler profile contains account information and notification preferences.
	Parking Coordination	Coordination with parking facilities and the OPAPP through APIs to exchange parking and reservation information and to update the PARKAPP and PARKWEB.
	Discounted Parking Options	Ability to offer discounted parking options with local merchants.
	Administration	Administrative access for the City of Columbus.
	Provider Accounts	Provider accounts are created for each Service Provider to receive payments. Provider accounts will store contact and billing information and provide the ability to view reports and individual transactions.
	Payment Processing	EPM Central System Payment Processing provides the back-office functions that support requests for parking payment, requests for funds availability, and updates to payment history. It also supports secure communications with the financial infrastructure and distributed payment infrastructure for payment reconciliation with Financial Institutions.
UFAC	Manual System	System in which parking payments are collected manually. Parking staff perform visual inspections of payment tickets as a method of validation and enforcement.
GFAC	Parking Management System	Pay-at-gate or kiosk systems which generally accept credit card and cash forms of payments.
OPAPP	Facility and Parking Availability Information	Ungated parking facility information and parking availability that is entered by the Parking Operator.
CITYPMS	Parking Management System	System for on-street parking management and payment collection for the City of Columbus.

Ref	Subcomponent	High-Level Functionality
PARKAPP / PARKWEB	Manage Profile	Ability to create and manage profile information that is stored in the EPM Central System.
	Search and Reserve Parking	Access to parking information through integration with the EPM Central System. Map-based navigation using the GPS device of a Traveler's phone or personal information device to determine location.
	Transaction Log	Access to parking and payment transaction history.
Operating System	Probability Calculation	Calculation of the probability of finding open on-street parking spaces.
	Analytics	Analytics are reports on parking and payment data to quantify performance.
	CITYPMS Data Processing	Integration with the CITYPMS to ingest on-street parking usage information and on-street parking location to create the probability calculation.
	Public APIs	The Operating System publishes public APIs to allow access to de-identified parking and payment data.

Source: City of Columbus

**Table 5** summarizes the interfaces, facilities, communications and messages used in the system. The reader should reference these figures and table throughout this section to foster a better understanding of the system concept. For the post-deployment update, each interface has been reviewed thoroughly to make sure it is in line with the final design and development of the project. Each interface is given a status to reflect the changes made as per the current system. The following interface status options are used for each of the interfaces below:

- Original Interface: No changes made to the data flow
- Amended Interface: Changes made to the source or destination elements, data flow and/or to communication layers
- Removed Interface: No data flow established between source and destination

**Table 5: Expected Interfaces**

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1843-V01	Interface 1.1	External	EPM Central System	GFAC	Request for Parking Availability Information	Secure Internet	Original Interface
EPM-IX1844-V01	Interface 1.2	External	EPM Central System	GFAC	Request for Reservation	Secure Internet	Original Interface
EPM-IX1845-V01	Interface 1.3	External	GFAC	EPM Central System	Parking Availability Information	Secure Internet	Original Interface
EPM-IX1846-V01	Interface 1.4	External	GFAC	EPM Central System	Confirm Parking Reservation	Secure Internet	Original Interface

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1848-V02	Interface 2.1	External	EPM Central System	GFAC	Request Provider Account Information	Secure Internet	<p>Amended Interface</p> <p><u>Original Source Element:</u> CPS</p> <p><u>Revised Source Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. EPM Central System will be holding the provider account information.</p>
EPM-IX1849-V02	Interface 2.2	External	GFAC	EPM Central System	Provider Account Information	Secure Internet	<p>Amended Interface</p> <p><u>Original Destination Element:</u> CPS</p> <p><u>Revised Destination Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. EPM Central System will be holding the provider account information.</p>

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1850-V01	Interface 2.3	External	CPS	GFAC	Payment	Secure Internet	Removed Interface  CPS is no longer part of the Smart Columbus program.
EPM-IX1852-V01	Interface 3.1	External	EPM Central System	CITYPMS	Parking Meter Time Activation	Secure Internet	Original Interface
EPM-IX1853-V01	Interface 3.2	External	CITYPMS	EPM Central System	Confirm Additional Parking Meter Time	Secure Internet	Removed Interface  EPM Central System does not require CITYPMS to confirm the parking meter information when additional time is requested. Hence, the interface for data flow from CITYPMS to EPM Central System is not established.
EPM-IX1855-V01	Interface 4.1	Internal	EPM Central System	OPAPP	Request for General Facility Information	Secure Internet	Original Interface
EPM-IX1856-V01	Interface 4.2	Internal	EPM Central System	OPAPP	Request Parking Availability Information	Secure Internet	Original Interface

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1857-V01	Interface 4.3	Internal	EPM Central System	OPAPP	Request Reservation	Secure Internet	Removed Interface  EPM Central System does not request reservation confirmation from OPAPP when there is a reservation from PARKAPP and PARKWEB. Hence, the interface is not established.
EPM-IX1858-V01	Interface 4.4	Internal	OPAPP	EPM Central System	General Facility Information	Secure Internet	Original Interface
EPM-IX1859-V01	Interface 4.5	Internal	OPAPP	EPM Central System	Parking Availability Information	Secure Internet	Original Interface
EPM-IX1860-V01	Interface 4.6	Internal	OPAPP	EPM Central System	Confirm Parking Reservation	Secure Internet	Removed Interface  OPAPP does not confirm any reservations when they are reserved from PARKAPP and PARKWEB. Hence, the interface is not established.

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1862-V02	Interface 5.1	External	OPAPP	EPM Central System	Provider Account Information	Secure Internet	<p>Amended Interface</p> <p><u>Original Destination Element:</u> CPS</p> <p><u>Revised Destination Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. EPM Central System will be holding the provider account information.</p>
EPM-IX1863-V02	Interface 5.2	External	EPM Central System	OPAPP	Request Provider Account Information	Secure Internet	<p>Amended Interface</p> <p><u>Original Source Element:</u> CPS</p> <p><u>Revised Source Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. EPM Central System will be holding the provider account information.</p>

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1864-V01	Interface 5.3	External	CPS	OPAPP	Payment	Secure Internet	Removed Interface  CPS is no longer part of the Smart Columbus program.
EPM-IX1866-V01	Interface 6.1	External	CPS	EPM Central System	Payment Status	Secure Internet	Removed Interface  CPS is no longer part of the Smart Columbus program.
EPM-IX1868-V01	Interface 7.1	External	CITYPMS	Operating System	Historic On-street Usage Information	Secure Internet	Original Interface
EPM-IX1870-V01	Interface 8.1	External	Operating System	EPM Central System	On-street Predictive Availability Information	Secure Internet	Original Interface
EPM-IX1871-V01	Interface 8.2	External	EPM Central System	Operating System	EPM Usage Data	Secure Internet	Original Interface

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1873-V01	Interface 9.1	Internal	PROBE	EPM Central System	Parking Availability Information	Secure Internet	Removed Interface  No probe vehicle data is used to get the parking availability information. Instead on-street parking occupancy, usage and payment information is used to get the parking availability information. Hence, the interface is not established.
EPM-IX1875-V01	Interface 10.1	Internal	PARKAPP and PARKWEB	EPM Central System	Request Parking Availability Information	Secure Internet	Original Interface
EPM-IX1876-V01	Interface 10.2	Internal	PARKAPP and PARKWEB	EPM Central System	Request Parking Reservation	Secure Internet	Original Interface
EPM-IX1877-V01	Interface 10.3	Internal	EPM Central System	PARKAPP and PARKWEB	Confirm Parking Availability Information	Secure Internet	Original Interface
EPM-IX1878-V01	Interface 10.4	Internal	EPM Central System	PARKAPP and PARKWEB	Confirm Parking Reservation	Secure Internet	Original Interface

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1881-V02	Interface 11.2	External	EPM Central System	PARKAPP and PARKWEB	Request Traveler Account Information	Secure Internet	<p>Amended Interface</p> <p><u>Original Source Element:</u> CPS <u>Revised Source Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. Traveler account information for PARKAPP and PARKWEB will be stored within the EPM Central System.</p>
EPM-IX1880-V02	Interface 11.1	External	PARKAPP and PARKWEB	EPM Central System	Traveler Account Information	Secure Internet	<p>Amended Interface</p> <p><u>Original Destination Element:</u> CPS <u>Revised Destination Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. Traveler account information for PARKAPP and PARKWEB will be stored within the EPM Central System.</p>

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1882-V02	Interface 11.3	External	EPM Central System	PARKAPP and PARKWEB	Payment Status	Secure Internet	<p>Amended Interface</p> <p><u>Original Source Element:</u> CPS</p> <p><u>Revised Source Element:</u> EPM Central System</p> <p>CPS is no longer part of the Smart Columbus program. Traveler reservation payment status and confirmation is received from the EPM Central System to PARKAPP and PARKWEB.</p>
EPM-IX1889-V01	Interface 12.1	External	PARKAPP and PARKWEB	Operating System	Payment Information	Secure Internet	<p>Removed Interface</p> <p>CPS is no longer part of the Smart Columbus program.</p>

Interface ID	Reference	Interface Type	Source Element	Destination Element	Data Flow	Communications Media	Interface Status
EPM-IX1890-V01	Interface 12.2	External	PARKAPP and PARKWEB	Operating System	User Feedback	Secure Internet	Removed Interface  The Smart Columbus project team and the City of Columbus Division of Parking Services will receive the feedback directly and won't be stored in the Operating System and be available for third-party users.

Source: City of Columbus

## 2.2. SYSTEM MODES AND STATES

**Table 6** defines the modes of operations for parking facilities in the new EPM System. It should be noted that while the City will share on-street parking information with the Operating System to use for the calculation of predictive analytics and then send to EPM Central System to show probability of finding an open meter, the EPM project will not have an on-street parking reservation component. The modes of operation for the on-street metered parking will be the same as the existing system.

**Table 6: New Event Parking Management System Modes of Operation**

Mode	Definition
Mode 1: Operational (Smart)	Operational (Smart) is where the Travelers are able to park, and that the smart parking technology is working as described earlier in this section (cash or card, reporting, etc.) Probable availability data is being provided as intended.
Mode 2: Operational (Limited)	Operational (Limited) is where part(s) of the technology or communications are not working properly such as the electronic payment system is offline, or communications are down, etc. In this case, Travelers are still able to park, pay by cash only, and parking enforcement is possible. This could be the case if availability data is limited from lack of predictive analytics or payment system data reporting.
Mode 3: Failure	Failure mode is when the EPM Central System is down or is not reachable by users or cannot reach out to the field operators. This would revert back to local operations with the operator's field equipment as though no EPM System had been in place.
Mode 4: Special (Conditional)	Special conditions could exist where the parking operators are allowing the Travelers to use some or all of the parking space for free or some or all of the parking spaces are taken out of service, perhaps during special times of the day or during special events, etc. This would provide EPM user alert messages about the limited functionality of the system either with inaccurate availability data or to follow local notices. A scenario like this might also apply in cases when the director temporarily designates an area for parking that is not normally used for parking.
Mode 5: Maintenance	Condition in which gated revenue equipment and/or components of the EPM System are under repair or preventative maintenance.

Source: City of Columbus

## 2.3. MAJOR SYSTEM CHARACTERISTICS

### 2.3.1. System Capabilities

The EPM System will be created using parking availability information from existing garages and surface lots and predicted parking availability from on-street parking in Downtown and the Short North. The EPM System will also house and share location and restriction information on the City's loading zones citywide. The EPM System will ingest and display on-street parking data from a parking prediction model created by the Operating System. The EPM usage data and the City's existing parking database and any real-time parking information available will be provided to the Operating System.

### 2.3.2 System Conditions

The EPM System is generally expected to perform under most conditions, securely and timely delivering parking data between the garages, the EPM Central System, the web portal and the mobile application, allowing for the stated objectives of the project to be met. Situations that may result in degraded or no performance include:

- **Loss of Communications** - Localized communications will be employed to ensure that loss of communications will not adversely affect the interaction between the mobile application and EPM Central System, or between the garages and EPM Central System, albeit there may be conditions whereby data collected from the EPM project will not be forwarded to the Operating System.

## 2.4. USER CHARACTERISTICS

This section defines the stakeholders, user classes, and their roles and responsibilities for the EPM System. Stakeholders refers to an individual or organization affected by the activities, inputs and outputs of the system being developed. They may have a direct or indirect interest in the system and their level of participation may vary. This includes public agencies, private organizations or the traveling public (end users) with a vested interest, or a "stake" in one or more aspect of the EPM project. User Classes are classified based on their perception of the system and the needs identified. Note that some key personnel may serve in multiple roles based on the User Needs and functions.

### 2.4.1. Parking Facility/Parking Operators

Parking Facility Systems and Parking Operators will provide information such as parking costs, hours of operation, and up-to-date availability. They will also provide access to the reservation component of their parking management systems and will be a consumer of the data analytics from the EPM System.

- **Gated Parking Facility System** – Parking Facilities that use a parking management system that will interface with the EPM Central System for parking information and reservation confirmations.
- **Ungated Parking Facility** – Parking Facilities that do not use a parking management system but have a Parking Operator who will be responsible for loading and updating parking information into the EPM Central System through OPAPP.
- **Manually Collected System** – Gated and ungated facilities can operate normally with a manual payment collection system or have exceptions (large events, system malfunction) where they collect payments manually. Most large parking facilities like to manage risk and avoid manual collection of payment unless there is a malfunction of the payment system.

### 2.4.2. City of Columbus Division of Parking Services

The City of Columbus Division of Parking Services will oversee the EPM System operations. System administration and analytics such as usage information, data accuracy, and performance metrics will also be the responsibility of the City.

### 2.4.3. Travelers

Travelers will utilize the EPM System to either plan for parking or locate near-term parking. Travelers may input a variety of information to assist the EPM System in recommending suitable parking locations. For the Travelers pre-planning for parking, this input may include filters such as the event or date, the destination, type of parking facility, amenities and other filters that may be identified in the system design phase. The near-term parking end user may browse a map of available parking.

## 2.4.4. Smart Columbus Operating System

The Operating System will receive EPM System usage data and share the data for third-party use on the Operating System web portal. The Operating System will also ingest and make available on-street parking data received from the City's Division of Parking Services.

The Operating System will create a parking prediction model for on-street parking and send the output to the EPM Central System for display.

## 2.4.5. Third-Party Users

Third-party users are members of the public, including researchers and entrepreneurs, who will have limited access to data that is generated by the EPM System through the Operating System for development purposes.

## 2.4.6. Local Merchants

Local merchants are businesses in the Columbus area that will be able to offer parking discounts to Travelers through the EPM System.

## 2.4.7. EPM Vendor

The EPM vendor will be responsible for delivery of the EPM System.

## 2.5. ASSUMPTIONS AND DEPENDENCIES

**Table 7** lists the known assumptions and dependencies that represent a risk to the EPM project and can affect the ability to meet the desired functionality, maintain the project schedule or meet performance goals.

**Table 7: Assumptions and Dependencies**

Assumption	Corresponding Risk	Dependency	Degree	Status
Integration with external gate/payment systems for real-time information	If integration is not possible, the EPM System will not meet all requirements	Interface to external gate/payment systems	Critical	Met
Integration with the City's current parking modernization program in the Short North, utilizing Conduent as the lead vendor for Virtual Permit Parking and project management, Genetec for 9 LPR units, and ParkMobile for mobile payments	The City will have two parking applications and not a comprehensive platform	The ParkMobile application launched in January 2019	Critical	Met

Assumption	Corresponding Risk	Dependency	Degree	Status
Integration with vehicle manufacturers for access to probe vehicle data	If integration is not possible, the EPM System will not meet all requirements	Relationship with vehicle manufacturers	High	Not Met  While probe vehicle data was not integrated, predictive availability was still achieved for on-street parking using historic payment and usage data

Source: City of Columbus

## 2.6. SYSTEM CONSTRAINTS

**Table 8** defines the system constraints in the new EPM System.

**Table 8: System Constraints**

Constraint ID	Reference	Constraint
EPM-CN1675-v1	Constraint 1	The EPM System needs to integrate and work with existing public and private parking management systems, for the data from those management systems to exclude photographs or video images with personally identifiable information (PII) or license plate information.
EPM-CN1676-v1	Constraint 2	The EPM project must adhere to the policies and technical requirements put forth by the Operating System team.
EPM-CN1677-v1	Constraint 3	The City will be responsible for establishing policies and agreements for interactions with any third-party developers, third-party reservation providers, testers and facility owners. The City will also need to create new policies around who will run the proposed system, failure mode procedures, how to receive, document and address compliments and complaints and types or reports that will be created.

Source: City of Columbus

## 2.7. OPERATIONAL SCENARIOS

Chapter 6 of the *Concept of Operations for the Event Parking Management Project for the Smart Columbus Demonstration Program*<sup>1</sup> captures and documents the operational scenarios.

<sup>1</sup> <https://d2rfd3nxvhnf29.cloudfront.net/2021-05/SCC-B-EPM-ConOps-UPDATE%204.30.21.pdf>



# Chapter 3. System Requirements

This section of the document lists the identified requirements for the EPM project. The requirements are organized by requirement type. Each requirement type has a requirement identifier (see **Appendix A**) along with its description, a reference number that identifies traceability to user needs, user scenarios and/or policies and constraints. **Table 9** describes the classifications of requirement types in this document. **Table 10** includes a verification method for each requirement.

**Table 9: List of Requirement Types**

Type	Description
Functional (FN)	FN Requirements specify actionable and qualitative behaviors (e.g. functions, tasks) of the system of interest.
Performance (PR)	PR Requirements specify quantifiable characteristics of operations that define the extent, or how well, and under what conditions a function or task is to be performed (e.g. rates, velocities).
Interfaces (IF)	IF Requirements define how the system will interact, communicate, or exchange data with external systems (External IF) and how core system elements interact with other parts of the system (Internal IF).
Data (DR)	DR Requirements define the data collected, transformed, and stored from various sources as well as identifies new data that is expected to be generated.
Security (SR)	SR Requirements specify what is necessary to protect the integrity and operability of the system, its microservices, connections, and data. This includes physical security as well as cyber prevention, detection, identification, response and recovery requirements.
Non-Functional (NF)	<p>NF Requirements define the characteristics of the overall operation of the system, including the following:</p> <ul style="list-style-type: none"> <li>• <b>Availability and Recovery (AR) Requirements</b> define the times of day, days of year, and overall percentage of time the system can be used, when it will not be available for use, and recovery point and time objectives.</li> <li>• <b>Disposal (DP) Requirements</b> specify the items related to the disposal of project/system components, due to either failure replacements, removal, end-of-life upgrade, or retirement.</li> </ul>

Type	Description
Enabling (EN)	<p>EN Requirements specify details concerning the management of information as well as the production of the system and its life cycle sustainment, including the following:</p> <ul style="list-style-type: none"> <li>• <b>Acceptance Testing (AT) Requirements</b> specify the requirements that are necessary to test the development system.</li> <li>• <b>Information Management (IM) Requirements</b> specify the acquisition, management, and ownership of information from one or more sources, the custodianship and the distribution of that information to those who need it.</li> <li>• <b>Life Cycle (LC) Sustainability Requirements</b> define what items the project or system will review, measure, and analyze as part of its commitment to quality during the life cycle of the system including development, integration, verification, validation and training.</li> </ul>
Policy and Regulation (RG)	<p>RG Requirements specify relevant and applicable organizational policies or regulations that affect the development, operation or performance of the system (e.g. IT and labor policies, reports to regulatory agencies, health or safety criteria, etc.). This section also includes new policy and regulation imposed to realize the system.</p>

Source: City of Columbus

The requirements also maintain a verification method, which details the plan for verifying the requirement based on its stated definition. For each requirement, one of the verification methods listed in **Table 10** is assigned.

**Table 10: Methods of Verification**

Type	Description
Inspection	Verification through a visual, auditory, or tactile observation and comparison of observations with required attributes and characteristics of the system.
Demonstration	Verification that exercises the system software or hardware as it is designed to be used, without external influence, to verify the system behaves as specified by the requirement.
Test	Verification using controlled and predefined inputs and other external elements (e.g. data, triggers, etc.) that influence or induce the system to produce the output specified by the requirement.
Analysis	Verification through indirect and logical conclusion using mathematical analysis, models, calculations, and derived outputs based on validated data sets.

Source: City of Columbus

### 3.1. REQUIREMENT STATUS

For the post-deployment update of SyRS document, each requirement has been read thoroughly to make sure it is in line with the final design and development of the project. Each requirement is then given a status to reflect the changes made as per the current system. The following requirement status options are used for each of the requirements below:

1. **Met:** The requirement was validated and successfully adopted into the project.
2. **Partially Met:** The requirement was revised to meet current system or due to technical efficiencies presenting a better solution.
3. **Not Met:** The requirement was not validated or fulfilled due to changing project conditions or due to some design requirements that are outside the scope of this project.

Originally all requirements were written as applicable only to PARKAPP with one requirement stating all requirements for PARKAPP would also be applicable to PARKWEB. During project development, the requirement descriptions were updated to show which platform the functionality is currently available on: PARKAPP, PARKWEB or PARKAPP and PARKWEB. This is not noted as a requirement change in the requirement status column.

### 3.2. FUNCTIONAL REQUIREMENTS

This section provides the high-level requirements for the system of interest (i.e. what the system will do). The requirements in **Table 11** are related to user needs identified in the EPM ConOps.

**Table 11: Functional Requirements**

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1893-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN008-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Met
EPM-FN1894-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility hours of operation to the PARKAPP and PARKWEB.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1895-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking restrictions at each parking facility to the PARKAPP and PARKWEB.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Met
EPM-FN1896-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking availability at each parking facility to the PARKAPP and PARKWEB.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Met
EPM-FN1897-V01	EPM Central System	Parking Coordination	The EPM Central System shall provide the number of parking spaces available at each parking facility to the PARKAPP.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Not Met  The specific number of spaces available is not provided for parking facilities which includes garages and surface lots. Hence, this requirement is considered 'Not Met'.
EPM-FN1898-V01	EPM Central System	Parking Coordination	The EPM Central System shall provide loading zone availability to the PARKAPP.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Not Met  Parking availability information is not available for loading zones. Hence, this requirement is considered 'Not Met'.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1899-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide the location of electric vehicle charging stations to the PARKAPP and PARKWEB.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	Met  <u>Original Requirement</u> The EPM Central System shall provide the location of electric vehicle charging stations and type of chargers to the PARKAPP.  Information about type of chargers is not available on the PARKAPP and PARKWEB. Requirement updated accordingly.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1900-V03	EPM Central System	Parking Coordination	The EPM Central System shall provide access to ADA accessible parking spaces in accordance with standards for accessible design as determined by the ADA to the PARKAPP and PARKWEB.	EPM-UN001-V01 EPM-UN003-V01 EPM-UN020-V01 EPM-UN030-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u></p> <p>The EPM Central System shall provide access to van-accessible parking spaces and spaces that connect to the shortest accessible route to the building entrance or facility they serve, in accordance with standards for accessible design as determined by the ADA.</p> <p>The PARKAPP and PARKWEB provide locations of the ADA accessible parking but do not provide the distance between the destination building entrance and the parking location.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1901-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of reservation confirmation.	EPM-UN006-V01 EPM-FN1941-V02	Demonstration	Met
EPM-FN1902-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of changes to an existing reservation.	EPM-UN006-V01 EPM-FN1941-V02	Demonstration	Met
EPM-FN1903-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of warnings of expiration of paid parking session.	EPM-UN006-V01 EPM-FN1941-V02	Demonstration	Met
EPM-FN1904-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of expiration of paid parking session.	EPM-UN006-V01 EPM-FN1941-V02	Demonstration	Met
EPM-FN1905-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall allow purchase of additional parking meter time.	EPM-UN006-V01 EPM-UN010-V01 EPM-UN011-V01 EPM-FN1906-V03 EPM-FN1907-V02	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1906-V03	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of additional parking meter time past the maximum time allowed within mobile pay zones.	EPM-UN006-V01 EPM-UN010-V01 EPM-UN011-V01 EPM-FN1905-V02	Demonstration	Met  <u>Original Requirement</u> The EPM Central System shall not allow purchase of additional parking meter time past the maximum time allowed for that parking location.  On-street parking locations are categorized and displayed as zones within the PARKAPP and PARKWEB. Requirement updated to say mobile pay zones instead of parking locations.
EPM-FN1907-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of parking meter time when restricted parking periods are in effect.	EPM-UN006-V01 EPM-UN010-V01 EPM-UN011-V01 EPM-FN1905-V02	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1908-V03	EPM Central System	Probability Calculation	The EPM Central System shall provide a visual indicator showing the probability of finding open on-street parking to the PARKAPP.	EPM-UN003-V01 EPM-UN017-V01	Demonstration	Partially Met  <u>Original Requirement</u> The EPM Central System shall calculate the probability of finding open on-street parking in the specified area.  The Operating System is responsible for the calculation of the probability of finding open on-street parking and sending that data to the EPM Central System for display in the PARKAPP. Requirement updated accordingly.
EPM-FN1909-V02	EPM Central System	Probability Calculation	The EPM Central System shall calculate the probability of finding an open loading zone parking spaces based on existing block faces and probe vehicle data.	EPM-UN017-V01	Demonstration	Not Met  Parking availability information is not available for loading zones.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1910-V01	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall include a visual indicator showing the probability of finding open on-street parking and open loading zone spaces.	EPM-UN003-V01	Demonstration	<p>Not Met</p> <p>This requirement was revised into two requirements to separate on-street parking and loading zones.</p> <p>EPM-FN1909-V02 pertains to loading zones. This requirement is marked as obsolete since no availability information is available for loading zones.</p> <p>EPM-FN1908-V03 pertains to on-street parking.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1911-V03	EPM Central System	Probability Calculation	The calculation of predicted availability for metered parking shall be based on data related to occupancy, availability and historic transaction data.	EPM-UN003-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The EPM Central System shall calculate the probability of finding open metered parking spaces based on occupancy, traffic volume, availability, event days, desired geographic range, desired parking type (metered, surface lot), and probe vehicle data.</p> <p>Probe vehicle data was not integrated to calculate predictive availability for on-street parking. Instead, occupancy and historic payment and usage data were used for the calculation of on-street parking availability. Requirement is updated to remove probe vehicle data.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1912-V01	Gated Parking Facility System	Parking Management System	The GFAC shall confirm reservations with the EPM Central System.	EPM-UN006-V01 EPM-UN021-V01 EPM-UN018-V01 EPM-CN1675-V01	Demonstration	Met
EPM-FN1913-V01	Ungated Parking Facility System	Manually Collected System	The UFAC shall confirm reservations with the EPM Central System.	EPM-UN006-V01 EPM-UN021-V01 EPM-UN018-V01 EPM-CN1675-V01	Demonstration	Met
EPM-FN1914-V02	EPM Central System	Payment Coordination	The EPM Central System shall provide a response to the PARKAPP and PARKWEB of a confirmed reservation.	EPM-UN006-V01 EPM-UN021-V01	Demonstration	Met
EPM-FN1915-V02	EPM Central System	Payment Coordination	The confirmation response provided to the PARKAPP and PARKWEB shall include a reservation confirmation code.	EPM-UN021-V01 EPM-UN006-V01	Demonstration	Met
EPM-FN1916-V02	EPM Central System	Payment Coordination	The EPM Central System shall not provide a reservation confirmation code to PARKAPP and PARKWEB if payment is not complete.	EPM-UN006-V01 EPM-UN021-V01	Demonstration	Met
EPM-FN1917-V02	EPM Central System	Payment Coordination	The confirmation response provided to the PARKAPP and PARKWEB shall include notice of payment completion and amount.	EPM-UN021-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1918-V02	EPM Central System	Discounted Parking Options	The EPM Central System shall allow local merchants to offer discounted parking options through the PARKAPP.	EPM-UN021-V01 EPM-FN3193-V02 EPM-FN3105-V01	Demonstration	Met
EPM-FN3193-V02	EPM Central System	Discounted Parking Options	The EPM Central System shall validate the discounted parking options and provide confirmation of validation to the PARKAPP and PARKWEB.	EPM-UN021-V01	Demonstration	Met
EPM-FN1920-V02	EPM Central System	Administration	The EPM Central System shall provide data storage and retrieval for the PARKAPP and PARKWEB.	EPM-UN019-V01	Demonstration	Met
EPM-FN1921-V02	EPM Central System	Payment Coordination	The EPM Central System shall communicate the paid status of reservations to the PARKAPP and PARKWEB in real-time.	EPM-IX1882-V02 EPM-UN009-v01	Demonstration	Met
EPM-FN1922-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall allow Travelers to pay for a specific period of parking time.	EPM-IX1882-V02 EPM-UN009-v01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1923-V02	EPM Central System	Parking Coordination	The EPM Central System shall update the PARKAPP and PARKWEB without any system downtime or data latency when data is entered or modified in the EPM Central System via the OPAPP.	EPM-UN020-V01 EPM-UN021-V01	Demonstration	Met
EPM-FN1924-V02	EPM Central System	Parking Coordination	The City shall have the ability to set demand-based pricing for meters in the OPAPP, allowing rates to be increased or decreased based on demand for parking.	EPM-UN022-V01	Demonstration	Partially Met  <u>Original Requirement</u> The City shall have the ability to set demand-based pricing for meters in the EPM Central System, allowing rates to be increased or decreased based on demand for parking.  The City and other parking operators will be able to enter/modify parking rates in the OPAPP and that information will be updated in the EPM Central System and displayed in the PARKAPP and PARKWEB.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1925-V02	Traveler Mobile Application	Manage Profile	The PARKAPP and PARKWEB shall allow Travelers to create a profile in the EPM Central System to store profile information and mobile application settings.	EPM-FN1927-V02 EPM-FN1928-V03 EPM-FN1929-V01 EPM-FN1930-V03 EPM-FN1932-V01 EPM-FN1936-V02 EPM-FN1937-V02	Demonstration	Met
EPM-FN1926-V01	Traveler Mobile Application	Manage Profile	Creating a profile in the EPM Central System shall require submission of Traveler's first and last name.	EPM-FN1925-V02	Demonstration	Not Met  PARKAPP and PARKWEB do not require a user to enter first and last name when creating a profile instead Travelers are allowed to enter first and last name later in the settings. Hence, this requirement is considered 'Not Met'.  Requirement EPM-FN1930-V03 talks about the Traveler having an option to enter first name and last name.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1927-V02	Traveler Mobile Application	Manage Profile	Creating a profile with PARKAPP and PARKWEB shall require submission of Traveler's email address.	EPM-FN1925-V02	Demonstration	Met
EPM-FN1928-V03	Traveler Mobile Application	Manage Profile	Creating a profile with PARKAPP and PARKWEB shall require authentication.	EPM-FN1925-V02	Demonstration	Partially Met  <u>Original Requirement</u> Creating a profile in the EPM Central System shall require submission of an authenticating security question and answer.  Creating a profile in the EPM Central System shall require the Traveler to enter email address and password.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1930-V03	Traveler Mobile Application	Manage Profile	Creating a profile with PARKAPP and PARKWEB should include the option of providing a Traveler's telephone number, first name and last name.	EPM-FN1925-V02	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> Creating a profile in the EPM Central System should include the submission of Traveler's telephone number.</p> <p>As stated for requirement EPM-FN1926-V01, submission of first and last name is optional and can be added under settings. Requirement updated to include Traveler's first name and last name.</p>
EPM-FN1934-V01	Common Payment System	Traveler Accounts	A profile in the EPM Central System may be associated with exactly one CPS account to reconcile transactions with the respective account.	EPM-CN1675-V01 EPM-FN1925-V02	Demonstration	<p>Not Met</p> <p>CPS is no longer part of the Smart Columbus program.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1935-V01	Common Payment System	Traveler Accounts	A profile in the EPM Central System may be associated with exactly one CPS account to collect reporting data.	EPM-CN1675-V01 EPM-FN1925-V02	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1936-V02	EPM Central System	Administration	The EPM Central System shall permit authorized individuals to close any Traveler profile (e.g. due to prolonged inactivity or abuse of policies).	EPM-FN1925-V02	Demonstration	Partially Met  <u>Original Requirement</u> The EPM Central System shall permit authorized individuals at the City to close any Traveler profile (e.g. due to prolonged inactivity or abuse of policies).  The EPM vendor has the ability to close any Traveler's profile due to prolonged inactivity or abuse of policies.
EPM-FN1937-V02	Traveler Mobile Application	Manage Profile	Travelers shall have access to manage their profiles in the PARKAPP and PARKWEB by correctly entering their login information.	EPM-FN1925-V02	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1938-V02	Traveler Mobile Application	Manage Profile	Travelers shall be able to use the PARKAPP to get parking availability information without having an EPM profile.	EPM-UN016-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> Travelers shall be able to use the PARKAPP to get parking availability information without having a CPS account or profile.</p> <p>CPS is no longer part of the Smart Columbus program. Traveler will still be able to search for parking options without creating a profile.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1939-V03	Traveler Mobile Application	Manage Profile	The PARKWEB shall provide Travelers with the option of creating an EPM guest account (temporary account) to book a one-time reservation.	EPM-UN016-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The PARKAPP shall provide Travelers with the option of creating a CPS guest account (temporary account) to be used for one-time payments.</p> <p>CPS is no longer part of the Smart Columbus program. Travelers will be able to create a guest account for one-time reservation through the PARKWEB.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1940-V01	Traveler Mobile Application	Manage Profile	The PARKAPP shall allow a Traveler to provide a one-time payment without requiring use of a CPS account.	EPM-UN016-V01	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program. Without CPS as part of the EPM System, Travelers will still be able to pay for parking using the EPM vendor's accepted payment methods like credit and debit card payments.
EPM-FN1941-V02	Traveler Mobile Application	Manage Profile	The PARKAPP and PARKWEB shall provide the Traveler the capability to configure notifications and alerts.	EPM-FN1901-V02 EPM-FN1902-V02 EPM-FN1903-V02 EPM-FN1904-V02	Demonstration	Met
EPM-FN1942-V02	Traveler Mobile Application	Transaction Log	The PARKAPP and PARKWEB shall provide Travelers with access to a transaction log consisting of a history of paid parking transactions, locations, and time and date.	EPM-UN017-v01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1943-V02	Traveler Mobile Application	Transaction Log	The transaction log shall be limited to prior 3 months of transactions.	EPM-UN007-V01	Demonstration	Partially Met  <u>Original Requirement</u> The transaction log shall be limited to prior 12 months of transactions.  Current parking payment history is limited to prior 3 months and any prior transaction information is available through EPM vendor customer service.
EPM-FN1944-V01	Traveler Mobile Application	Manage Profile	The PARKAPP shall provide Travelers with the ability to store favorite searches for easy retrieval.		Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1945-V02	Traveler Mobile Application	Manage Profile	The PARKAPP shall provide Travelers with the ability to select amenities that will be used to filter search results for parking options.	EPM-FN3094-V03 EPM-FN3095-V03 EPM-FN3096-V03	Demonstration	Partially Met  <u>Original Requirement</u> The PARKAPP shall provide Travelers with the ability to store favorite amenities that will be used to filter search results for parking options.  To allow the Travelers to view all parking options around the desired location, the PARKAPP does not allow to store favorite parking locations and amenities, which will filter the parking locations automatically. Requirement updated accordingly to remove that storing of amenities under preferences.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1946-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall use the GPS (Global Positioning System) device of the Traveler's smartphone or computer to determine current location to search for parking options.	EPM-UN008-V01	Demonstration	Met
EPM-FN1947-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall obtain affirmative express consent from the Traveler before accessing geolocation information or contact info.	EPM-UN028-V01	Demonstration	Met
EPM-FN1948-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall provide the Traveler the ability to search for parking options by entering a street address.	EPM-UN008-V01	Demonstration	Met
EPM-FN1949-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall provide the Traveler the ability to search for parking options by selecting an on-street parking zone or parking loading zone.	EPM-UN008-V01	Demonstration	Met
EPM-FN1950-V02	Traveler Mobile Application	Feedback	The PARKAPP and PARKWEB shall provide the Traveler the ability to submit user feedback.	EPM-UN012-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1951-V04	Traveler Mobile Application	Feedback	The PARKAPP and PARKWEB shall provide the Traveler the ability to contact the customer care with complaints.	EPM-UN012-V01	Demonstration	Met
EPM-FN1952-V03	Traveler Mobile Application	Feedback	The PARKAPP and PARKWEB shall provide a link to the City's 311 webpage.	EPM-UN013-V01	Demonstration	Met
EPM-FN1953-V03	Traveler Mobile Application	Search and Reserve Parking	Accessibility audits of the mobile and web applications will occur by external third-party auditors and internal auditors relative to Section 508 of the Rehabilitation Act of 1973.	EPM-UN001-V01	Demonstration	Partially Met  <u>Original Requirement</u> The PARKAPP shall provide compliance with ADA Section 508 standards for accessibility.  Updated requirement to industry standard.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1954-V03	Traveler Mobile Application	Search and Reserve Parking	Accessibility audits of the mobile and web applications will occur by external third-party auditors and internal auditors relative to the WCAG 2.0 guidelines.	EPM-UN001-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The PARKAPP shall provide compliance with WCAG 2.0 guidelines for mobile applications.</p> <p>Updated requirement to industry standard.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1955-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall default to English language user interface unless Spanish is chosen as language within the phone settings.	EPM-UN005-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The PARKAPP shall default to English language user interface.</p> <p>Traveler will need to change the mobile phone language setting to Spanish for the PARKAPP to display in Spanish. Therefore, the PARKAPP will not default to English and is based on the mobile phone language settings. The requirement is updated accordingly.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1956-V03	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall provide the Traveler with the option of changing all static text (including CTAs, navigational items, links, authentication (create account/login), on-demand flow (excluding error text), reservations flow (excluding error text), activity (tab labels and on-demand active session UI), time selector units (days, hours, minutes), setting screen section labels) in the user interface from English to Spanish, and vice versa (images will remain the same regardless of language choice).	EPM-UN005-V01	Demonstration	Partially Met  <u>Original Requirement</u> The PARKAPP shall provide the Traveler with the option of changing the language in the user interface from English to Spanish, and vice versa.  Requirement updated to include the content that will be updated to the language chosen within the PARKAPP.
EPM-FN1957-V01	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall support mobile portrait mode (form factor).	EPM-UN008-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1958-V01	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall support mobile landscape mode (form factor).	EPM-UN002-V01	Demonstration	Not Met  This requirement is specific to the navigation and the app allows the traveler to open his or her navigation app and can change to landscape mode if supported by the navigation app but it is not supported by the EPM System.
EPM-FN1959-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKWEB and PARKAPP shall allow requests for locating metered parking spaces (including on-street EV and ADA metered spaces).	EPM-UN003-V01	Demonstration	Met
EPM-FN1961-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKWEB and PARKAPP shall display loading zone locations, hours, and restrictions.	EPM-UN001-V01	Demonstration	Met
EPM-FN1962-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall provide the ability to filter by any combination of garages, lots, and streets.	EPM-UN002-V01	Demonstration	Met
EPM-FN1963-V01	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall provide an interactive map display showing real-time parking options.	EPM-UN002-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1964-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall include the ability to link to map-based navigation on the Traveler's smartphone/computer/tablet to direct the Traveler to the designated parking location.	EPM-UN008-V01	Demonstration	Met
EPM-FN1965-V01	Traveler Mobile Application	Search and Reserve Parking	Map-based navigation shall use the GPS device of the Traveler's smartphone to update the location of the Traveler on the map in real-time.	EPM-UN008-V01	Demonstration	Met
EPM-FN1966-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall provide the ability to reserve parking in accordance with the policies of individual facilities.	EPM-UN006-V01	Demonstration	Met
EPM-FN1967-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall allow Travelers to pay for parking in accordance with the policies of individual facilities, parking rates, and payment methods.	EPM-UN006-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1968-V01	Traveler Mobile Application	CPS Landing Pages	The PARKAPP shall display the dollar amount of available funds in the Traveler's CPS account.	EPM-UN009-V01	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1969-V01	Traveler Mobile Application	CPS Landing Pages	The PARKAPP shall integrate with CPS landing pages for payment processing and CPS account management.	EPM-UN009-V01	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1970-V02	Traveler Website	Traveler Website	The PARKWEB shall have functionality as the PARKAPP.	EPM-UN001-V01 EPM-UN005-V01	Demonstration	Not Met  The PARKAPP and PARKWEB functionalities were broken out in each requirement to allow for appropriate development modifications based on user needs and industry standards. This allowed resources to be focused where the highest priority functionalities were concerned.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1971-V01	Traveler Website	Traveler Website	The PARKWEB shall provide the same access to real-time parking availability information for gated parking facility systems as the PARKAPP.	EPM-UN005-V01	Demonstration	Met
EPM-FN1972-V01	Parking Operator Application	Facility and Availability Information	UFAC parking operators shall be able to interface with the EPM Central System through the OPAPP.	EPM-UN021-V01	Demonstration	Met
EPM-FN1973-V01	Parking Operator Application	Facility and Availability Information	UFAC parking operators shall be able to enter and modify event rates and schedules in real-time through the OPAPP.	EPM-UN020-V01	Demonstration	Met
EPM-FN1974-V01	Ungated Parking Facility System	Manually Collected Systems	UFAC parking operators shall be able to manage create and manage CPS Provider accounts.	EPM-UN020-V01	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1975-V01	Gated Parking Facility System	Parking Management System	GFAC parking operators shall be able to manage create and manage CPS Provider accounts.	EPM-CN1675-V01 EPM-UN020-V01	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1976-V01	Common Payment System	Payment Processing	The EPM Central System shall utilize the CPS to process payment transactions in real-time.	EPM-CN1675-V01	Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1977-V02	EPM Central System	Payment Coordination	The PARKWEB and PARKAPP shall allow pre-payment of parking up to the allowable timeframe prior to paid parking operational hours.	EPM-UN010-V01	Demonstration	Met
EPM-FN1978-V01	Common Payment System	CPS Landing Pages	Payment shall be held in reserve in the Traveler's CPS account for the vehicle until the parking reservation goes into effect.		Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1979-V01	Traveler Mobile Application	CPS Landing Pages	The PARKAPP shall provide Travelers with access to CPS landing pages to make payments.		Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-FN1980-V02	Traveler Mobile Application	Payment Processing	Travelers shall be able to pay instantly without being redirected away from the PARKAPP and PARKWEB to complete a transaction.	EPM-UN009-V01	Demonstration	Met
EPM-FN1981-V01	Traveler Mobile Application	CPS Landing Pages	The PARKAPP shall provide Travelers with access to CPS landing pages to manage CPS accounts.		Demonstration	Not Met  CPS is no longer part of the Smart Columbus program.

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN1982-V01	EPM Central System	Payment Coordination	The EPM Central System shall be capable of mobile device payments by presenting a reservation ID via an optical barcode on the Traveler's mobile device screen.	EPM-UN027-V01	Demonstration	Met
EPM-FN1983-V01	EPM Central System	Payment Coordination	The EPM Central System shall be capable of mobile device payments by presenting a reservation ID through NFC, if supported by the Traveler's mobile device.	EPM-UN027-V01	Demonstration	Not Met  Parking operators in Columbus support bar codes for mobile device payments and do not support near-field communications (NFCs) as a payment method. Hence, this requirement is marked as 'Not Met'.
EPM-FN2109-V01	EPM Central System	Traveler Profile	Travelers shall not be required to create a profile to search for parking options.	EPM-UN014-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN3094-V03	Traveler Mobile Application	Manage Profile	The PARKAPP and PARKWEB shall allow Travelers to filter available parking spaces based on ADA compliance.	EPM-FN1945-V02	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The PARKAPP shall allow Travelers to store ADA compliant parking spaces as a favorite amenity.</p> <p>To allow the Travelers to view all parking options around the desired location, the PARKAPP does not allow to store favorite parking locations and amenities, which will filter the parking locations automatically. Requirement updated accordingly to remove storing of amenities under preferences.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN3095-V03	Traveler Mobile Application	Manage Profile	The PARKAPP and PARKWEB shall allow Travelers to filter available parking spaces based on availability of EV charging.	EPM-FN1945-V02	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The PARKAPP shall allow Travelers to store EV charging stations as a favorite amenity.</p> <p>To allow the Travelers to view all parking options around the desired location, the PARKAPP does not allow to store favorite parking locations and amenities, which will filter the parking locations automatically. Requirement updated accordingly to remove storing of amenities under preferences.</p>

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN3096-V03	Traveler Mobile Application	Manage Profile	The PARKAPP and PARKWEB shall allow Travelers to select preferred/frequently traveled zones.	EPM-FN1945-V02	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The PARKAPP shall allow Travelers to store a street address as a favorite amenity.</p> <p>To allow the Travelers to view all parking options around the desired location, the PARKAPP does not allow to store favorite parking locations and amenities, which will filter the parking locations automatically. Requirement updated accordingly to remove storing of amenities under preferences.</p>
EPM-FN3097-V01	EPM Central System	Administration	The EPM Central System shall provide a secure administrative account for authorized individuals at the City.	EPM-UN030-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN3098-V01	EPM Central System	Administration	The EPM Central System shall allow the administrative account to block any parking provider from using the EPM System due to abuse of policies.	EPM-UN030-V01	Demonstration	Met
EPM-FN3105-V01	EPM Central System	Discounted Parking Options	The PARKAPP shall provide Travelers with the ability to activate discounted parking options.	EPM-UN021-V01	Demonstration	Met
EPM-FN3266-V00	EPM Central System	Probability Calculation	The EPM Central System shall provide predictive availability for on-street parking to the PARKAPP.	EPM-UN003-V01	Demonstration	Met
EPM-FN3267-V00	EPM Central System	Search and Reserve Parking	The PARKAPP and PARKEB shall not allow the reservation of on-street parking.	EPM-UN006-V01	Demonstration	Met
EPM-FN3270-V00	EPM Central System	Administration	The EPM Central System shall provide the ability for Parking Operators to create "to be determined" events where date and time are unknown, or date is known but time has yet to be announced.	EPM-UN030-V01	Demonstration	Met

Req ID	Functional Group	Sub-Component	Final Description	References	Verification Method	Requirement Status
EPM-FN3271-V00	EPM Central System	Administration	The EPM Central System shall provide the ability for Parking Operators to modify "to be determined" events when date/time becomes known.	EPM-UN030-V01	Demonstration	Met
EPM-FN3272-V00	EPM Central System	Discounted Parking Options	The PARKAPP shall provide the ability for event employees to enter an access code associated with an event.	EPM-UN021-V01	Demonstration	Met
EPM-FN3273-V00	EPM Central System	Discounted Parking Options	The PARKAPP provides event employees access to appropriate parking options after entering event access code associated with that event.	EPM-UN021-V01	Demonstration	Met
EPM-FN3274-V00	EPM Central System	Traveler Accounts	The PARKWEB shall provide the ability for Travelers to create a fleet account to manage multiple user profiles on a single account.	EPM-CN1675-V01 EPM-FN1925-V02	Demonstration	Met

Source: City of Columbus

### 3.3. PERFORMANCE REQUIREMENTS

**Table 12** provides the PR requirements for the system of interest (i.e. what the system will do).

**Table 12: Performance Requirements**

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-PR1984-V01	The system shall perform with minimal discernible latency (response time of roughly 150ms or less, excluding delays in internet service not controlled by the EPM vendor).	EPM-UN025-V01	Test	Met
EPM-PR1985-V01	The EPM vendor shall be able to measure data input/output latency on their servers and provide these statistics to the City for the purpose of assessing performance against requirement EPM-PR1984-v1.	EPM-UN025-V01 EPM-UN030-V01	Demonstration	Met

Source: City of Columbus

### 3.4. INTERFACE REQUIREMENTS

The EPM IF requirements listed in **Table 13** allow dynamic and configurable functionality between internal components of the Smart Columbus SoS and external systems that provide data or some other stated functionality as per the user needs.

**Table 13: Interface Requirements**

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF1986-V01	The PARKAPP shall operate on iOS version 12+.	EPM-UN005-V01	Inspection	Met
EPM-IF1987-V01	The PARKAPP shall operate on Android version 6.0+.	EPM-UN005-V01	Inspection	Met
EPM-IF1988-V01	The PARKWEB shall support Chrome, Safari and Firefox.	EPM-UN005-V01 EPM-UN001-V01	Inspection	Met
EPM-IF1989-V01	The Operating System shall receive parking data from the City Parking Management System.	EPM-UN029-V01 EPM-CN1676-V01	Inspection	Met
EPM-IF1990-V01	The Operating System shall receive parking data from the EPM Central System.	EPM-UN029-V01 EPM-CN1676-V01	Inspection	Met

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF1991-V01	APIs developed for the EPM Central System shall be open architecture.	EPM-UN027-V01	Inspection	Met
EPM-IF1992-V01	The protocol for all API calls shall be HTTPS to protect data in transit.	EPM-UN023-V01	Inspection	Met
EPM-IF1993-V01	Authentication keys shall be supplied for all API calls.	EPM-UN023-V01	Inspection	Met
EPM-IF1994-V01	External systems shall communicate with the EPM Central System via Internet.	EPM-UN023-V01	Inspection	Met
EPM-IF2004-V02	The EPM Central System shall provide an interface to send and receive rate information, parking availability, and reservation information between the OPAPP and the EPM Central System.	EPM-UN018-V01 EPM-UN020-V01 EPM-UN021-V01 EPM-IX1856-V01 EPM-IX1858-V01 EPM-IX1859-V01 EPM-IX1855-V01	Inspection	Partially Met  <u>Original Requirement</u> The EPM Central System shall provide an interface to send and receive rate information, information pertaining to road closures or changes of entrances or exits, parking availability, and reservation information between the OPAPP and the EPM Central System.  Requirement updated to include information that is sent and received between OPAPP and EPM Central System.

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF2006-V02	The EPM System shall provide an interface to allow the OPAPP to update provider account information.	EPM-IX1862-V02 EPM-IX1863-V02	Inspection	Partially Met  <u>Original Requirement</u> The EPM System shall provide an interface to allow the OPAPP to update CPS provider account information with the CPS.  CPS is no longer part of the Smart Columbus program. Requirement updated to remove CPS.
EPM-IF2009-V02	The EPM System shall provide an interface to allow the EPM Central System to send and receive payment information and payment status to the Traveler.	EPM-IX1880-V02 EPM-IX1881-V02 EPM-IX1882-V02	Inspection	Partially Met  <u>Original Requirement</u> The EPM system shall provide an interface to allow the EPM Central System to send and receive payment information and payment status with the CPS.  CPS is no longer part of the Smart Columbus program. Requirement updated to remove CPS.

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF2011-V02	The Operating System shall provide an interface to send meter closed/out of service information (due to event, construction, etc.), loading zone and meter location, rates, hours of operation, restrictions, and out-of-service information from the CITYPMS to the Operating System.	EPM-UN029-V01 EPM-CN1676-V01 EPM-IX1868-V01 EPM-UN026-V01	Inspection	Partially Met  <u>Original Requirement</u> The EPM Central System shall provide an interface to send meter closed/out of service information (due to event, construction, etc.), loading zone and meter location, rates, hours of operation, restrictions, and out-of-service information from the CITYPMS to the Operating System.  The Operating System provided the interface to send the on-street parking information from the CITY PMS to the Operating System and not the EPM vendor. Requirement updated accordingly.
EPM-IF2013-V01	The EPM Central System shall provide an interface to send loading zone and meter location, rates, hours of operation, restrictions, and out-of-service information from the Operating System to the EPM Central System.	EPM-IX1870-V01 EPM-CN1676-V01 EPM-UN029-V01	Inspection	Not Met  The on-street parking and loading zone related information is sent directly to the EPM vendor to update in the EPM Central System. No direct interface has been developed for this information to be automatically updated in the EPM Central System.

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF2015-V01	The EPM Central System shall provide an interface to send PARKAPP and PARKWEB usage information from the EPM Central System to the Operating System.	EPM-UN029-V01 EPM-IX1871-V01	Inspection	Met
EPM-IF2016-V02	The EPM Central System shall provide an interface to send predictive availability information from the Operating System to the EPM Central System.	EPM-UN017-V01 EPM-IX1870-V01	Inspection	Partially Met  <u>Original Requirement</u> The EPM Central System shall provide an interface to send probe vehicle occupancy information to the EPM Central System.  Probe vehicle occupancy information is not used to calculate predictive availability information for on-street parking. Predictive availability information is calculated in the Operating System using historic usage, payment data and occupancy and is sent to EPM Central System.
EPM-IF2019-V01	The EPM Central System shall provide an interface to send and receive parking availability and reservation information between the EPM Central System and the PARKAPP and PARKWEB.	EPM-UN021-V01 EPM-IX1875-V01 EPM-IX1876-V01 EPM-IX1877-V01 EPM-IX1878-V01	Inspection	Met

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF2021-V01	The CPS shall provide an interface to send and receive payment and CPS account information between the CPS and the PARKAPP.	EPM-IX1880-V02 EPM-IX1881-V02 EPM-IX1882-V02	Inspection	Not Met  CPS is no longer part of the Smart Columbus program.
EPM-IF2028-V01	The PARKAPP shall provide the ability to send a payment request to the Payment Broker in the Operating System.	EPM-UN029-V01 EPM-CN1676-V01	Inspection	Not Met  CPS is no longer part of the Smart Columbus program. Payment broker was intended to be CPS in the Operating System.
EPM-IF2030-V02	The EPM Central System shall provide an interface to send user feedback from the PARKAPP to the Operating System.	EPM-UN029-V01 EPM-CN1676-V01	Inspection	Not Met  The Smart Columbus project team and the City of Columbus Division of Parking Services will receive the feedback directly and won't be stored in the Operating System and be available for third-party users.
EPM-IF3102-V01	The EPM Central System shall provide an interface to send and receive reservation requests, availability (percentage full for facilities or probability of finding an available on-street parking), location of the parking facility, and cost (if available) from the GFAC.	EPM-IX1843-V01 EPM-IX1844-V01 EPM-IX1845-V01 EPM-IX1846-V01	Inspection	Met

ReqID	Final Description	References	Verification Method	Requirement Status
EPM-IF3103-V02	The EPM System shall provide an interface to allow the GFAC parking vendors to update provider account information.	EPM-IX1848-V02 EPM-IX1849-V02	Inspection	Partially Met  <u>Original Requirement</u> The EPM system shall provide an interface to allow the GFAC parking vendors to update CPS provider account information with the CPS.  CPS is no longer part of the Smart Columbus program. The EPM vendor will work with the City of Columbus or operators directly to update provider account information in the EPM System during and post implementation.
EPM-IF3104-V01	The EPM Central System shall provide an interface to request additional parking meter time and receive confirmation from the CITYPMS.	EPM-IX1852-V01 EPM-UN026-V01	Inspection	Met

Source: City of Columbus

### 3.5. DATA REQUIREMENTS

The DR requirements for the system of interest listed in **Table 14** define the data collected, transformed, and stored from various sources as well as identifies new data that is expected to be generated.

**Table 14: Data Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-DR2033-V02	The PARKAPP and PARKWEB shall send Traveler feedback on the experience of using the PARKAPP and PARKWEB to the project team.	EPM-UN012-V01 EPM-CN1676-V01	Demonstration	Partially Met  <u>Original Requirement</u> The PARKAPP shall send Traveler feedback on the experience of using the PARKAPP to the Operating System for storage.  The Smart Columbus project team and the City of Columbus Division of Parking Services will receive the feedback directly and won't be stored in the Operating System and be available for third-party users.

ReqID	Description	References	Verification Method	Requirement Status
EPM-DR2034-V01	The EPM Central System shall send usage data to the Operating System to generate performance measures.	EPM-UN029-V01 EPM-CN1676-V01	Demonstration	<p>Partially Met</p> <p><u>Original Requirement</u> The EPM Central System shall send usage data to the Operating System to generate performance measures regarding parking options around major events.</p> <p>Due to COVID-19, major events were canceled. Therefore data collection around major events was not possible but all PARKAPP and PARKWEB data usage is still sent to the Operating System.</p>
EPM-DR2035-V01	Data posted to the Operating System from the EPM Central System shall have PII obfuscated so that it may be available to third-party users.	EPM-UN028-V01 EPM-UN029-V01 EPM-UN030-V01 EPM-CN1676-V01	Demonstration	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-DR2036-V01	The vendor shall provide probe vehicle data related to parking availability (as well as other car specific data) to the EPM Central System to be used to calculate parking probability.	EPM-UN017-V01	Demonstration	Not Met  Probe vehicle data was not integrated to calculate predictive availability for on-street parking. Instead occupancy and historic payment and usage data was used for the calculation of parking availability for on-street parking.
EPM-DR3099-V01	The EPM vendor shall be responsible for establishing contracts with Original Equipment Manufacturers (OEMs) to capture real-time parking occupancy information using probe vehicle data.	EPM-UN017-V01	Demonstration	Not Met  Probe vehicle data was not integrated to calculate predictive availability for on-street parking. Instead occupancy and historic payment and usage data was used for the calculation of parking availability for on-street parking.

ReqID	Description	References	Verification Method	Requirement Status
EPM-DR3100-V01	Probe vehicle data shall include the number of spaces available to determine block-by-block occupancy levels.	EPM-UN017-V01	Demonstration	Not Met  Probe vehicle data was not integrated to calculate predictive availability for on-street parking. Instead occupancy and historic payment and usage data was used for the calculation of parking availability for on-street parking.

Source: City of Columbus

### 3.6. SECURITY REQUIREMENTS

The SR requirements listed in **Table 15** specify what is necessary to protect the integrity and operability of the system, its microservices, connections, and data. This includes physical security as well as cyber prevention, detection, identification, response and recovery requirements.

**Table 15: Security Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-SR2037-V01	The system shall be compliant with ISO/IEC 27000 series security standards.	EPM-UN028-V01	Test	Met
EPM-SR2038-V01	The EPM vendor shall perform security testing to verify the system security at least once per quarter.	EPM-UN028-V01	Test	Met
EPM-SR2039-V01	Security testing shall include penetration and vulnerability testing.	EPM-UN028-V01	Test	Met
EPM-SR2040-V01	The system shall provide secure communications, including certificates management.	EPM-UN028-V01	Test	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-SR2041-V01	The EPM vendor shall perform external threat assessment for the web portal.	EPM-UN028-V01	Test	Met
EPM-SR2042-V01	Communication between external systems and EPM Central System shall operate in an encrypted (256-bit), end-to-end connection in accordance with the EPM Central System interface.	EPM-UN023-V01	Test	Met

Source: City of Columbus

### 3.7. NON-FUNCTIONAL REQUIREMENTS

The NF requirements for the system of interest specify the characteristics of the overall operation of the system such as availability, maintainability, reliability, safety, environmental, human factors, and ergonomics.

#### 3.7.1. Availability and Recoverability Requirements

The AR requirements listed in **Table 16** define the times of day, days of year, and overall percentage the system can be used and when it will not be available for use. It also specifies the recovery time objective (RTO) of the system, which describes the time frame permitted for a system to become operational, the recovery point objective (RPO), which specifies up to what point in time shall the data be restored, as well as how the system is expected to restore services (e.g. failover, backups, etc.) in an event of a failure. The ability to recover quickly from a system failure or disaster depends on a blend of technologies and having a predefined plan for recovering the data on new hardware, when appropriate.

**Table 16: Availability and Recovery Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-AR2043-V01	The system shall provide continually available, 24-hour per day, 365-day per year operation.	EPM-UN025-V01	Analyze	Met
EPM-AR2044-V01	The functioning of system features at performance levels as defined in EPM-PR1984-v1 shall be used to determine system availability.	EPM-UN025-V01	Analyze	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-AR2046-V01	The City shall retain the ability to determine and modify which system features are to be included or excluded from the system scope to which availability requirements are applied.	EPM-UN025-V01	Analyze	Met
EPM-AR2047-V01	Reduced availability associated with planned maintenance but falling outside the start and/or end times and dates agreed between the City and the EPM vendor, shall be considered as impacting system availability.	EPM-UN025-V01	Analyze	Met

Source: City of Columbus

### 3.7.2 Disposal Requirements

The DR requirements listed in **Table 17** specify the items related to the disposal of project/system components, due to either failure replacements, removal, end-of-life upgrade, or retirement.

**Table 17: Disposal Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-DP2051-V01	The system should remain operational after the completion of the deployment period.	EPM-UN027-V01	Analyze	Met

Source: City of Columbus

### 3.8. ENABLING REQUIREMENTS

The enabling requirements specify details concerning the management of information as well as the production of the system and its life cycle sustainment, including development, integration, verification, validation, and training.

#### 3.8.1. Acceptance Testing Requirements

The AT requirements listed in **Table 18** pertains to the requirements for testing the system.

**Table 18: Acceptance Testing**

ReqID	Description	References	Verification Method	Requirement Status
EPM-AT2082-V01	The EPM vendor shall undertake testing to demonstrate that all contract requirements have been provided.	EPM-UN025-V01	Demonstration	Met
EPM-AT2083-V01	All testing shall be conducted according to the approved Acceptance Test Procedures (ATP).	EPM-UN025-V01 EPM-AT2088-V01 EPM-AT2089-V01 EPM-AT2090-V01 EPM-AT2091-V01 EPM-AT2092-V01 EPM-AT2093-V01	Demonstration	Met
EPM-AT2084-V01	Testing shall be completed on the entire system once it has been installed and configured.	EPM-UN025-V01	Demonstration	Met
EPM-AT2085-V01	At a minimum, testing shall include (as applicable): verification of major functions, and verification of necessary communications and operational interfaces.	EPM-UN025-V01	Demonstration	Met
EPM-AT2086-V01	Testing shall be completed on the system to confirm that the system meets the required functionality.	EPM-UN025-V01	Demonstration	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-AT2087-V01	Testing may be witnessed by City representatives (City staff and/or designated support consultants).	EPM-UN025-V01	Demonstration	Met
EPM-AT2088-V01	The EPM vendor shall submit an ATP document for approval prior to undertaking testing.	EPM-UN025-V01 EPM-AT2083-V01	Demonstration	Met
EPM-AT2089-V01	The ATP shall address how each requirement will be verified, including the method for performing each test.	EPM-UN025-V01 EPM-AT2083-V01	Demonstration	Met
EPM-AT2090-V01	The ATP shall address the results that will constitute success for each test.	EPM-UN025-V01 EPM-AT2083-V01	Demonstration	Met
EPM-AT2091-V01	The ATP shall address the responsibilities of both the EPM vendor and City representatives during each test.	EPM-UN025-V01 EPM-AT2083-V01	Demonstration	Met
EPM-AT2092-V01	The ATP shall include the test stage(s) at which each requirement will be demonstrated.	EPM-UN025-V01 EPM-AT2083-V01	Demonstration	Met
EPM-AT2093-V01	ATP test(s) shall use cross-references to link to each requirement being tested to verify the requirement.	EPM-UN025-V01 EPM-AT2083-V01	Demonstration	Met
EPM-AT2094-V01	The EPM vendor shall perform dry-run tests prior to the formal start of any testing involving the City representatives to ensure that successful completion of the formal witnessed tests can be reasonably anticipated.	EPM-UN025-V01	Demonstration	Met
EPM-AT2095-V01	The EPM vendor shall notify the City and receive authorization from the City to proceed with testing.	EPM-UN025-V01	Demonstration	Met
EPM-AT2096-V01	The EPM vendor shall make appropriate provisions, so the City can witness any tests each test stage.	EPM-UN025-V01	Demonstration	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-AT2097-V01	Test Results Documentation (TRD) shall be provided upon completion of testing.	EPM-UN025-V01 EPM-AT2099-V01 EPM-AT2100-V01 EPM-AT2101-V01 EPM-AT2102-V01 EPM-AT2103-V01	Demonstration	Met
EPM-AT2098-V01	The City shall approve all proposed time for testing.	EPM-UN025-V01	Demonstration	Met
EPM-AT2099-V01	The TRD shall document version number of each software system component being tested.	EPM-UN025-V01 EPM-AT2097-V01	Demonstration	Met
EPM-AT2100-V01	The TRD shall document details of the dataset used.	EPM-UN025-V01 EPM-AT2097-V01	Demonstration	Met
EPM-AT2101-V01	The TRD shall document the result of each ATP procedure.	EPM-UN025-V01 EPM-AT2097-V01	Demonstration	Met
EPM-AT2102-V01	The TRD shall document which contract requirements have been demonstrated.	EPM-UN025-V01 EPM-AT2097-V01	Demonstration	Met
EPM-AT2103-V01	The TRD shall document list of failures and open issues identified during testing along with action plan to resolve them.	EPM-UN025-V01 EPM-AT2097-V01	Demonstration	Met
EPM-AT2104-V01	The TRD shall be approved by the City before a test stage can be considered complete.	EPM-UN025-V01	Demonstration	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-AT2105-V01	The EPM vendor shall rectify and retest all deficiencies as part of completing each testing stage.	EPM-UN025-V01	Demonstration	Met
EPM-AT2106-V01	System Acceptance (SA) shall not be granted until all tests are complete and all requirements formally verified through Acceptance Testing.	EPM-UN025-V01 EPM-AT2107-V01 EPM-AT2108-V01	Demonstration	Met
EPM-AT2107-V01	A requirement classified as having been demonstrated during a certain Acceptance Testing stage should be subsequently redefined as having been not demonstrated if compliance issues emerge prior to SA.	EPM-UN025-V01 EPM-AT2106-V01	Demonstration	Met
EPM-AT2108-V01	The EPM vendor shall rectify any residual deficiencies, together with any outstanding training and documentation having been provided before the City will grant SA.	EPM-UN025-V01 EPM-AT2106-V01	Demonstration	Met

Source: City of Columbus

### 3.8.2 Information Management Requirements

The IM requirements listed in **Table 19** specify the acquisition, management, and ownership of information from one or more sources, the custodianship and the distribution of that information to those who need it, and its ultimate disposition through archiving or deletion.

**Table 19: Information Management Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-IM2054-V01	The EPM Central System contract shall reside within the City Division of Parking Services.	EPM-CN1677-V01	Inspection	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-IM2055-V02	The EPM vendor shall be responsible for creating an API to allow the Operating System (cloud) to ingest data from the EPM Central System.	EPM-UN029-V01 EPM-CN1676-V01	Analyze	Partially Met  <u>Original Requirement</u> APIs shall reside in the Operating System (cloud) to ingest data from the EPM Central System.  The EPM vendor is responsible for creating the APIs. The APIs also reside within the EPM Central System and not in the Operating System. Therefore, requirement is updated accordingly.
EPM-IM2056-V02	Data ingested into the Operating System shall be transformed, stored, and made searchable to end-users of the system (City of Columbus and Third-Party Users).	EPM-UN029-V01	Analyze	Partially Met  <u>Original Requirement</u> Data ingested into the Operating System shall be transformed and stored in a Hadoop data lake where it will be searchable utilizing Apache Hive to end-users of the system (City of Columbus and Third-Party Users).  Requirement updated to remove specific information about the storage and retrieval of data within the Operating System.

ReqID	Description	References	Verification Method	Requirement Status
EPM-IM2057-V01	Gated parking facilities shall provide APIs to send and receive parking and reservation information with the EPM Central System.	EPM-CN1675-V01	Analyze	Met
EPM-IM2058-V02	The City's Parking Management System shall provide parking space information (on-street parking and loading zones) to the EPM Central System via email or EPM vendor preferred methods.	EPM-UN017-V01	Analyze	Partially Met  <u>Original Requirement</u> The City's Parking Management System shall provide APIs to send parking space information (on-street parking and loading zones) to the EPM Central System.  CITYPMS sends the on-street parking and loading zone information through email or EPM vendor preferred methods to ingest into the EPM Central System. No API was developed between City's Parking Management System and EPM Central System.
EPM-IM2059-V01	The OPAPP shall send parking information to the EPM Central System.	EPM-UN021-V01 EPM-UN020-V01	Analyze	Met
EPM-IM2060-V01	APIs for CPS account management shall be provided by the CPS.	EPM-CN1675-V01	Analyze	Not Met  CPS is no longer part of the Smart Columbus program.

ReqID	Description	References	Verification Method	Requirement Status
EPM-IM2061-V01	APIs for parking payment shall be provided by the CPS.	EPM-CN1675-V01	Analyze	Not Met  CPS is no longer part of the Smart Columbus program.

Source: City of Columbus

### 3.8.3. Life Cycle Sustainability Requirements

The LC requirements listed in **Table 20** define what items the project or system will review, measure, and analyze as part of its commitment to quality during the life cycle of the system. The capacity to change or enhance the product and life cycle processes can be designed into the system architecture to enable the cost-effective sustainment of the system throughout its life cycle. This design attribute should be established early in the system's development to provide a basis for planning each incremental development effort.

**Table 20: Life Cycle Sustainability Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-LC2048-V01	The EPM vendor shall be responsible for maintenance of the EPM Central System and interfaces.	EPM-CN1677-V01	Demonstration	Met
EPM-LC2049-V01	The EPM vendor shall be responsible for maintenance of the PARKAPP, PARKWEB and interfaces with the EPM Central System.	EPM-CN1677-V01	Demonstration	Met
EPM-LC2050-V01	The EPM vendor shall be responsible for maintenance of the OPAPP and interfaces with PARKAPP, PARKWEB, and EPM Central System.	EPM-CN1677-V01	Demonstration	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-LC2062-V01	The EPM vendor shall provide EPM Central System performance reports on a monthly and on an ad-hoc basis.	EPM-UN024-V01 EPM-LC2063-V01 EPM-LC2064-V01 EPM-LC2065-V01 EPM-LC2066-V01 EPM-LC2067-V01 EPM-LC2068-V01	Demonstration	Met
EPM-LC2063-V01	EPM Central System performance reports shall include system availability.	EPM-UN024-V01 EPM-LC2062-V01	Inspection	Met
EPM-LC2064-V01	EPM Central System performance reports shall include system usage.	EPM-UN024-V01 EPM-LC2062-V01	Inspection	Met
EPM-LC2065-V01	EPM Central System performance reports shall include average and percentile response times.	EPM-UN024-V01 EPM-LC2062-V01	Inspection	Met
EPM-LC2066-V01	EPM Central System performance reports shall include security breaches.	EPM-UN024-V01 EPM-LC2062-V01	Inspection	Met
EPM-LC2067-V01	EPM Central System performance reports shall include attempted security breaches.	EPM-UN024-V01 EPM-LC2062-V01	Inspection	Met
EPM-LC2068-V01	EPM Central System performance reports shall include critical issues observed during the month along with information regarding issue causes and resolutions.	EPM-UN024-V01 EPM-LC2062-V01	Inspection	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-LC2069-V01	The EPM vendor shall provide a Quality Assurance/Quality Control (QA/QC) Plan for approval before award of the contract.	EPM-UN025-V01 EPM-LC2070-V01 EPM-LC2071-V01 EPM-LC2072-V01 EPM-LC2073-V01 EPM-LC2074-V01 EPM-LC2075-V01	Demonstration	Met
EPM-LC2070-V01	The QA/QC Plan shall define principles and processes the EPM vendor shall follow while developing the system.	EPM-UN025-V01 EPM-LC2069-V01	Demonstration	Met
EPM-LC2071-V01	The QA/QC Plan shall identify the risk management process the EPM vendor shall follow, which shall define the risks and critical elements of the system development process, along with the contingency plans to address these.	EPM-UN025-V01 EPM-LC2069-V01	Demonstration	Met
EPM-LC2072-V01	The QA/QC Plan shall identify the system development, testing, and QA/QC standards the EPM vendor shall follow while developing the system.	EPM-UN025-V01 EPM-LC2069-V01	Demonstration	Met
EPM-LC2073-V01	The QA/QC Plan shall identify the error/defect collection and analysis process to ensure that any introduced errors shall be tracked, identified, and eliminated.	EPM-UN025-V01 EPM-LC2069-V01	Demonstration	Met
EPM-LC2074-V01	The QA/QC Plan shall identify the change management practices the EPM vendor shall follow while developing the system, to ensure that any system development changes and associated reasons are documented.	EPM-UN025-V01 EPM-LC2069-V01	Demonstration	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-LC2075-V01	The QA/QC Plan shall identify the security management process the EPM vendor shall follow to ensure that the system development follows secure processes and technology and the system achieves the desired security level.	EPM-UN025-V01 EPM-LC2069-V01	Demonstration	Met

Source: City of Columbus

### 3.9. POLICY AND REGULATION REQUIREMENTS

The RG requirements for the system of interest specifies relevant and applicable organizational policies and regulations that affect the development, operation or performance of the system (e.g. IT and labor policies, reports to regulatory agencies, health or safety criteria, etc.). This section also includes new policy and regulation imposed to realize the system. The policy and regulation requirements for the EPM project are listed in **Table 21**.

**Table 21: Policy and Regulation Requirements**

ReqID	Description	References	Verification Method	Requirement Status
EPM-RG2076-V01	APIs developed for the EPM Central System shall be well documented and follow an established coding standard.	EPM-UN029-V01 EPM-CN1676-V01	Analyze	Met
EPM-RG2077-V01	The EPM System should follow open architecture with specifications that are public as opposed to proprietary.	EPM-UN029-V01 EPM-CN1676-V01	Analyze	Met

ReqID	Description	References	Verification Method	Requirement Status
EPM-RG2078-V02	The EPM System shall be responsible for PCI compliance.	EPM-CN1676-V01	Analyze	Partially Met  <u>Original Requirement</u> The EPM System shall not be responsible for PCI compliance.  With CPS not being part of Smart Columbus program, the EPM vendor is responsible for PCI compliance.
EPM-RG2079-V01	The EPM System shall ensure that reservations are made in accordance with the policies of individual facilities.	EPM-UN006-V01	Analyze	Met
EPM-RG2080-V02	The EPM System shall save any PCI information as a result of a payment transaction.	EPM-CN1676-V01	Analyze	Partially Met  <u>Original Requirement</u> The EPM System shall not save any PCI information as a result of a payment transaction using the CPS.  CPS is no longer part of the Smart Columbus program. PCI information is the responsibility of the EPM System and shall be saved within the EPM System.

ReqID	Description	References	Verification Method	Requirement Status
EPM-RG2081-V02	The EPM vendor shall be responsible for all applicable card transaction security rules and regulations including payment card industry and data security standards (PCI DSS) compliance, all laws, and any other governing authority requirements as may apply.	EPM-CN1675-V01	Analyze	<p>Partially Met</p> <p><u>Original Requirement</u> The CPS shall be responsible for all applicable card transaction security rules and regulations including payment card industry and data security standards (PCI DSS) compliance, all laws, and any other governing authority requirements as may apply.</p> <p>CPS is no longer part of the Smart Columbus program and the EPM vendor is responsible for the security of the PCI information with the EPM System.</p>
EPM-RG3101-V01	APIs developed for the EPM Central System should follow best practices to achieve the business needs and purposes for which they are designed.	EPM-UN029-V01 EPM-CN1676-V01	Analyze	Met

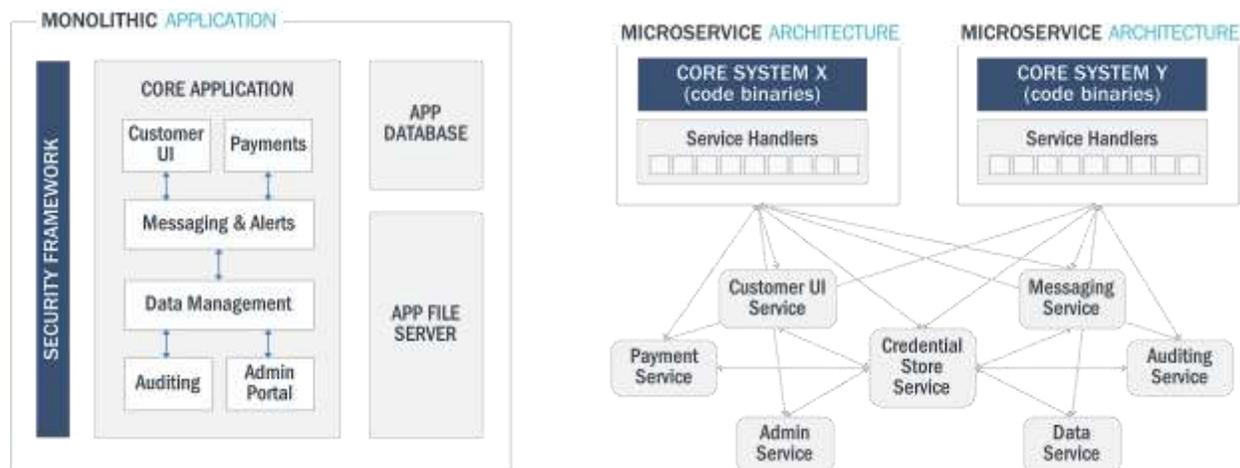
Source: City of Columbus

# Chapter 4. Engineering Principles

This section describes engineering principles that guide composition of the EPM project.

## 4.1. REFERENCE ARCHITECTURE

Historically, software systems have been developed as a single, monolithic unit constructed from a blend of hand-built custom technologies. The more features added, the more complicated the system becomes to work with contributing to high-risk, high-maintenance dependencies and a software structure that resembles spaghetti code, making software very difficult and costly to manage over time. The architecture of the Smart Columbus program breaks apart this model by designing a set of small, discrete, independent and standardized processes (i.e., FGs) that produce a service and can be plugged in for a cleaner, more efficient build. **Figure 5** provides an illustration of the reference architecture for monolithic versus services by FG.



Source: City of Columbus

**Figure 5: Monolithic Versus Microservice Reference Architecture**

As **Figure 5** depicts, system features in a monolithic application are hard-wired into the application and cannot be used otherwise. In theory, the entire system would need to be cloned. On the other hand, a modular design allows services to operate independently, making plug and play features easy and quick to configure, deploy and scale.

The EPM System is mindfully designed to leverage this model to create an SoS targeted for performance, agility and scalability in a manageable way. Each API establishes a set of rules and principles for how the prepackaged FG microservice will integrate. The communications bus will be built over hardware infrastructure and governed by software, which will enable FG microservices to communicate securely while operating independently.



# Appendix A. Document Terminology and Conventions

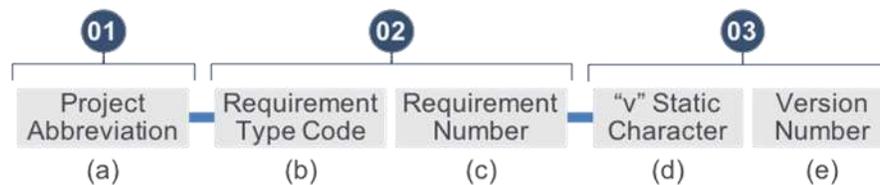
## A.1 REFERENCE CONVENTIONS

The following conventions are used through this document:

- Titles of externally referenced documents or sources are underlined.
- Titles of internally referenced exhibits, sections, etc. are *italicized*.

### A.1.1 Requirement Numbering Convention

Each requirement contains a unique ID for traceability and configuration management. Requirements for all projects in the Smart Columbus program will follow the same convention. As shown in **Figure 6**, the requirement identifier contains six elements partitioned into four octets, each representing an identifiable attribute of the requirement.



**Figure 6: Numbering Convention**

Source: City of Columbus

**Table 22: Requirements Numbering Convention**

	Description	Data Type, Casing	Number of Characters/Digits
Project Abbreviation	The designated Smart Columbus project acronym (e.g. EPM, etc.)	String, upper case	Variable
Requirement Type Code	<ul style="list-style-type: none"> <li>• FN: Functional</li> <li>• PR: Performance</li> <li>• IF: Interface</li> <li>• IX: Interface (internal tracking number)</li> <li>• DR: Data</li> <li>• SR: Security</li> <li>• RG: Policy and Regulation</li> <li>• AR: Availability and Recovery</li> <li>• ST: Storage and Transport</li> <li>• AT: Acceptance Testing</li> <li>• DP: Disposal</li> <li>• IM: Information Management</li> <li>• LC: Life Cycle Sustainability</li> </ul>	String, upper case	2
Requirement Number	An integer incrementing by one, indicating the number of requirements established.	Integer	3
"v" Static Character	Static letter "v" represents the requirement version.	Character	1
Version Number	An integer incrementing by one, indicating the number of revisions made to the requirement.	Integer	2

Source: City of Columbus

An example of a Functional Requirement would be "EPM-FN001-V01" in which the following applies:

- "EPM" is the Project Abbreviation
- "FN001" is the requirement type code coupled with the 3-digit Requirement Number
- "V01" is the static "V" coupled with the 2-digit version number

## A.1.2 Requirements Table Headings

The columns in the requirements tables throughout this document have the following definitions:

- **ReqID:** a unique identifier providing a reference to a specific requirement.
- **Description:** Statement of the business function or conditions the system must meet.
- **Reference:** Additional requirement(s), documents, standards, etc. relating to the function or condition the system must meet.
- **Verification Method:** Approach to confirming requirement is satisfied.

## A.1.3 Conformance

Requirements listed in this document use the following terminology:

- **SHALL:** indicates the definition is an absolute requirement of the specification.
- **SHALL NOT:** Indicates the definition is an absolute prohibition of the specification.
- **SHOULD (RECOMMENDED):** Indicates there may exist valid reasons or circumstances to omit a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- **SHOULD NOT (NOT RECOMMENDED):** Indicates there may exist valid reasons or circumstances when a particular function or condition is acceptable or even useful, but the full implications should be understood, and the case carefully weighed before implementing any function or condition described with this label.
- **MAY (OPTIONAL):** Indicates an item is truly optional. Some vendors may choose to include or implement Optional Requirements to add value or enhance their overall product while other vendors may omit the same Optional Requirement to reduce cost, increase time to market, etc. An implementation which does not include an Optional Requirement SHALL be interoperable with implementations which does include the Optional Requirement, though perhaps with reduced functionality. In the same vein an implementation which does include an Optional Requirement SHALL be interoperable with an implementation which does not include the Optional Requirement (with the exception for the feature the option provides).



## Appendix B. Requirements by System Functional Groups

**Table 23** organizes requirements defined in **Chapter 3** into its functional groups. This organization is intended for ease of use and quick reference during system design.

**Table 23: Requirements Organized by Functional Groups**

Functional Group	ReqID	Description
EPM Central System	EPM-FN1893-V02	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1894-V02	The EPM Central System shall provide parking facility hours of operation to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1895-V02	The EPM Central System shall provide parking restrictions at each parking facility to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1896-V02	The EPM Central System shall provide parking availability at each parking facility to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1899-V02	The EPM Central System shall provide the location of electric vehicle charging stations to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1900-V03	The EPM Central System shall provide access to ADA accessible parking spaces in accordance with standards for accessible design as determined by the ADA to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1901-V02	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of reservation confirmation.
EPM Central System	EPM-FN1902-V02	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of changes to an existing reservation.
EPM Central System	EPM-FN1903-V02	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of warnings of expiration of paid parking session.
EPM Central System	EPM-FN1904-V02	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of expiration of paid parking session.
EPM Central System	EPM-FN1905-V02	The PARKAPP and PARKWEB shall allow purchase of additional parking meter time.
EPM Central System	EPM-FN1906-V03	The PARKAPP and PARKWEB shall not allow purchase of additional parking meter time past the maximum time allowed within mobile pay zones.

Functional Group	ReqID	Description
EPM Central System	EPM-FN1907-V02	The PARKAPP and PARKWEB shall not allow purchase of parking meter time when restricted parking periods are in effect.
EPM Central System	EPM-FN1908-V03	The EPM Central System shall provide a visual indicator showing the probability of finding open on-street parking to the PARKAPP.
EPM Central System	EPM-FN1911-V03	The calculation of predicted availability for metered parking shall be based on data related to occupancy, availability, and historic transaction data.
Gated Parking Facility System	EPM-FN1912-V01	The GFAC shall confirm reservations with the EPM Central System.
Ungated Parking Facility System	EPM-FN1913-V01	The UFAC shall confirm reservations with the EPM Central System.
EPM Central System	EPM-FN1914-V02	The EPM Central System shall provide a response to the PARKAPP and PARKWEB of a confirmed reservation.
EPM Central System	EPM-FN1915-V02	The confirmation response provided to the PARKAPP and PARKWEB shall include a reservation confirmation code.
EPM Central System	EPM-FN1916-V02	The EPM Central System shall not provide a reservation confirmation code to PARKAPP and PARKWEB if payment is not complete.
EPM Central System	EPM-FN1917-V02	The confirmation response provided to the PARKAPP and PARKWEB shall include notice of payment completion and amount.
EPM Central System	EPM-FN1918-V02	The EPM Central System shall allow local merchants to offer discounted parking options through the PARKAPP.
EPM Central System	EPM-FN3193-V02	The EPM Central System shall validate the discounted parking options and provide confirmation of validation to the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1920-V02	The EPM Central System shall provide data storage and retrieval for the PARKAPP and PARKWEB.
EPM Central System	EPM-FN1921-V02	The EPM Central System shall communicate the paid status of reservations to the PARKAPP and PARKWEB in real-time.
Traveler Mobile Application	EPM-FN1922-V02	The PARKAPP and PARKWEB shall allow Travelers to pay for a specific period of parking time.
EPM Central System	EPM-FN1923-V02	The EPM Central System shall update the PARKAPP and PARKWEB without any system downtime or data latency when data is entered or modified in the EPM Central System via the OPAPP.

Functional Group	ReqID	Description
EPM Central System	EPM-FN1924-V02	The City shall have the ability to set demand-based pricing for meters in the OPAPP, allowing rates to be increased or decreased based on demand for parking.
Traveler Mobile Application	EPM-FN1925-V02	The PARKAPP and PARKWEB shall allow Travelers to create a profile in the EPM Central System to store profile information and mobile application settings.
Traveler Mobile Application	EPM-FN1927-V02	Creating a profile with PARKAPP and PARKWEB shall require submission of Traveler's email address
Traveler Mobile Application	EPM-FN1928-V03	Creating a profile with PARKAPP and PARKWEB shall require authentication.
Traveler Mobile Application	EPM-FN1930-V03	Creating a profile with PARKAPP and PARKWEB should include the option of providing a Traveler's telephone number, first name and last name.
EPM Central System	EPM-FN1936-V02	The EPM Central System shall permit authorized individuals to close any Traveler profile (e.g. due to prolonged inactivity or abuse of policies).
Traveler Mobile Application	EPM-FN1937-V02	Travelers shall have access to manage their profiles in the PARKAPP and PARKWEB by correctly entering their login information.
Traveler Mobile Application	EPM-FN1938-V02	Travelers shall be able to use the PARKAPP to get parking availability information without having an EPM profile.
Traveler Mobile Application	EPM-FN1939-V03	The PARKWEB shall provide Travelers with the option of creating an EPM guest account (temporary account) to book a one-time reservation.
Traveler Mobile Application	EPM-FN1941-V02	The PARKAPP and PARKWEB shall provide the Traveler the capability to configure notifications and alerts.
Traveler Mobile Application	EPM-FN1942-V02	The PARKAPP and PARKWEB shall provide Travelers with access to a transaction log consisting of a history of paid parking transactions, locations, and time and date.
Traveler Mobile Application	EPM-FN1943-V02	The transaction log shall be limited to prior 3 months of transactions.
Traveler Mobile Application	EPM-FN1944-V01	The PARKAPP shall provide Travelers with the ability to store favorite searches for easy retrieval.
Traveler Mobile Application	EPM-FN1945-V02	The PARKAPP shall provide Travelers with the ability to select amenities that will be used to filter search results for parking options.
Traveler Mobile Application	EPM-FN1946-V02	The PARKAPP and PARKWEB shall use the GPS device of the Traveler's smartphone or computer to determine current location to search for parking options.

Functional Group	ReqID	Description
Traveler Mobile Application	EPM-FN1947-V02	The PARKAPP and PARKWEB shall obtain affirmative express consent from the Traveler before accessing geolocation information or contact info.
Traveler Mobile Application	EPM-FN1948-V02	The PARKAPP and PARKWEB shall provide the Traveler the ability to search for parking options by entering a street address.
Traveler Mobile Application	EPM-FN1949-V02	The PARKAPP and PARKWEB shall provide the Traveler the ability to search for parking options by selecting an on-street parking zone or parking loading zone.
Traveler Mobile Application	EPM-FN1950-V02	The PARKAPP and PARKWEB shall provide the Traveler the ability to submit user feedback.
Traveler Mobile Application	EPM-FN1951-V04	The PARKAPP and PARKWEB shall provide the Traveler the ability to contact the customer care with complaints.
Traveler Mobile Application	EPM-FN1952-V03	The PARKAPP and PARKWEB shall provide a link to the City's 311 webpage.
Traveler Mobile Application	EPM-FN1953-V03	Accessibility audits of the mobile and web applications will occur by external third-party auditors and internal auditors relative to Section 508 of the Rehabilitation Act of 1973.
Traveler Mobile Application	EPM-FN1954-V03	Accessibility audits of the mobile and web applications will occur by external third-party auditors and internal auditors relative to the WCAG 2.0 guidelines.
Traveler Mobile Application	EPM-FN1955-V02	The PARKAPP shall default to English language user interface unless Spanish is chosen as language within the phone settings.
Traveler Mobile Application	EPM-FN1956-V03	The PARKAPP shall provide the Traveler with the option of changing all static text (including CTAs, navigational items, links, authentication (create account/login), on-demand flow (excluding error text), reservations flow (excluding error text), activity (tab labels and on-demand active session UI), time selector units (days, hours, minutes), setting screen section labels) in the user interface from English to Spanish, and vice versa (images will remain the same regardless of language choice).
Traveler Mobile Application	EPM-FN1957-V01	The PARKAPP shall support mobile portrait mode (form factor).
Traveler Mobile Application	EPM-FN1959-V02	The PARKWEB and PARKAPP shall allow requests for locating metered parking spaces (including on-street EV and ADA metered spaces).
Traveler Mobile Application	EPM-FN1961-V02	The PARKWEB and PARKAPP shall display loading zone locations, hours, and restrictions.

Functional Group	ReqID	Description
Traveler Mobile Application	EPM-FN1962-V02	The PARKAPP and PARKWEB shall provide the ability to filter by any combination of garages, lots, and streets.
Traveler Mobile Application	EPM-FN1963-V01	The PARKAPP shall provide an interactive map display showing real-time parking options.
Traveler Mobile Application	EPM-FN1964-V02	The PARKAPP and PARKWEB shall include the ability to link to map-based navigation on the Traveler's smartphone/computer/tablet to direct the Traveler to the designated parking location
Traveler Mobile Application	EPM-FN1965-V01	Map-based navigation shall use the GPS device of the Traveler's smartphone to update the location of the Traveler on the map in real-time.
Traveler Mobile Application	EPM-FN1966-V02	The PARKAPP and PARKWEB shall provide the ability to reserve parking in accordance with the policies of individual facilities.
Traveler Mobile Application	EPM-FN1967-V02	The PARKAPP and PARKWEB shall allow Travelers to pay for parking in accordance with the policies of individual facilities, parking rates, and payment methods.
Traveler Website	EPM-FN1971-V01	The PARKWEB shall provide the same access to real-time parking availability information for gated parking facility systems as the PARKAPP.
Parking Operator Application	EPM-FN1972-V01	UFAC parking operators shall be able to interface with the EPM Central System through the OPAPP.
Parking Operator Application	EPM-FN1973-V01	UFAC parking operators shall be able to enter and modify event rates and schedules in real-time through the OPAPP.
EPM Central System	EPM-FN1977-V02	The PARKWEB and PARKAPP shall allow pre-payment of parking up to the allowable timeframe prior to paid parking operational hours.
Traveler Mobile Application	EPM-FN1980-V02	Travelers shall be able to pay instantly without being redirected away from the PARKAPP and PARKWEB to complete a transaction.
EPM Central System	EPM-FN1982-V01	The EPM Central System shall be capable of mobile device payments by presenting a reservation ID via an optical barcode on the Traveler's mobile device screen.
EPM Central System	EPM-PR1984-V01	The system shall perform with minimal discernible latency (response time of roughly 150ms or less, excluding delays in internet service not controlled by the EPM vendor).
EPM Central System	EPM-PR1985-V01	The EPM vendor shall be able to measure data input/output latency on their servers and provide these statistics to the City for the purpose of assessing performance against requirement EPM-PR1984-v1.

Functional Group	ReqID	Description
Traveler Mobile Application	EPM-IF1986-V01	The PARKAPP shall operate on iOS version 10+.
Traveler Mobile Application	EPM-IF1987-V01	The PARKAPP shall operate on Android version 4.4+.
Traveler Website	EPM-IF1988-V01	The PARKWEB shall support Chrome, Safari, Firefox, and Edge: current versions as of the final draft of this SyRS and -1 versions.
Smart Columbus Operating System	EPM-IF1989-V01	The Operating System shall receive parking data from the City Parking Management System.
Smart Columbus Operating System	EPM-IF1990-V01	The Operating System shall receive parking data from the EPM Central System.
EPM Central System	EPM-IF1991-V01	APIs developed for the EPM Central System shall be open architecture.
EPM Central System	EPM-IF1992-V01	The protocol for all API calls shall be HTTPS to protect data in transit.
EPM Central System	EPM-IF1993-V01	Authentication keys shall be supplied for all API calls.
EPM Central System	EPM-IF1994-V01	External systems shall communicate with the EPM Central System via Internet.
Parking Operator Application	EPM-IF2004-V02	The EPM Central System shall provide an interface to send and receive rate information, parking availability, and reservation information between the OPAPP and the EPM Central System.
Common Payment System	EPM-IF2006-V02	The EPM System shall provide an interface to allow the OPAPP to update provider account information.
EPM Central System	EPM-IF2009-V02	The EPM System shall provide an interface to allow the EPM Central System to send and receive payment information and payment status to the Traveler.
City Parking Management System	EPM-IF2011-V02	The Operating System shall provide an interface to send meter closed/out of service information (due to event, construction, etc.), loading zone and meter location, rates, hours of operation, restrictions, and out-of-service information from the CITYPMS to the Operating System.
EPM Central System	EPM-IF2015-V01	The EPM Central System shall provide an interface to send PARKAPP usage information from the EPM Central System to the Operating System.
Probe Vehicles	EPM-IF2016-V02	The EPM Central System shall provide an interface to send predictive availability information from the Operating System to the EPM Central System.
Traveler Mobile Application	EPM-IF2019-V01	The EPM Central System shall provide an interface to send and receive parking availability and reservation information between the EPM Central System and the PARKAPP.

Functional Group	ReqID	Description
Smart Columbus Operating System	EPM-DR2033-V02	The PARKAPP shall send Traveler feedback on the experience of using the PARKAPP to the project team.
Smart Columbus Operating System	EPM-DR2034-V01	The EPM Central System shall send usage data to the Operating System to generate performance measures.
Smart Columbus Operating System	EPM-DR2035-V01	Data posted to the Operating System from the EPM Central System shall have PII obfuscated so that it may be available to third-party users.
EPM Central System	EPM-SR2037-V01	The system shall be compliant with ISO/IEC 27000 series security standards.
Smart Columbus Operating System	EPM-SR2038-V01	The EPM vendor shall perform security testing to verify the system security at least once per quarter.
EPM Central System	EPM-SR2039-V01	Security testing shall include penetration and vulnerability testing.
EPM Central System	EPM-SR2040-V01	The system shall provide secure communications, including certificates management.
EPM Central System	EPM-SR2041-V01	The EPM vendor shall perform external threat assessment for the web portal.
EPM Central System	EPM-SR2042-V01	Communication between external systems and EPM Central System shall operate in an encrypted (256-bit), end-to-end connection in accordance with the EPM Central System interface.
EPM Central System	EPM-AR2043-V01	The system shall provide continually available, 24-hour per day, 365-day per year operation.
EPM Central System	EPM-AR2044-V01	The functioning of system features at performance levels as defined in EPM-PR1984-v1 shall be used to determine system availability.
EPM Central System	EPM-AR2045-V01	The functioning of system features in compliance with planned maintenance requirements as defined in EPM-MT001-v01 shall be used to determine system availability.
EPM Central System	EPM-AR2046-V01	The City shall retain the ability to determine and modify which system features are to be included or excluded from the system scope to which availability requirements are applied.
EPM Central System	EPM-AR2047-V01	Reduced availability associated with planned maintenance but falling outside the start and/or end times and dates agreed between the City and the EPM vendor, shall be considered as impacting system availability.
EPM Central System	EPM-LC2048-V01	The EPM vendor shall be responsible for maintenance of the EPM Central System and interfaces.

Functional Group	ReqID	Description
EPM Central System	EPM-LC2049-V01	The EPM vendor shall be responsible for maintenance of the PARKAPP and interfaces with the EPM Central System.
EPM Central System	EPM-LC2050-V01	The EPM vendor shall be responsible for maintenance of the OPAPP, PARKAPP, PARKWEB, and interfaces with the EPM Central System.
EPM Central System	EPM-DP2051-V01	The system should remain operational after the completion of the deployment period.
EPM Central System	EPM-IM2054-V01	The EPM Central System shall reside within the City Division of Parking Services.
Smart Columbus Operating System	EPM-IM2055-V02	The EPM vendor shall be responsible for creating an API to allow the Operating System (cloud) to ingest data from the EPM Central System.
Smart Columbus Operating System	EPM-IM2056-V02	Data ingested into the Operating System shall be transformed, stored, and made searchable to end-users of the system (City of Columbus and Third-Party Users).
Gated Parking Facility System	EPM-IM2057-V01	Gated parking facilities shall provide APIs to send and receive parking and reservation information with the EPM Central System.
Probe Vehicles	EPM-IM2058-V02	The City's Parking Management System shall provide parking space information (on-street parking and loading zones) to the EPM Central System via email or EPM vendor preferred methods.
Parking Operator Application	EPM-IM2059-V01	The OPAPP shall send parking information to the EPM Central System.
EPM Central System	EPM-LC2062-V01	The EPM vendor shall provide EPM Central System performance reports on a monthly and on an ad-hoc basis.
EPM Central System	EPM-LC2063-V01	EPM Central System performance reports shall include system availability.
EPM Central System	EPM-LC2064-V01	EPM Central System performance reports shall include system usage.
EPM Central System	EPM-LC2065-V01	EPM Central System performance reports shall include average and percentile response times.
EPM Central System	EPM-LC2066-V01	EPM Central System performance reports shall include security breaches.
EPM Central System	EPM-LC2067-V01	EPM Central System performance reports shall include attempted security breaches.
EPM Central System	EPM-LC2068-V01	EPM Central System performance reports shall include critical issues observed during the month along with information regarding issue causes and resolutions.

Functional Group	ReqID	Description
EPM Central System	EPM-LC2069-V01	The EPM vendor shall provide a Quality Assurance/Quality Control (QA/QC) Plan for approval before award of the contract.
EPM Central System	EPM-LC2070-V01	The QA/QC Plan shall define principles and processes the EPM vendor shall follow while developing the system.
EPM Central System	EPM-LC2071-V01	The QA/QC Plan shall identify the risk management process the EPM vendor shall follow, which shall define the risks and critical elements of the system development process, along with the contingency plans to address these.
EPM Central System	EPM-LC2072-V01	The QA/QC Plan shall identify the system development, testing, and QA/QC standards the EPM vendor shall follow while developing the system.
EPM Central System	EPM-LC2073-V01	The QA/QC Plan shall identify the error/defect collection and analysis process to ensure that any introduced errors shall be tracked, identified, and eliminated.
EPM Central System	EPM-LC2074-V01	The QA/QC Plan shall identify the change management practices the EPM vendor shall follow while developing the system, to ensure that any system development changes and associated reasons are documented.
EPM Central System	EPM-LC2075-V01	The QA/QC Plan shall identify the security management process the EPM vendor shall follow to ensure that the system development follows secure processes and technology and the system achieves the desired security level.
EPM Central System	EPM-RG2076-V01	APIs developed for the EPM Central System shall be well documented and follow an established coding standard.
EPM Central System	EPM-RG2077-V01	The EPM System should follow open architecture with specifications that are public as opposed to proprietary.
EPM Central System	EPM-RG2078-V02	The EPM System shall be responsible for PCI compliance.
EPM Central System	EPM-RG2079-V01	The EPM System shall ensure that reservations are made in accordance with the policies of individual facilities.
EPM Central System	EPM-RG2080-V02	The EPM System shall save any PCI information as a result of a payment transaction.

Functional Group	ReqID	Description
Common Payment System	EPM-RG2081-V02	The EPM vendor shall be responsible for all applicable card transaction security rules and regulations including payment card industry and data security standards (PCI DSS) compliance, all laws, and any other governing authority requirements as may apply.
EPM Central System	EPM-AT2082-V01	The EPM vendor shall undertake testing to demonstrate that all contract requirements have been provided.
EPM Central System	EPM-AT2083-V01	All testing shall be conducted according to the approved ATP.
EPM Central System	EPM-AT2084-V01	Testing shall be completed on the entire system once it has been installed and configured.
EPM Central System	EPM-AT2085-V01	At a minimum, testing shall include (as applicable): verification of major functions, and verification of necessary communications and operational interfaces.
EPM Central System	EPM-AT2086-V01	Testing shall be completed on the system to confirm that the system meets the required functionality.
EPM Central System	EPM-AT2087-V01	Testing may be witnessed by City representatives (City staff and/or designated support consultants).
EPM Central System	EPM-AT2088-V01	The EPM vendor shall submit an ATP document for approval prior to undertaking testing.
EPM Central System	EPM-AT2089-V01	The ATP shall address how each requirement will be verified, including the method for performing each test.
EPM Central System	EPM-AT2090-V01	The ATP shall address the results that will constitute success for each test.
EPM Central System	EPM-AT2091-V01	The ATP shall address the responsibilities of both the EPM vendor and City representatives during each test.
EPM Central System	EPM-AT2092-V01	The ATP shall include the test stage(s) at which each requirement will be demonstrated.
EPM Central System	EPM-AT2093-V01	ATP test(s) shall use cross-references to link to each requirement being tested to verify the requirement.
EPM Central System	EPM-AT2094-V01	The EPM vendor shall perform dry-run tests prior to the formal start of any testing involving the City representatives to ensure that successful completion of the formal witnessed tests can be reasonably anticipated.
EPM Central System	EPM-AT2095-V01	The EPM vendor shall notify the City and receive authorization from the City to proceed with testing.
EPM Central System	EPM-AT2096-V01	The EPM vendor shall make appropriate provisions, so the City can witness any tests each test stage.

Functional Group	ReqID	Description
EPM Central System	EPM-AT2097-V01	Test Results Documentation (TRD) shall be provided upon completion of testing.
EPM Central System	EPM-AT2098-V01	The City shall approve all proposed time for testing.
EPM Central System	EPM-AT2099-V01	The TRD shall document version number of each software system component being tested.
EPM Central System	EPM-AT2100-V01	The TRD shall document details of the dataset used.
EPM Central System	EPM-AT2101-V01	The TRD shall document the result of each ATP procedure.
EPM Central System	EPM-AT2102-V01	The TRD shall document which contract requirements have been demonstrated.
EPM Central System	EPM-AT2103-V01	The TRD shall document list of failures and open issues identified during testing along with action plan to resolve them.
EPM Central System	EPM-AT2104-V01	The TRD shall be approved by the City before a test stage can be considered complete.
EPM Central System	EPM-AT2105-V01	The EPM vendor shall rectify and retest all deficiencies as part of completing each testing stage.
EPM Central System	EPM-AT2106-V01	System Acceptance (SA) shall not be granted until all tests are complete, and all requirements formally verified through Acceptance Testing.
EPM Central System	EPM-AT2107-V01	A requirement classified as having been demonstrated during a certain Acceptance Testing stage should be subsequently redefined as having been not demonstrated if compliance issues emerge prior to SA.
EPM Central System	EPM-AT2108-V01	The EPM vendor shall rectify any residual deficiencies, together with any outstanding training and documentation having been provided before the City will grant System Acceptance (SA).
EPM Central System	EPM-FN2109-V01	Travelers shall not be required to create a profile to search for parking options.
Traveler Mobile Application	EPM-FN3094-V03	The PARKAPP and PARKWEB shall allow Travelers to filter available parking spaces based on ADA compliance.
Traveler Mobile Application	EPM-FN3095-V03	The PARKAPP and PARKWEB shall allow Travelers to filter available parking spaces based on availability of EV charging.
Traveler Mobile Application	EPM-FN3096-V03	The PARKAPP and PARKWEB shall allow Travelers to select preferred/frequently traveled zones.
EPM Central System	EPM-FN3097-V01	The EPM Central System shall provide a secure administrative account for authorized individuals at the City.

Functional Group	ReqID	Description
EPM Central System	EPM-FN3098-V01	The EPM Central System shall allow the administrative account to block any parking provider from using the EPM System due to abuse of policies.
EPM Central System	EPM-RG3101-V01	APIs developed for the EPM Central System should follow best practices to achieve the business needs and purposes for which they are designed.
EPM Central System	EPM-IF3102-V01	The EPM Central System shall provide an interface to send and receive reservation requests, availability (percentage full for facilities or probability of finding an available on-street parking), location of the parking facility, and cost (if available) from the GFAC.
Common Payment System	EPM-IF3103-V02	The EPM System shall provide an interface to allow the GFAC parking vendors to update provider account information.
EPM Central System	EPM-IF3104-V01	The EPM Central System shall provide an interface to request additional parking meter time and receive confirmation from the CITYPMS.
EPM Central System	EPM-FN3105-V01	The PARKAPP shall provide Travelers with the ability to activate discounted parking options.
EPM Central System	EPM-FN3266-V00	The EPM Central System shall provide predictive availability for on-street parking to the PARKAPP.
EPM Central System	EPM-FN3267-V00	The PARKAPP and PARKEB shall not allow the reservation of on-street parking.
EPM Central System	EPM-FN3270-V00	The EPM Central System shall provide the ability for Parking Operators to create "to be determined" events where date and time are unknown, or date is known but time has yet to be announced.
EPM Central System	EPM-FN3271-V00	The EPM Central System shall provide the ability for Parking Operators to modify "to be determined" events when date/time becomes known.
EPM Central System	EPM-FN3272-V00	The PARKAPP shall provide the ability for event employees to enter an access code associated with an event.
EPM Central System	EPM-FN3273-V00	The PARKAPP provides event employees access to appropriate parking options after entering event access code associated with that event.
EPM Central System	EPM-FN3274-V00	The PARKWEB shall provide the ability for Travelers to create a fleet account to manage multiple user profiles on a single account.

Source: City of Columbus

# Appendix C. Mapped User Needs

**Table 24** provides a mapping of each user need established in the ConOps with the requirements that were created based off that user defined in **Chapter 3**. This organization is intended for ease of use and quick reference during system design.

**Table 24: Mapped User Needs**

USER NEED:		EPM-UN001-V01			USER: TRAVELER
Title:	EPM Real-Time Parking Information				
Description:	Traveler needs the EPM System to provide real-time parking information including the location, hours of operation, restrictions, availability, price other information to help locate available parking including loading zones, specialty meter for electric vehicle charging, and Americans with Disability Act (ADA) hours of loading zones.				
Priority:	Essential				
Related Requirements, Constraints and System Interfaces					
Type	Identifier	Functional Group	Sub-Component	Description	
Functional	EPM-FN1900-V03	EPM Central System	Parking Coordination	The EPM Central System shall provide access to ADA accessible parking spaces in accordance with standards for accessible design as determined by the ADA to the PARKAPP and PARKWEB.	
Functional	EPM-FN1896-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking availability at each parking facility to the PARKAPP and PARKWEB.	
Functional	EPM-FN1899-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide the location of electric vehicle charging stations to the PARKAPP and PARKWEB.	
Functional	EPM-FN1894-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility hours of operation to the PARKAPP and PARKWEB.	
Functional	EPM-FN1893-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.	
Functional	EPM-FN1895-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking restrictions at each parking facility to the PARKAPP and PARKWEB.	

Functional	EPM-FN1953-V03	Traveler Mobile Application	Search and Reserve Parking	Accessibility audits of the mobile and web applications will occur by external third-party auditors and internal auditors relative to Section 508 of the Rehabilitation Act of 1973.
Functional	EPM-FN1954-V03	Traveler Mobile Application	Search and Reserve Parking	Accessibility audits of the mobile and web applications will occur by external third-party auditors and internal auditors relative to the WCAG 2.0 guidelines.
Functional	EPM-FN1961-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKWEB and PARKAPP shall display loading zone locations, hours, and restrictions.
Interface	EPM-IF1988-V01	Traveler Website	Website support for Chrome, Safari, Firefox and Edge	The PARKWEB shall support Chrome, Safari, Firefox, and Edge: current versions as of the final draft of this SyRS and -1 versions.

**USER NEED: EPM-UN002-V01 USER: TRAVELER**

**Title:** EPM Map Display

**Description:** Travelers need the EPM System to provide above parking information on interactive maps that can see all parking options or can turn on and off the meter/loading zone locations.

**Priority:** Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1963-V01	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall provide an interactive map display showing real-time parking options.
Functional	EPM-FN1962-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall provide the ability to filter by any combination of garages, lots, and streets.

**USER NEED: EPM-UN003-V01 USER: TRAVELER**

**Title:** EPM Parking Meter Availability

**Description:** Travelers need the EPM System to provide information on the probability that a metered parking space will be available in a given area (i.e., a given segment of road).

**Priority:** Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1900-V03	EPM Central System	Parking Coordination	The EPM Central System shall provide access to ADA accessible parking spaces in accordance with standards for accessible design as determined by the ADA to the PARKAPP and PARKWEB.
Functional	EPM-FN1899-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide the location of electric vehicle charging stations to the PARKAPP and PARKWEB.
Functional	EPM-FN1894-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility hours of operation to the PARKAPP and PARKWEB.
Functional	EPM-FN1893-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.
Functional	EPM-FN1895-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking restrictions at each parking facility to the PARKAPP and PARKWEB.
Functional	EPM-FN1896-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking availability at each parking facility to the PARKAPP and PARKWEB.
Functional	EPM-FN1908-V03	EPM Central System	Probability Calculation	The EPM Central System shall provide a visual indicator showing the probability of finding open on-street parking to the PARKAPP.
Functional	EPM-FN1959-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKWEB and PARKAPP shall allow requests for locating metered parking spaces (including on-street EV and ADA metered spaces).
Functional	EPM-FN1911-V03	EPM Central System	Probability Calculation	The calculation of predicted availability for metered parking shall be based on data related to occupancy, availability, and historic transaction data.
Functional	EPM-FN3266-V00	EPM Central System	Probability Calculation	The EPM Central System shall provide predictive availability for on-street parking to the PARKAPP.

**USER NEED: EPM-UN005-V01****USER: TRAVELER**

Title:	EPM One-Stop-Shop
Description:	Travelers need the EPM System to allow access to all available parking information including location, availability, prices, hours of operations, and other related information from a single location, which could be through smartphone app (iOS and Android) or through website.
Priority:	Essential

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Interface	EPM-IF1987-V01	Traveler Mobile Application	Support for Android version 4.4+	The PARKAPP shall operate on Android version 4.4+.
Interface	EPM-IF1986-V01	Traveler Mobile Application	Support for iOS version 10+	The PARKAPP shall operate on iOS version 10+.
Functional	EPM-FN1955-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall default to English language user interface unless Spanish is chosen as language within the phone settings.
Functional	EPM-FN1971-V01	Traveler Website	Traveler Website	The PARKWEB shall provide the same access to real-time parking availability information for gated parking facility systems as the PARKAPP.
Interface	EPM-IF1988-V01	Traveler Website	Website support for Chrome, Safari, Firefox and Edge	The PARKWEB shall support Chrome, Safari, Firefox, and Edge: current versions as of the final draft of this SyRS and -1 versions.
Functional	EPM-FN1956-V03	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall provide the Traveler with the option of changing all static text (including CTAs, navigational items, links, authentication (create account/login), on-demand flow (excluding error text), reservations flow (excluding error text), activity (tab labels and on-demand active session UI), time selector units (days, hours, minutes), setting screen section labels) in the user interface from English to Spanish, and vice versa (images will remain the same regardless of language choice).

**USER NEED: EPM-UN006-V01****USER: TRAVELER**

<b>Title:</b>	EPM Parking Reservation
<b>Description:</b>	Travelers need the EPM System to provide the ability to book/reserve and pay for parking in accordance with the policies of individual facilities, and to receive confirmation that bookings/reservations have been processed and accepted.
<b>Priority:</b>	Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1905-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall allow purchase of additional parking meter time.
Functional	EPM-FN1906-V03	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of additional parking meter time past the maximum time allowed within mobile pay zones.
Policy and Regulation	EPM-RG2079-V01	EPM Central System	Reservations made with policies of individual facilities	The EPM System shall ensure that reservations are made in accordance with the policies of individual facilities.
Functional	EPM-FN1907-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of parking meter time when restricted parking periods are in effect.
Functional	EPM-FN1912-V01	Gated Parking Facility System	Parking Management System	The GFAC shall confirm reservations with the EPM Central System.
Functional	EPM-FN1903-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of warnings of expiration of paid parking session.
Functional	EPM-FN1966-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall provide the ability to reserve parking in accordance with the policies of individual facilities.
Functional	EPM-FN1914-V02	EPM Central System	Payment Coordination	The EPM Central System shall provide a response to the PARKAPP and PARKWEB of a confirmed reservation.
Functional	EPM-FN1902-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of changes to an existing reservation.

Functional	EPM-FN1913-V01	Ungated Parking Facility System	Manually Collected System	The UFAC shall confirm reservations with the EPM Central System.
Functional	EPM-FN1967-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall allow Travelers to pay for parking in accordance with the policies of individual facilities, parking rates, and payment methods.
Functional	EPM-FN1901-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of reservation confirmation.
Functional	EPM-FN1916-V02	EPM Central System	Payment Coordination	The EPM Central System shall not provide a reservation confirmation code to PARKAPP and PARKWEB if payment is not complete.
Functional	EPM-FN1904-V02	EPM Central System	Traveler Notifications	The PARKAPP and PARKWEB shall be capable of notifying Travelers via text, email, or push notification of expiration of paid parking session.
Functional	EPM-FN1915-V02	EPM Central System	Payment Coordination	The confirmation response provided to the PARKAPP and PARKWEB shall include a reservation confirmation code.
Functional	EPM-FN3267-V00	EPM Central System	Search and Reserve Parking	The PARKAPP and PARKWEB shall not allow the reservation of on-street parking.

<b>USER NEED:</b>	<b>EPM-UN007-V01</b>	<b>USER: TRAVELER</b>
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Title: EPM Facility Access

Description: Travelers need the EPM System to provide easy and clear access information to enter the pre-paid facility and find parking as previously confirmed through the purchase and receipt of parking. When parking, the Traveler should be able to bring up the necessary access information regarding booking/reservation/payment.

Priority: Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1943-V02	Traveler Mobile Application	Transaction Log	The transaction log shall be limited to prior 3 months of transactions.

<b>USER NEED:</b>		<b>EPM-UN008-V01</b>		<b>USER: TRAVELER</b>	
<b>Title:</b>	EPM Navigation				
<b>Description:</b>	Travelers need the EPM System to provide an address for the parking facility that will automatically link to the Traveler's smartphone's mapping application. Alternatively, the EPM System can automatically link to a navigation application.				
<b>Priority:</b>	Essential				
Related Requirements, Constraints and System Interfaces					
<b>Type</b>	<b>Identifier</b>	<b>Functional Group</b>	<b>Sub-Component</b>	<b>Description</b>	
Functional	EPM-FN1946-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall use the GPS device of the Traveler's smartphone or computer to determine current location to search for parking options.	
Functional	EPM-FN1893-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.	
Functional	EPM-FN1964-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall include the ability to link to map-based navigation on the Traveler's smartphone/computer/tablet to direct the Traveler to the designated parking location	
Functional	EPM-FN1948-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall provide the Traveler the ability to search for parking options by entering a street address.	
Functional	EPM-FN1965-V01	Traveler Mobile Application	Search and Reserve Parking	Map-based navigation shall use the GPS device of the Traveler's smartphone to update the location of the Traveler on the map in real-time.	
Functional	EPM-FN1949-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall provide the Traveler the ability to search for parking options by selecting an on-street parking zone or parking loading zone.	
Functional	EPM-FN1957-V01	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP shall support mobile portrait mode (form factor).	

<b>USER NEED:</b>	<b>EPM-UN009-V01</b>	<b>USER: TRAVELER</b>
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Title:	EPM Payment Management
Description:	Travelers need to be able to set-up and manage their payment methods from the EPM mobile app or web portal.
Priority:	Desirable

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1921-V02	EPM Central System	Payment Coordination	The EPM Central System shall communicate the paid status of reservations to the PARKAPP and PARKWEB in real-time.
Functional	EPM-FN1922-V02	Traveler Mobile Application	Search and Reserve Parking	The PARKAPP and PARKWEB shall allow Travelers to pay for a specific period of parking time.
Functional	EPM-FN1980-V02	Traveler Mobile Application	Payment Processing	Travelers shall be able to pay instantly without being redirected away from the PARKAPP and PARKWEB to complete a transaction.
Policy and Regulation	EPM-RG2078-V02	EPM Central System	Payment Coordination	The EPM System shall be responsible for PCI compliance.
Policy and Regulation	EPM-RG2080-V02	EPM Central System	Payment Coordination	The EPM System shall save any PCI information as a result of a payment transaction.
Policy and Regulation	EPM-RG2081-V02	EPM Central System	Payment Coordination	The EPM vendor shall be responsible for all applicable card transaction security rules and regulations including payment card industry and data security standards (PCI DSS) compliance, all laws, and any other governing authority requirements as may apply.

<b>USER NEED:</b>	<b>EPM-UN010-V01</b>	<b>USER: TRAVELER</b>
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Title:	EPM Parking Meter Time Left
Description:	Travelers need the EPM System to provide the time left on their meter and warn them prior to expiration.
Priority:	Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1905-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall allow purchase of additional parking meter time.
Functional	EPM-FN1906-V03	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of additional parking meter time past the maximum time allowed within mobile pay zones.
Functional	EPM-FN1907-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of parking meter time when restricted parking periods are in effect.
Functional	EPM-FN1977-V02	EPM Central System	Payment Coordination	The PARKWEB and PARKAPP shall allow pre-payment of parking up to the allowable timeframe prior to paid parking operational hours.

**USER NEED:** EPM-UN011-V01 **USER: TRAVELER**

Title: EPM Parking Meter Time Extension

Description: Travelers need the EPM System to allow extension of parking time. (Extension of time will only be allowed if the initial meter purchase was less than the full amount of the time restriction.)

Priority: Optional

#### Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1905-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall allow purchase of additional parking meter time.
Functional	EPM-FN1906-V03	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of additional parking meter time past the maximum time allowed within mobile pay zones.
Functional	EPM-FN1907-V02	EPM Central System	Payment Coordination	The PARKAPP and PARKWEB shall not allow purchase of parking meter time when restricted parking periods are in effect.

**USER NEED:** EPM-UN012-V01 **USER: TRAVELER**

Title: EPM User Feedback

Description: Travelers need to be able to provide feedback on the user experience via the EPM app.

Priority: Desirable

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1950-V02	Traveler Mobile Application	Feedback	The PARKAPP and PARKWEB shall provide the Traveler the ability to submit user feedback.
Functional	EPM-FN1951-V04	Traveler Mobile Application	Feedback	The PARKAPP and PARKWEB shall provide the Traveler the ability to contact the customer care with complaints.
Data	EPM-DR2033-V02	Smart Columbus Operating System	Feedback stored in Operating System	The PARKAPP shall send Traveler feedback on the experience of using the PARKAPP to the project team.

**USER NEED: EPM-UN013-V01 USER: TRAVELER**

Title: EPM Report a Problem

Description: Travelers need the EPM System to provide an email link and phone number for the City's 311 system.

Priority: Optional

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1952-V03	Traveler Mobile Application	Feedback	The PARKAPP and PARKWEB shall provide a link to the City's 311 webpage.

**USER NEED: EPM-UN014-V01 USER: TRAVELER**

Title: EPM Anonymous Search

Description: Travelers need the EPM System to provide an anonymous user experience while searching for parking options unless they create a profile.

Priority: Optional

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN2109-V01	EPM Central System	Traveler Profile	Travelers shall not be required to create a profile to search for parking options.

**USER NEED: EPM-UN016-V01 USER: TRAVELER**

Title: EPM Guest Accounts

Description: Travelers need the EPM System to allow a Traveler to continue as a guest to the system to purchase parking without setting up an account.

Priority: Optional

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1938-V02	Traveler Mobile Application	Manage Profile	Travelers shall be able to use the PARKAPP to get parking availability information without having an EPM profile.
Functional	EPM-FN1939-V03	Traveler Mobile Application	Manage Profile	The PARKWEB shall provide Travelers with the option of creating an EPM guest account (temporary account) to book a one-time reservation.

**USER NEED:** EPM-UN017-V01 **USER: TRAVELER**

Title: EPM Probe Vehicle Data

Description: Travelers need the EPM System to use occupancy, availability and historic transaction data to gather information about the availability of loading zone and parking meter.

Priority: Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1908-V03	EPM Central System	Probability Calculation	The EPM Central System shall provide a visual indicator showing the probability of finding open on-street parking to the PARKAPP.
Functional	EPM-FN1942-V02	Traveler Mobile Application	Transaction Log	The PARKAPP and PARKWEB shall provide Travelers with access to a transaction log consisting of a history of paid parking transactions, locations, and time and date.
Information Management	EPM-IM2058-V02	EPM Central System	Administration	The City's Parking Management System shall provide parking space information (on-street parking and loading zones) to the EPM Central System via email or EPM vendor preferred methods.
Interface	EPM-IF2016-V02	EPM Central System	Administration	The EPM Central System shall provide an interface to send predictive availability information from the Operating System to the EPM Central System.

**USER NEED:** EPM-UN018-V01 **USER: PARKING OPERATOR**

Title:	EPM Parking Facility Data Accuracy
Description:	Parking Operators need the EPM data to be up-to-date in real time to maintain overall parking facility system functionality and reliability.
Priority:	Essential

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1912-V01	Gated Parking Facility System	Parking Management System	The GFAC shall confirm reservations with the EPM Central System.
Functional	EPM-FN1913-V01	Ungated Parking Facility System	Manually Collected System	The UFAC shall confirm reservations with the EPM Central System.
Interface	EPM-IF2004-V02	Parking Operator Application	Facility info and availability from OPAPP	The EPM Central System shall provide an interface to send and receive rate information, parking availability, and reservation information between the OPAPP and the EPM Central System.

**USER NEED:****EPM-UN019-V01****USER: PARKING OPERATOR**

Title:	EPM Reports
Description:	Parking Operators need the EPM System to allow them to generate reports on their parking activities.
Priority:	Desirable

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1920-V02	EPM Central System	Administration	The EPM Central System shall provide data storage and retrieval for the PARKAPP and PARKWEB.

**USER NEED:****EPM-UN020-V01****USER: PARKING OPERATOR**

Title:	EPM Parking Facility Information
Description:	Parking Operators need the EPM System to accept their static parking facility information through an API (application programming interface), mobile app or web portal.
Priority:	Essential

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1900-V03	EPM Central System	Parking Coordination	The EPM Central System shall provide access to ADA accessible parking spaces in accordance with standards for accessible design as determined by the ADA to the PARKAPP and PARKWEB.
Functional	EPM-FN1899-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide the location of electric vehicle charging stations to the PARKAPP and PARKWEB.
Functional	EPM-FN1894-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility hours of operation to the PARKAPP and PARKWEB.
Functional	EPM-FN1893-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.
Functional	EPM-FN1895-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking restrictions at each parking facility to the PARKAPP and PARKWEB.
Functional	EPM-FN1896-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking availability at each parking facility to the PARKAPP and PARKWEB.
Functional	EPM-FN1973-V01	Parking Operator Application	Facility and Availability Information	UFAC parking operators shall be able to enter and modify event rates and schedules in real-time through the OPAPP.
Functional	EPM-FN1923-V02	EPM Central System	Parking Coordination	The EPM Central System shall update the PARKAPP and PARKWEB without any system downtime or data latency when data is entered or modified in the EPM Central System via the OPAPP.
Interface	EPM-IF2004-V02	Parking Operator Application	Facility info and availability from OPAPP	The EPM Central System shall provide an interface to send and receive rate information, parking availability, and reservation information between the OPAPP and the EPM Central System.

Information Management	EPM-IM2059-V01	Parking Operator Application	OPAPP sends parking information to EPM Central System	The OPAPP shall send parking information to the EPM Central System.
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<b>USER NEED:</b>	<b>EPM-UN021-V01</b>	<b>USER: PARKING OPERATOR</b>
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**Title:** EPM Parking Facility Reservations

**Description:** Parking Operators need the EPM System to use the parking facility’s current reservation system to process any reservations and payments. All reservations made through EPM must also be recorded and synchronized with the facility owner’s parking system to maintain data integrity across systems.

**Priority:** Essential

**Related Requirements, Constraints and System Interfaces**

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1917-V02	EPM Central System	Payment Coordination	The confirmation response provided to the PARKAPP and PARKWEB shall include notice of payment completion and amount.
Functional	EPM-FN1912-V01	Gated Parking Facility System	Parking Management System	The GFAC shall confirm reservations with the EPM Central System.
Functional	EPM-FN1914-V02	EPM Central System	Payment Coordination	The EPM Central System shall provide a response to the PARKAPP and PARKWEB of a confirmed reservation.
Functional	EPM-FN1923-V02	EPM Central System	Parking Coordination	The EPM Central System shall update the PARKAPP and PARKWEB without any system downtime or data latency when data is entered or modified in the EPM Central System via the OPAPP.
Functional	EPM-FN1913-V01	Ungated Parking Facility System	Manually Collected System	The UFAC shall confirm reservations with the EPM Central System.
Functional	EPM-FN1918-V02	EPM Central System	Discounted Parking Options	The EPM Central System shall allow local merchants to offer discounted parking options through the PARKAPP.
Interface	EPM-IF2004-V02	Parking Operator Application	Facility info and availability from OPAPP	The EPM Central System shall provide an interface to send and receive rate information, parking availability, and reservation information between the OPAPP and the EPM Central System.

Functional	EPM-FN1972-V01	Parking Operator Application	Facility and Availability Information	UFAC parking operators shall be able to interface with the EPM Central System through the OPAPP.
Interface	EPM-IF2019-V01	Traveler Mobile Application	Parking availability and reservation from application	The EPM Central System shall provide an interface to send and receive parking availability and reservation information between the EPM Central System and the PARKAPP.
Functional	EPM-FN1916-V02	EPM Central System	Payment Coordination	The EPM Central System shall not provide a reservation confirmation code to PARKAPP and PARKWEB if payment is not complete.
Functional	EPM-FN1915-V02	EPM Central System	Payment Coordination	The confirmation response provided to the PARKAPP and PARKWEB shall include a reservation confirmation code.
Information Management	EPM-IM2059-V01	Parking Operator Application	OPAPP sends parking information to EPM Central System	The OPAPP shall send parking information to the EPM Central System.
Functional	EPM-FN3193-V02	EPM Central System	Discounted Parking Options	The EPM Central System shall validate the discounted parking options and provide confirmation of validation to the PARKAPP and PARKWEB.
Functional	EPM-FN3105-V01	EPM Central System	Discounted Parking Options	The PARKAPP shall provide Travelers with the ability to activate discounted parking options.
Functional	EPM-FN3272-V00	EPM Central System	Discounted Parking Options	The PARKAPP shall provide the ability for event employees to enter an access code associated with an event.
Functional	EPM-FN3273-V00	EPM Central System	Discounted Parking Options	The PARKAPP provides event employees access to appropriate parking options after entering event access code associated with that event.

**USER NEED:****EPM-UN022-V01****USER:  
CITY OF COLUMBUS  
DIVISION OF PARKING SERVICES****Title:** EPM Demand-Based Pricing**Description:** The City needs the EPM System to be capable of allowing demand-based pricing for meters in the future.

Priority:	Essential
Related Requirements, Constraints and System Interfaces	

Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1924-V02	EPM Central System	Parking Coordination	The City shall have the ability to set demand-based pricing for meters in the OPAPP, allowing rates to be increased or decreased based on demand for parking.

<b>USER NEED:</b>	<b>EPM-UN023-V01</b>	<b>USER: CITY OF COLUMBUS DIVISION OF PARKING SERVICES</b>		
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Title:	EPM Communications Reliability
Description:	The City needs the EPM System to be reliably connected through a secure and reliable communications network.
Priority:	Essential

Related Requirements, Constraints and System Interfaces	
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Type	Identifier	Functional Group	Sub-Component	Description
Interface	EPM-IF1993-V01	EPM Central System	Authentication keys supplied for API calls	Authentication keys shall be supplied for all API calls.
Security	EPM-SR2042-V01	EPM Central System	Encrypted communications within EPM Central System	Communication between external systems and EPM Central System shall operate in an encrypted (256-bit), end-to-end connection in accordance with the EPM Central System interface.
Interface	EPM-IF1992-V01	EPM Central System	Use of HTTPS to protect data in transit	The protocol for all API calls shall be HTTPS to protect data in transit.
Interface	EPM-IF1994-V01	EPM Central System	External system communications	External systems shall communicate with the EPM Central System via Internet.

<b>USER NEED:</b>	<b>EPM-UN024-V01</b>	<b>USER: CITY OF COLUMBUS DIVISION OF PARKING SERVICES</b>		
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Title:	EPM Utilization Information
Description:	The City needs the EPM System to provide usage information to the City (and other third-parties).
Priority:	Essential

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Life Cycle Sustainment	EPM-LC2066-V01	EPM Central System	Security breaches in performance reports	EPM Central System performance reports shall include security breaches.
Life Cycle Sustainment	EPM-LC2062-V01	EPM Central System	System performance reports	The EPM vendor shall provide EPM Central System performance reports on a monthly and on an ad-hoc basis.
Life Cycle Sustainment	EPM-LC2063-V01	EPM Central System	System availability in performance reports	EPM Central System performance reports shall include system availability.
Life Cycle Sustainment	EPM-LC2067-V01	EPM Central System	Attempted security breaches in performance reports	EPM Central System performance reports shall include attempted security breaches.
Life Cycle Sustainment	EPM-LC2064-V01	EPM Central System	System usage in performance reports	EPM Central System performance reports shall include system usage.
Life Cycle Sustainment	EPM-LC2065-V01	EPM Central System	Response times in performance reports	EPM Central System performance reports shall include average and percentile response times.
Life Cycle Sustainment	EPM-LC2068-V01	EPM Central System	Critical issues in performance reports	EPM Central System performance reports shall include critical issues observed during the month along with information regarding issue causes and resolutions.

**USER NEED:****EPM-UN025-V01****USER:  
CITY OF COLUMBUS  
DIVISION OF PARKING SERVICES**

Title: EPM System Reliability

Description: The City needs the EPM System to sustain a high percent of in-service (or up-) time.

Priority: Essential

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Performance	EPM-PR1985-V01	EPM Central System	Ability to measure input and output latency on servers	The EPM vendor shall be able to measure data input/output latency on their servers and provide these statistics to the City for the purpose of assessing performance against requirement EPM-PR1984-v1.
Availability and Recovery	EPM-AR2045-V01	EPM Central System	Compliance with planned maintenance requirements	The functioning of system features in compliance with planned maintenance requirements as defined in EPM-MT001-v01 shall be used to determine system availability.
Availability and Recovery	EPM-AR2043-V01	EPM Central System	System availability	The system shall provide continually available, 24-hour per day, 365-day per year operation.
Performance	EPM-PR1984-V01	EPM Central System	System to operate with minimal latency	The system shall perform with minimal discernible latency (response time of roughly 150ms or less, excluding delays in internet service not controlled by the EPM vendor).
Availability and Recovery	EPM-AR2044-V01	EPM Central System	System performance levels	The functioning of system features at performance levels as defined in EPM-PR1984-v1 shall be used to determine system availability.
Availability and Recovery	EPM-AR2047-V01	EPM Central System	Reduced availability associated with planned maintenance	Reduced availability associated with planned maintenance but falling outside the start and/or end times and dates agreed between the City and the EPM vendor, shall be considered as impacting system availability.
Availability and Recovery	EPM-AR2046-V01	EPM Central System	System availability requirements	The City shall retain the ability to determine and modify which system features are to be included or excluded from the system scope to which availability requirements are applied.
Life Cycle Sustainment	EPM-LC2070-V01	EPM Central System	QA/QC plan to define principles and processes	The QA/QC Plan shall define principles and processes the EPM vendor shall follow while developing the system.

Life Cycle Sustainment	EPM-LC2071-V01	EPM Central System	QAQC plan to identify risk management process	The QA/QC Plan shall identify the risk management process the EPM vendor shall follow, which shall define the risks and critical elements of the system development process, along with the contingency plans to address these.
Life Cycle Sustainment	EPM-LC2072-V01	EPM Central System	QAQC plan to identify system development standards	The QA/QC Plan shall identify the system development, testing, and QA/QC standards the EPM vendor shall follow while developing the system.
Life Cycle Sustainment	EPM-LC2073-V01	EPM Central System	QAQC plan to identify error collection process	The QA/QC Plan shall identify the error/defect collection and analysis process to ensure that any introduced errors shall be tracked, identified, and eliminated.
Life Cycle Sustainment	EPM-LC2074-V01	EPM Central System	QAQC plan to identify change management practices	The QA/QC Plan shall identify the change management practices the EPM vendor shall follow while developing the system, to ensure that any system development changes and associated reasons are documented.
Life Cycle Sustainment	EPM-LC2075-V01	EPM Central System	QAQC plan to identify security management process	The QA/QC Plan shall identify the security management process the EPM vendor shall follow to ensure that the system development follows secure processes and technology and the system achieves the desired security level.
Life Cycle Sustainment	EPM-LC2069-V01	EPM Central System	Provide QAQC plan for approval	The EPM vendor shall provide a Quality Assurance/Quality Control (QA/QC) Plan for approval before award of the contract.
Acceptance Testing	EPM-AT2082-V01	EPM Central System	System testing to meet all requirements	The EPM vendor shall undertake testing to demonstrate that all contract requirements have been provided.
Acceptance Testing	EPM-AT2083-V01	EPM Central System	Acceptance Test Procedures (ATP)	All testing shall be conducted according to the approved Acceptance Test Procedures (ATP).
Acceptance Testing	EPM-AT2084-V01	EPM Central System	Testing completed on the entire system	Testing shall be completed on the entire system once it has been installed and configured.

Acceptance Testing	EPM-AT2085-V01	EPM Central System	Verification of major requirements, necessary communications, and operational interfaces	At a minimum, testing shall include (as applicable): verification of major functions, and verification of necessary communications and operational interfaces.
Acceptance Testing	EPM-AT2086-V01	EPM Central System	Confirm system meets required functionality	Testing shall be completed on the system to confirm that the system meets the required functionality.
Acceptance Testing	EPM-AT2087-V01	EPM Central System	Testing witnessed by City representatives	Testing may be witnessed by City representatives (City staff and/or designated support consultants).
Acceptance Testing	EPM-AT2088-V01	EPM Central System	Submit ATP for approval prior to testing	The EPM vendor shall submit an ATP document for approval prior to undertaking testing.
Acceptance Testing	EPM-AT2089-V01	EPM Central System	ATP: address how each testable requirement will be demonstrated	The ATP shall address how each requirement will be verified, including the method for performing each test.
Acceptance Testing	EPM-AT2108-V01	EPM Central System	System Acceptance (SA)	The EPM vendor shall rectify any residual deficiencies, together with any outstanding training and documentation having been provided before the City will grant System Acceptance (SA).
Acceptance Testing	EPM-AT2107-V01	EPM Central System	Demonstration of requirements for acceptance testing	A requirement classified as having been demonstrated during a certain Acceptance Testing stage should be subsequently redefined as having been not demonstrated if compliance issues emerge prior to SA.
Acceptance Testing	EPM-AT2106-V01	EPM Central System	Formal demonstration of requirements	System Acceptance (SA) shall not be granted until all tests are complete and all requirements formally verified through Acceptance Testing.
Acceptance Testing	EPM-AT2105-V01	EPM Central System	Deficiencies as a result of testing	The EPM vendor shall rectify and retest all deficiencies as part of completing each testing stage.
Acceptance Testing	EPM-AT2104-V01	EPM Central System	Test stage approval by City	The TRD shall be approved by the City before a test stage can be considered complete.

Acceptance Testing	EPM-AT2103-V01	EPM Central System	TRD: list failures and open issues identified	The TRD shall document list of failures and open issues identified during testing along with action plan to resolve them.
Acceptance Testing	EPM-AT2102-V01	EPM Central System	TRD: identify requirements that have been demonstrated	The TRD shall document which contract requirements have been demonstrated.
Acceptance Testing	EPM-AT2101-V01	EPM Central System	TRD: document results of each ATP procedure	The TRD shall document the result of each ATP procedure.
Acceptance Testing	EPM-AT2100-V01	EPM Central System	TRD: document details of each dataset used	The TRD shall document details of the dataset used.
Acceptance Testing	EPM-AT2099-V01	EPM Central System	TRD: document software version number	The TRD shall document version number of each software system component being tested.
Acceptance Testing	EPM-AT2098-V01	EPM Central System	Test times approved by the City	The City shall approve all proposed time for testing.
Acceptance Testing	EPM-AT2097-V01	EPM Central System	Test Results Documentation (TRD)	Test Results Documentation (TRD) shall be provided upon completion of testing.
Acceptance Testing	EPM-AT2096-V01	EPM Central System	City to witness any test stage	The EPM vendor shall make appropriate provisions, so the City can witness any tests each test stage.
Acceptance Testing	EPM-AT2095-V01	EPM Central System	Notice to proceed with testing	The EPM vendor shall notify the City and receive authorization from the City to proceed with testing.
Acceptance Testing	EPM-AT2094-V01	EPM Central System	Performance of dry run tests	The EPM vendor shall perform dry-run tests prior to the formal start of any testing involving the City representatives to ensure that successful completion of the formal witnessed tests can be reasonably anticipated.
Acceptance Testing	EPM-AT2093-V01	EPM Central System	ATP: cross-reference requirements	ATP test(s) shall use cross-references to link to each requirement being tested to verify the requirement.

Acceptance Testing	EPM-AT2092-V01	EPM Central System	ATP: include test stages	The ATP shall include the test stage(s) at which each requirement will be demonstrated.
Acceptance Testing	EPM-AT2091-V01	EPM Central System	ATP: address responsibilities during each test	The ATP shall address the responsibilities of both the EPM vendor and City representatives during each test.
Acceptance Testing	EPM-AT2090-V01	EPM Central System	ATP: address results that will constitute success	The ATP shall address the results that will constitute success for each test.

<b>USER NEED:</b>	<b>EPM-UN026-V01</b>	<b>USER: CITY OF COLUMBUS DIVISION OF PARKING SERVICES</b>
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Title:	EPM Integration with Current City Systems
Description:	The City needs the EPM System to reliably work with and integrate with existing legacy parking system(s).
Priority:	Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Interface	EPM-IF2011-V02	City Parking Management System	Interface between CITYPMS and Operating System	The Operating System shall provide an interface to send meter closed/out of service information (due to event, construction, etc.), loading zone and meter location, rates, hours of operation, restrictions, and out-of-service information from the CITYPMS to the Operating System.
Interface	EPM-IF3104-V01	EPM Central System	EPM Central System integration with the CITYPMS	The EPM Central System shall provide an interface to request additional parking meter time and receive confirmation from the CITYPMS.

<b>USER NEED:</b>	<b>EPM-UN027-V01</b>	<b>USER: CITY OF COLUMBUS DIVISION OF PARKING SERVICES</b>
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Title:	EPM Expandability
Description:	The City needs the EPM System to be expandable based on the needs of the City.
Priority:	Essential

Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Interface	EPM-IF1991-V01	EPM Central System	Open architecture	APIs developed for the EPM Central System shall be open architecture.
Functional	EPM-FN1982-V01	EPM Central System	Payment Coordination	The EPM Central System shall be capable of mobile device payments by presenting a reservation ID via an optical barcode on the Traveler's mobile device screen.
Disposal	EPM-DP2051-V01	EPM Central System	System to remain operational after deployment period	The system should remain operational after the completion of the deployment period.

**USER NEED:****EPM-UN028-V01****USER:  
CITY OF COLUMBUS  
DIVISION OF PARKING SERVICES**

Title: EPM Security and Privacy

Description: The City needs the EPM System to provide security around identifying or financial information which is securely and privately collected or shared throughout the system. The collection or sharing of that information will only be done as necessary for the function of the system. Users must be able to safely and securely input information pertinent to the desired functionality without concern that the information is being used for reasons other than those necessary for the system's performance and assessment of the system's functionality.

Priority: Essential

## Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Security	EPM-SR2040-V01	EPM Central System	Secure communications	The system shall provide secure communications, including certificates management.
Security	EPM-SR2037-V01	EPM Central System	System security standards	The system shall be compliant with ISO/IEC 27000 series security standards.
Security	EPM-SR2039-V01	EPM Central System	Penetration and vulnerability testing	Security testing shall include penetration and vulnerability testing.
Security	EPM-SR2038-V01	Smart Columbus Operating System	Security testing schedule	The EPM vendor shall perform security testing to verify the system security at least once per quarter.

Security	EPM-SR2041-V01	EPM Central System	External threat assessments	The EPM vendor shall perform external threat assessment for the web portal.
Functional	EPM-FN1947-V02	Traveler Mobile Application	Parking Search	The PARKAPP and PARKWEB shall obtain affirmative express consent from the Traveler before accessing geolocation information or contact info.
Data	EPM-DR2035-V01	Smart Columbus Operating System	PII removed from data posted to Operating System	Data posted to the Operating System from the EPM Central System shall have PII obfuscated so that it may be available to third-party users.

<b>USER NEED:</b>	<b>EPM-UN029-V01</b>	<b>USER: CITY OF COLUMBUS DEPARTMENT OF TECHNOLOGY</b>		
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Title:	EPM Integration with the Operating System
Description:	The City needs the EPM to accept parking database information through the Operating System. The Operating System will be the official repository of this information from the City. The Operating System needs the EPM information provided to the Operating System so that the program may track the performance measures and activity metrics of this project and share information across projects.
Priority:	Essential

#### Related Requirements, Constraints and System Interfaces

Type	Identifier	Functional Group	Sub-Component	Description
Information Management	EPM-IM2055-V02	Smart Columbus Operating System	APIs to ingest data into EPM Central System	The EPM vendor shall be responsible for creating an API to allow the Operating System (cloud) to ingest data from the EPM Central System.
Interface	EPM-IF2015-V01	EPM Central System	EPM Central System integration with the Operating System	The EPM Central System shall provide an interface to send PARKAPP usage information from the EPM Central System to the Operating System.
Policy and Regulation	EPM-RG2076-V01	EPM Central System	API best practices	APIs developed for the EPM Central System shall be well documented and follow an established coding standard.
Policy and Regulation	EPM-RG2077-V01	EPM Central System	Open architecture	The EPM System should follow open architecture with specifications that are public as opposed to proprietary.

Interface	EPM-IF1990-V01	Smart Columbus Operating System	Operating System receives parking data from EPM Central System	The Operating System shall receive parking data from the EPM Central System.
Interface	EPM-IF1989-V01	Smart Columbus Operating System	Operating System receive parking data from CITYPMS	The Operating System shall receive parking data from the City Parking Management System.
Interface	EPM-IF2011-V02	City Parking Management System	Interface between CITYPMS and Operating System	The Operating System shall provide an interface to send meter closed/out of service information (due to event, construction, etc.), loading zone and meter location, rates, hours of operation, restrictions, and out-of-service information from the CITYPMS to the Operating System.
Data	EPM-DR2034-V01	Smart Columbus Operating System	Performance measures	The EPM Central System shall send usage data to the Operating System to generate performance measures.
Data	EPM-DR2035-V01	Smart Columbus Operating System	PII removed from data posted to Operating System	Data posted to the Operating System from the EPM Central System shall have PII obfuscated so that it may be available to third-party users.
Information Management	EPM-IM2056-V02	Smart Columbus Operating System	Operating System data transferring	Data ingested into the Operating System shall be transformed, stored, and made searchable to end-users of the system (City of Columbus and Third-Party Users).
Policy and Regulation	EPM-RG3101-V01	EPM Central System	API best practices	APIs developed for the EPM Central System should follow best practices to achieve the business needs and purposes for which they are designed.

**USER NEED:****EPM-UN030-V01****USER:  
CITY OF COLUMBUS  
DIVISION OF PARKING SERVICES**

Title: EPM Data Accuracy

Description: EPM data must be accurate to maintain overall Smart Columbus system functionality and reliability.

Priority:		Essential		
Related Requirements, Constraints and System Interfaces				
Type	Identifier	Functional Group	Sub-Component	Description
Functional	EPM-FN1900-V03	EPM Central System	Parking Coordination	The EPM Central System shall provide access to ADA accessible parking spaces in accordance with standards for accessible design as determined by the ADA to the PARKAPP and PARKWEB.
Performance	EPM-PR1985-V01	EPM Central System	Ability to measure input and output latency on servers	The EPM vendor shall be able to measure data input/output latency on their servers and provide these statistics to the City for the purpose of assessing performance against requirement EPM-PR1984-v1.
Functional	EPM-FN1899-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide the location of electric vehicle charging stations to the PARKAPP and PARKWEB.
Functional	EPM-FN1894-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility hours of operation to the PARKAPP and PARKWEB.
Functional	EPM-FN1893-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking facility location information to the PARKAPP and PARKWEB.
Functional	EPM-FN1895-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking restrictions at each parking facility to the PARKAPP and PARKWEB.
Functional	EPM-FN1896-V02	EPM Central System	Parking Coordination	The EPM Central System shall provide parking availability at each parking facility to the PARKAPP and PARKWEB.
Data	EPM-DR2035-V01	Smart Columbus Operating System	PII removed from data posted to Operating System	Data posted to the Operating System from the EPM Central System shall have PII obfuscated so that it may be available to third-party users.
Functional	EPM-FN3097-V01	EPM Central System	Administration	The EPM Central System shall provide a secure administrative account for authorized individuals at the City.

Functional	EPM-FN3098-V01	EPM Central System	Administration	The EPM Central System shall allow the administrative account to block any parking provider from using the EPM System due to abuse of policies.
Functional	EPM-FN3270-V00	EPM Central System	Administration	The EPM Central System shall provide the ability for Parking Operators to create "to be determined" events where date and time are unknown, or date is known but time has yet to be announced.
Functional	EPM-FN3271-V00	EPM Central System	Administration	The EPM Central System shall provide the ability for Parking Operators to modify "to be determined" events when date/time becomes known.

Source: City of Columbus



# Appendix D. Mapped System Interfaces

**Table 25** provides a relational mapping of each system interface to the requirements that were created based off that user defined in **Chapter 3**. This organization is intended for ease of use and quick reference during system design.

**Table 25: Mapped System Interfaces**

Interface ID	Reference	Requirement ID
EPM-IX1843-V01	Interface 1.1	EPM-IF3102-V01
EPM-IX1844-V01	Interface 1.2	EPM-IF3102-V01
EPM-IX1845-V01	Interface 1.3	EPM-IF3102-V01
EPM-IX1846-V01	Interface 1.4	EPM-IF3102-V01
EPM-IX1848-V02	Interface 2.1	EPM-IF3103-V02
EPM-IX1849-V02	Interface 2.2	EPM-IF3103-V02
EPM-IX1852-V01	Interface 3.1	EPM-IF3104-V01
EPM-IX1855-V01	Interface 4.1	EPM-IF2004-V02
EPM-IX1856-V01	Interface 4.2	EPM-IF2004-V02
EPM-IX1858-V01	Interface 4.4	EPM-IF2004-V02
EPM-IX1859-V01	Interface 4.5	EPM-IF2004-V02
EPM-IX1862-V02	Interface 5.1	EPM-IF2006-V02
EPM-IX1863-V02	Interface 5.2	EPM-IF2006-V02
EPM-IX1868-V01	Interface 7.1	EPM-IF2011-V02
EPM-IX1870-V01	Interface 8.1	EPM-IF2013-V01 EPM-IF2016-V02
EPM-IX1871-V01	Interface 8.2	EPM-IF2015-V01
EPM-IX1875-V01	Interface 10.1	EPM-IF2019-V01
EPM-IX1876-V01	Interface 10.2	EPM-IF2019-V01
EPM-IX1877-V01	Interface 10.3	EPM-IF2019-V01
EPM-IX1878-V01	Interface 10.4	EPM-IF2019-V01
EPM-IX1880-V02	Interface 11.1	EPM-IF2009-V02 EPM-IF2021-V01
EPM-IX1881-V02	Interface 11.2	EPM-IF2009-V02 EPM-IF2021-V01

Interface ID	Reference	Requirement ID
EPM-IX1882-V02	Interface 11.3	EPM-IF2009-V02 EPM-IF2021-V01 EPM-FN1921-V02 EPM-FN1922-V02

Source: City of Columbus

## Appendix E. Mapped Constraints

**Table 26** provides a relational mapping of each project constraint to the requirements that were created based off that user defined in Section 2.6. The organization is intended for ease of use and quick reference during system design.

**Table 26: Mapped Constraints**

Constraint ID	Reference	Requirement ID
EPM-CN1675-V01	Constraint 1	EPM-RG2081-V02 EPM-FN1912-V01 EPM-FN1913-V01 EPM-FN3274-V00 EPM-IM2057-V01
EPM-CN1676-V01	Constraint 2	EPM-IM2055-V02 EPM-RG2076-V01 EPM-RG2078-V02 EPM-RG2077-V01 EPM-RG2080-V02 EPM-IF1990-V01 EPM-IF1989-V01 EPM-IF2011-V02 EPM-DR2034-V01 EPM-DR2035-V01 EPM-DR2033-V02 EPM-RG3101-V01
EPM-CN1677-V01	Constraint 3	EPM-IM2054-V01 EPM-LC2048-V01 EPM-LC2049-V01 EPM-LC2050-V01 SMH-PR2275-V01

Source: City of Columbus



# Appendix F. Acronyms and Definitions

**Table 27** contains project specific acronyms used throughout this document.

**Table 27: Acronym List**

Abbreviation/Acronym	Definition
ADA	Americans with Disabilities Act
API	Application Programming Interface
AR	Availability and Recovery
AT	Acceptance Testing
ATP	Acceptance Test Procedures
CITYPMS	City Parking Management System
CoC	City of Columbus
ConOps	Concept of Operations
CPS	Common Payment System
DDS	Data Security Standards
DMP	Data Management Plan
DP	Disposal
DPP	Data Privacy Plan
DR	Data Requirements
EN	Enabling Requirements
EPM	Event Parking Management
EPM Central System	Event Parking Management Central System
EV	Electric Vehicle
FG	Functional Group
FHWA	Federal Highway Administration
FN	Functional Requirements
GFAC	Gated Parking Facility System
GIS	Geographic Information Systems
GPS	Global Positioning System
HTTPS	Hyper-Text Transfer Protocol Secured
IEEE	Institute of Electrical and Electronics Engineers
IF	Interface Requirements
IM	Information Management

<b>Abbreviation/Acronym</b>	<b>Definition</b>
IT	Information Technology
ITS	Intelligent Transportation System
LC	Life Cycle Sustainability
NF	Non-Functional Requirements
JPO	Joint Program Office
NFC	Near Field Communication
OEM	Original Equipment Manufacturer
Operating System	Smart Columbus Operating System
OPAPP	Parking Operator Application
PARKAPP	Traveler Mobile Application
PARKWEB	Traveler Website
PCI	Payment Card Industry
PII	Personally Identifiable Information
QA	Quality Acceptance
QC	Quality Control
QR	Quick Response
RTM	Requirements Traceability Matrix
RTO	Recovery Time Objective
RPO	Recovery Point Objective
RTVM	Requirements Traceability Verification Matrix
SA	System Acceptance
SC	Smart Columbus
SEMP	Systems Engineering Management Plan
SOS	System of Systems
SR	Security Requirements
ST	Storage and Transport
SyRS	System Requirements Specification
TRD	Test Results Documentation
UC	Use Case
UFAC	Ungated Parking Facility System
UI	User Interface
USDOT	United States Department of Transportation

Source: City of Columbus

# Appendix G. Glossary

**Table 28** contains project specific terms used throughout this document.

**Table 28: Glossary**

Term	Definition
311 Columbus Call Center	The City of Columbus Service Center, which is the single point of contact for requesting all non-emergency City services and is available to residents, City businesses and visitors
Agile	A method of project management that is characterized by the division of tasks into short phases of work and frequent reassessment and adaptation of plans
App	Software application
Travelers (end users)	The Travelers (residents and visitors) in Columbus who will be interacting with the EPM System to view, plan, reserve, and navigate to desired parking
Commercial-off-the-shelf system (COTS)	Software or hardware products that are ready-made and available for sale to the public
Data privacy	The reasonable expectation that data of a sensitive nature will be kept confidential, sanitized and/or encrypted, and respectfully and responsibly maintained by all users, managers, and collectors of the data
Data retention	The continued storage of data for compliance or business reasons
Data security	The tools, policies, practices, and procedures used to protect data from being accessed, manipulated or destroyed or being leveraged by those with a malicious intent or without authorization, as well as the corrective actions taken when data breaches are suspected or have been identified.
Dependency	When one Project, agency or entity requires data or functionality provided by another Project, agency or entity to meet its objectives
Enabling Technologies	An innovation that alone or paired with an existing solution produces a better end user solution at a rapid rate
Experience Columbus	An organization whose mission is to market and promote Columbus services, attractions and facilities to visitors, meeting planners, convention delegates, and residents
Failure operations	When a complete failure of the intersection occurs, primarily due to loss of power or other malfunctions
Multimodal transportation	Travel that is performed with more than one mode of transportation
Normal operations	When a signalized intersection is cycling through its pre-planned phases correctly, servicing all approaches, including pedestrian phases
Open-data	Information freely available for anyone to use and republish as they wish
Open-source concepts	The notion of open collaboration and voluntary contribution for software development by writing and exchanging programming code

<b>Term</b>	<b>Definition</b>
Original Equipment Manufacturer	Term that relates to any automotive company that manufactures parts for use in new vehicles.
Personally Identifiable Information (PII)	Information used in security and privacy laws that can be used to identify an individual, such as vehicle, traveler, and payment information
Parking facility	Land or a structure used for light-duty vehicle parking
Parking management system	A system intended to aggregate location, availability, payment information, and reservation capabilities across all public and private parking options
Procurement	The act of obtaining or acquiring goods, services or works, from a competitive bidding process
Quick Response barcode	Commonly referred to as a QR Code. A barcode that stores information that can be used for marketing or sharing information and can be read using a digital device such as a cell phone
Real-time data	Information that is delivered immediately after collection
Smart Meter	IPS Group proprietary meter and kiosk equipped with technology to collect data and make interactions easier for the end user
Smart sensors	A device that takes input from the physical environment and uses built-in technology to perform functions upon detection of specific input and then process data before passing it on
System analytics or data analytics	The analysis of data, procedures or business practices to locate information which can be used to create more efficient solutions
Systems Engineering (waterfall) approach	A linear and sequential product or software development model that includes Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation, and Maintenance phases
Third party	Organizations not affiliated with the Smart Columbus Program
Unified parking availability and reservation system	One system that would allow parking availability information and reservations for parking lots and garages without concern for lot or garage ownership

Source: City of Columbus



THE CITY OF  
**COLUMBUS**  
ANDREW J. GINTHER, MAYOR