Agenda Item 3b

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TO: Clipper® Executive Board DATE: March 21, 2016

FR: Carol Kuester

RE: Next Generation Clipper® System (C2) Request for Expressions of Interest

The current Clipper® system currently processes over 700,000 transactions daily and is available to 95% of all transit customers in the Bay Area. However, designed nearly two decades ago as one of the first contactless transit payment systems implemented in the United States, the technology landscape has advanced in such a way that brings additional capabilities that can significantly enhance the user experience for both the transit customer and the agencies managing the system. In 2013, MTC and the Clipper® agencies began preparing for an electronic fare collection system that would bring Clipper® into the next generation (C2).

MTC would like to issue a Request for Expressions of Interest (RFEI) for firms interested in participating in procurements for the C2 System Integrator, the C2 Customer Service Center, or other potential program areas. The purpose of the RFEI is not to commence a procurement process or obligate MTC and its partner agencies to procure or award a contract, but rather to identify firms interested in participating in a future C2 procurement and to refine MTC's delivery strategy through consultation with the industry. Participating in the RFEI is not required for participation in any future procurements.

**Approval**

MTC requests that the Executive Board approve the release of the RFEI on April 4, 2016. There is no fiscal impact to this approval item.

Carol Kuester

Carol Kuester

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METROPOLITAN TRANSPORTATION COMMISSION

# DRAFT

# *Request for Expressions of Interest (RFEI) for Next Generation Clipper® (C2) Regional Transit Fare Payment System Integrator and Customer Service Center*

**Release Date: April 4, 2016**

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DRAFT

# 1.0 Introduction and General Information

## 1.1 Metropolitan Transportation Commission

The Metropolitan Transportation Commission (MTC) was created by the state Legislature in 1970 (California Government Code § 66500 *et seq*.) to serve as the transportation planning, coordinating and financing agency for the nine-county San Francisco Bay Area.

## 1.2 Clipper® Program

### 1.2.1 Background

Originally called Translink®, the Clipper® system began operation in the Bay Area in 2002 and has been expanding to all participating agencies through a phased implementation. Over the next several years the system became available to more and more transit customers throughout the region, gradually gaining participation and market share. In 2010 Translink® was rebranded as Clipper® and participation climbed more dramatically; by 2013 the Clipper® agencies began preparation for a next-generation electronic fare collection system.

Today, Clipper® is available on 20 participating agencies including AC Transit, San Francisco Bay Area Rapid Transit District (BART), Caltrain, County Connection, Fairfield and Suisun Transit (FAST), Golden Gate Transit & Ferry, Livermore Amador Valley Transit Authority (WHEELS), Marin Transit, Petaluma Transit, the San Mateo Valley Transit District (SamTrans), San Francisco Bay Ferry, San Francisco Municipal Transportation Agency (SFMTA), Santa Rosa CityBus, Solano County Transit (SolTrans), Sonoma County Transit, Tri Delta Transit, Vacaville City Coach, VINE transit (Napa County), Santa Clara Valley Transportation Authority (VTA) and Western Contra Costa Transit Authority (WestCAT) (collectively, the "partner transit operators"). Clipper® is currently available to 95 percent of all transit customers in the Bay Area; however, expansion to the remaining participating agencies is planned to continue during the development of the next generation Clipper® regional fare payment system ("C2").

The current Clipper® system reliably supports over 100 fare products, calculates transfer discounts between agencies and handles complex payment functions. This includes a variety of partner transit operator-specific fare policies including flat fares on some services, distance based fares on others, tap-in only with free exit, and tap-in/tap-out; all of which co-exist and operate in the system. The region also operates a variety of employer and institutional programs and is considering how to integrate other services such as parking, paratransit, and other services to help riders in the Bay Area move effectively and seamlessly through the region.

Much of the Clipper® infrastructure is designed to require little ongoing maintenance. The current system design also emphasizes quick fare payment and auto-load features, promoting efficient boarding and convenience. While the strengths of the Clipper® system have provided the Bay Area today with a sound fare payment system, there are several opportunities for expansion, improvement and wholesale modernization. To continue supporting the mission of Clipper®, MTC and the partner transit agencies will build on the current successes of Clipper® and implement C2.

The original system was supplied by ERG Transit Systems (now Vix Technology), which was responsible for providing all of the fare collection devices and back-end transaction processing, reporting and customer service systems as a subcontractor under MTC's original TransLink® system contract with Motorola. ERG and Cubic Transportation Systems reached an agreement for the purchase or license of the ERG assets relating to TransLink® by Cubic, subject to the occurrence of certain conditions, and negotiated with MTC terms and conditions for a conformed contract that both MTC and Cubic would be willing to execute after such a purchase of ERG assets. MTC approved this approach, and Cubic took over as contractor under the Clipper® Contract in July 2009. Over time the system has evolved and now represents a blend of the original ERG systems, software and equipment, and Cubic-supplied systems, software and equipment. Additionally, agencies such as BART maintain their own fare collection equipment and systems with Clipper® devices integrated into that equipment. Under C2, MTC does not currently intend to replace existing Clipper® equipment and instead expects that any new C2 components will be integrated and work with existing transit operator infrastructure.

### 1.2.2 Next Generation

Today's Clipper® is generally well-liked by Bay Area transit customers and highly regarded among industry professionals. With more than 700,000 transactions processed on a typical weekday and a high customer satisfaction rate, the current system functions soundly. However, designed nearly two decades ago, the Clipper® system in place today was one of the first contactless transit payment systems implemented in the United States. The technology landscape has changed since then with technological advances bringing capabilities able to significantly enhance the user experience for both the transit customer and the agencies managing the system.

Generally, the desire to bring Clipper® into the next generation is two-fold. First, there is a strong desire to improve functionality with the purpose of enhancing the customer experience and usability. Second, at nearly twenty years old, the system is in need of a full scale analysis to determine which components of the system are working well and which need to be refreshed, redesigned or improved.

For example, one of the major drawbacks of the current system is the lack of real-time information and support for both the customer and the agencies. Today, funds added to the customer's account can take days to be reflected on the fare media. This can produce justifiable frustration when a customer attempts to pay a transit fare knowing they have already added funds online, but finds out at the point of payment that the funds have not yet reached their Clipper® card. Additionally, partner transit operators are looking for ways to provide real-time operational support to improve the services they provide. The process and software modifications required to reflect fare rule changes can be cumbersome and time-consuming and an improved design would allow MTC and its partner transit operators to manage change more effectively. This deficiency of not having a real-time or near real-time system for both the customers and the agencies could be resolved with a new system.

Furthermore, the Bay Area has a worldwide reputation for being at the forefront of technology innovation, and is often one of the first communities to embrace technology revolutions. The

region has expressed an interest in procuring a transit fare-payment system reflective of its innovative culture and able to adapt to a changing technological landscape. Developing a system concept grounded in this vision will allow for a C2 system able to utilize the current technological choices of the customer (e.g., mobile apps) with an eye to help position the system to be more responsive to new solutions that may present themselves years after C2 has been implemented.

Through coordination with the partner transit agencies, the public and other key stakeholders, MTC is planning for the development, implementation and operation of C2. MTC expects to issue one or more procurements to obtain a C2 System Integrator and C2 Customer Service Center (CSC) Contractor.

## 2.0 Purpose and Overview of RFEI

MTC is issuing this RFEI to receive Expressions of Interest (EOIs) from firms (Respondents) interested in participating in procurement(s) for the C2 System Integrator, the C2 CSC Contractor, or both.

Issuing this RFEI does not commence a procurement process nor does it obligate MTC to commence a procurement or award a contract. Participation in this RFEI is not required for participation in any future procurements.

The purpose of this RFEI is to refine MTC's delivery strategy through consultation with the industry. Specifically, MTC seeks detailed feedback on the technical, commercial, financial, and procurement aspects of its preferred delivery strategies, as well as industry's view on the potential benefits from and challenges of combining large remaining portions of the Clipper® program into one or more Design Build Operate and Maintain (DBOM) or similar contracts, as further detailed in this RFEI. MTC is particularly interested in opportunities for cost savings and schedule acceleration and wishes to identify key commercial and financial terms that would reduce cost, reduce risk and assist in achieving those objectives. MTC is also open to receiving feedback from the industry on other delivery models that may allow it to meet these objectives. MTC may use the feedback received from industry to update its delivery strategy and commence one or more procurements in the future.

## 3.0 Submittal of the Expression of Interest

The following summarizes the submission and format guidelines of the EOIs. In addition to the information described below, MTC may request confirmation or clarification of information furnished by a Respondent, request additional information from a Respondent concerning its EOI, request additional evidence of experience pursuant to Section 4.0, or request additional evidence of Respondent's ability to perform the work described in this RFEI. The evidence of experience and formatting requirements Respondents should meet and adhere to are detailed in Section 4.0 and Section 9.0.

EOI submittal and all communications for this RFEI must be submitted to the MTC point of contact below:

Denise Rodrigues
**Metropolitan Transportation Commission**
101 8th Street
Oakland, CA 94607
Phone: (510) 817-5897
Email: drodri@mtc.ca.gov

All contact regarding this RFEI shall be through the MTC contact person listed above only. Respondents shall neither contact nor lobby any other MTC staff, any MTC consultant, or any partner transit operator staff regarding the RFEI during the RFEI process.

Respondents should submit an original and four (4) copies, as well as one electronic PDF version, of their EOI by **4:00 p.m. on Friday, May 6, 2016**, in accordance with the instructions contained in this RFEI. EOIs are requested by the due date and time listed, but may still be considered if received after that date at MTC's sole and absolute discretion.

This RFEI and any written material submitted in response to this RFEI are subject to public inspection under the California Public Records Act (Government Code §6250 et seq.), unless exempt by law. Other than proprietary information or other information exempt from disclosure by law, the content of EOIs submitted to MTC will be made available for inspection consistent with its policy regarding Public Records Act requests.

If Respondent believes any EOI content contains trade secrets or other proprietary information that Respondent believes would cause substantial injury to the Respondent's competitive position if disclosed, the Respondent may request that MTC withhold from disclosure such proprietary materials by marking each page containing proprietary information as confidential and shall include the following notice at the front of its EOI:

> "The data on the following pages of this EOI, marked along the right margin with a vertical line, contain technical or financial information that constitute trade secrets and/or that, if disclosed, would cause substantial injury to Respondent's competitive position. Respondent requests that such data be used for review by MTC only, but understands that exemption from disclosure will be limited by MTC's obligations under the California Public Records Act. [List pages]."

Failure to include this notice with relevant page numbers shall render any "confidential/proprietary" markings inadequate. Individual pages shall accordingly not be treated confidentially. Any language purporting to render the entire EOI confidential or proprietary will be regarded as ineffective and will be disregarded.

In the event properly marked data is requested pursuant to the California Public Records Act, Respondent will be advised of the request. If the EOI requests that MTC withhold such data from disclosure and MTC complies with the Respondent's request, the Respondent shall assume all

responsibility for any challenges resulting from the non-disclosure; indemnify and defend MTC and hold it harmless from and against all claims, legal proceedings, and resulting damages and costs (including but not limited to attorneys' fees that may be awarded to the party requesting such Respondent information); and pay any and all costs and expenses relating to the withholding of the Respondent's information.

If the Respondent does not mark each page containing proprietary information as confidential, does not include the statement described above at the front of its EOI, and does not request that MTC withhold information marked as confidential and requested under the California Public Records Act, MTC shall have no obligation to withhold the information from disclosure, and the Respondent shall not have a right to make a claim or maintain any legal action against MTC or its commissioners, officers, employees or agents in connection with such disclosure.

## 4.0 Evidence of Experience

4.1 C2 System Integrator and C2 CSC

To be likely to be considered for one-on-one meetings with MTC (see Section 5.0), Respondents should demonstrate that the firm or team submitting the EOI submits the following evidence of experience.

### 4.1.1 C2 System Integrator

Experience within North America:

- Delivering and integrating at least one large, complex, multi-operator transit fare collection system using smart card technology.
- Implementing at least one account-based revenue collection system.

### 4.1.2 C2 CSC Contractor

Experience within North America:

- Operating a CSC exceeding 25,000 incoming calls per month involving product sales, customer self-service, customer account management, and customer information.
- Operating at least one commercial off-the-shelf customer relationship management system integrated with a revenue collection system.

MTC encourages Respondents who do not demonstrate the evidence of experience listed above to submit an EOI. MTC seeks any and all industry input on technical, commercial, financial, and procurement aspects of MTC's preferred delivery strategies and on the potential benefits from and challenges of combining large remaining portions of the Clipper® program into one or more DBOM or similar contracts.

4.2 Other Industry Providers

Respondents who provide other ancillary industry services, including, but not limited to, payment application providers, mobile developers, Service as a Software (SaaS) providers or other technology leaders are encouraged to submit on questions related to their area of interest but are not required to submit evidence of experience.

## 5.0 One-on-One Meetings

After receipt of the EOIs, MTC plans to conduct a series of one-on-one meetings with Respondents. The one-on-one meetings will be conducted in order to discuss and ask questions about the EOIs. Upon completion of all one-on-one meetings, MTC may prepare and share a summary of the discussions as a whole; however, individual Respondents' perspectives and comments will be treated as confidential. MTC reserves the right to use any/all information discussed in the one-on-one meetings for the purposes of developing any future procurements.

One-on-one meetings are expected to be held with those Respondents who meet the evidence of experience listed in Section 4.0 for the C2 System Integrator, the C2 CSC Contractor, or both. MTC reserves the right to hold one-on-one meetings with Respondents that do not meet the evidence of experience listed in Section 4.0, if the Respondent will provide beneficial industry input on the key goals listed in Section 6.1 below. MTC reserves the right not to hold any one-on-one meetings or to limit the number of one-on-one meetings held.

One-on-one meetings are expected to occur in May or June 2016. MTC's point of contact will schedule the one-on-one meetings with Respondents.

## 6.0 The Project

### 6.1 Overview

MTC is seeking input on potential approaches and considerations for the delivery of C2, focusing on two primary elements: the C2 system integration and the C2 CSC and its operation. MTC welcomes feedback on different or innovative approaches that have the potential to provide a more effective system, reduce cost, reduce risk and/or accelerate the schedule.

Key goals that have been defined for C2 include:

1. Provide excellent, proactive **customer service** that is efficient, intuitive and familiar.
2. Ensure transparent, efficient and cost-effective program **governance** that minimizes risk.
3. Support **data-driven operations** that are flexible, responsive, efficient and reliable.

### 6.2 C2 System Integrator

The C2 System Integrator is expected to be the entity that delivers the core fare collection and

associated systems, operates and maintains the systems and software, and manages the configuration and refresh of the system through its life cycle, and integrates and manages third party suppliers and components. The C2 System Integrator is expected to be an entity or consortium with demonstrated experience in multi-agency transit fare collection projects, with the depth of capabilities and resources needed to not only deploy C2, but operate it effectively and maintain the condition of all assets and manage supplier relationships through an expected operating phase of 10-15 years.

The C2 System Integrator is also expected to work on a partnership basis with MTC and the partner transit operators to finalize approaches to meeting C2 system requirements based both on the requirements themselves and the capabilities of the systems and suppliers brought forward by the C2 System Integrator. This concept is still under exploration and comments and concepts are invited in Section 10.

### 6.3 C2 CSC Contractor

A key objective of C2 is to deliver high quality customer service that acknowledges the way in which customers purchase products and obtain information today, and that makes maximum use of commercial or commonly used customer information systems and tools that provide a consistent, user-centric experience. MTC is considering alternative approaches for the CSC Contractor scope that could potentially include contracting with a third-party CSC operator to operate customer service systems provided by the System Integrator; contracting with a third-party CSC operator both to provide the customer service systems and to operate the CSC itself; working closely with the system integrator to integrate those systems with the core fare collection systems, or having the systems and services be provided directly by the C2 System Integrator.

### 6.4 Relationship to C2 Equipment and Other Suppliers

Prior to issuance of any RFP for C2 System Integrator services, MTC anticipates pre-qualifying selected sub-suppliers including potentially fare collection equipment suppliers and CSC Contractors. The C2 System Integrator would be required to bring suppliers from the prequalified list, and in the case of fare collection equipment suppliers would need to bring at least two alternative suppliers.

MTC anticipates that potential C2 System Integrators would be allowed to submit their own equipment or services for prequalification and would not be excluded from proposing their own equipment and services or those of other suppliers for the final RFP, provided that the suppliers have been prequalified.

## 7.0 Technical Description

C2 is envisioned as a modern, highly-modular system that is constantly refreshed and maintained current without the need for major, wholesale system changes when equipment or software reaches end-of-life or as new technologies emerge.

A draft Life Cycle Concept is attached to this RFEI as a reference document. The draft Life Cycle Concept embodies key C2 principles and concepts including:

- Maximizing self-serve options for customers to purchase fare media and obtain customer support;
- Providing, as much as possible, seamless transitions for customers and the partner transit operators moving from the current Clipper® system to C2;
- Providing effective and transparent operation and management of the system, and effective operational, financial, security and other controls;
- Providing greater capabilities for the partner transit operators to manage their own fare rules, providing consistent customer service, making better use of data, and providing choices in equipment;
- Recognizing that C2 will continue to grow and evolve over time, and that fundamental provisions should therefore be put in place to allow staged replacement of systems and devices over time to reduce the risk and impact of a "forklift" system replacement in the future; and
- Being able to proactively manage C2 through automation and data-driven decisions.

The draft Life Cycle Concept document describes, through a series of capability statements, what C2 will ultimately need to deliver in terms of the initial deployment, ongoing operation, and life cycle replacement or expansion of systems and services. Once finalized, it is the intent that the Life Cycle Concept will form the basis for subsequent requirements definition so comments and feedback on the concepts embodied therein are encouraged.

## 8.0 Cost and Schedule

MTC welcomes Respondents' input on ways to reduce whole-life-cycle costs of either or both the C2 System Integrator work scope, the C2 CSC Contractor work scope, or both, as well as strategies to accelerate schedules and/or reduce risk and delay.

## 9.0 Funding

MTC's long-term funding sources for C2 consist of federal funding, local matching funds and other operating funds. For purposes of this RFEI, Respondents should assume that federal, state and local funding will all be used.

## 10.0 Expressions of Interest

### 10.1 Formatting

MTC requests that each EOI comply with the following requirements:

10.1.1 Documents should be prepared in single-spaced type, 12 point font, on

8-1/2" x 11" sheets printed double-sided. A page is considered to be a single side of an 8-1/2" x 11" sheet. Should the Respondent wish to submit materials that benefit from larger format paper sizes such as charts, drawings, graphs and schedules then they should do so sparingly.

10.1.2 Pages should be numbered at the bottom to show the page numbers and total number of pages in the response (e.g., Page 1 of 25, Page 2 of 25, etc.).

10.1.3 MTC requests that your EOI be limited to 50 or fewer pages.

10.1.4 Brochures and miscellaneous materials should not be submitted.

10.1.5 The EOI should be divided into sections and each section be presented in the same order as they appear in this RFEI.

10.1.6 The EOI should be submitted by the due date and time listed in Section 3.0 of the RFEI, though EOIs received after that date may still be considered.

### 10.2 Transmittal Letter

The EOI should be transmitted with a letter that should specify a contact person for the Respondent. The contact information should include the following: name, title, address, email and telephone number. The transmittal letter should specify whether the Respondent is submitting its EOI individually or as part of a joint venture or consortium. If the Respondent is submitting its EOI as part of a joint venture or consortium, then it should identify all of the joint venture or consortium members, if known. Definition of a likely joint venture or consortium is not required in order to submit an EOI, however.

### 10.3 Firm Experience and Team Structure

The EOI should clearly detail how the Respondent meets the evidence of experience for the C2 System Integrator, the evidence of experience for the C2 CSC Contractor, or both, listed in Section 4.0. Respondent may also provide additional information on its relevant experience with similar projects and similar services.

To the extent that the Respondent is submitting an EOI as part of a joint venture or consortium, then the EOI shall include a description of the proposed team structure, including what strengths and experience each entity brings to the overall team.

### 10.4 Project Approach

MTC would like to know whether each Respondent is interested in bidding as the C2 System Integrator, the C2 CSC Contractor, or both, in future procurements, as well as any recommendations for improvement to delivery strategies.

The EOI shall include a description of how the Respondent will approach the applicable project

scope, how its approach will meet the goals and objectives of MTC, and the hurdles that will need to be overcome to deliver the project(s) on time and on budget.

This section of the EOI shall also include any innovative ideas for delivering one or both of the projects.

### 10.5 Responses to Questions

The majority of the EOI should respond to the questions below. MTC is very interested in the feedback provided by industry in response to these questions and encourages Respondents to respond in detail. Respondents aren't required to answer all questions, but Respondents are encouraged to answer any/all questions where they can provide industry insight and/or input.

#### 10.5.1 Procurement and Contractual Questions

1. MTC is considering a delivery strategy that would involve prequalification of potential bidders through a Request for Qualifications, followed by a Request for Proposals from pre-qualified bidders. Further, MTC is considering requiring proposers for the C2 System Integrator role to select from a pre-qualified list of providers of certain elements of the system including potentially some or all of:

    - The CSC systems and customer relationship management system;
    - The staffing and operations of the CSC; and/or
    - The supply of fare collection equipment from two or more pre-qualified providers.

    If the proposer for C2 System Integrator is on the pre-qualified list of providers in one or more of these areas, it will be permitted to propose performing that work itself. MTC is also open to requiring pre-qualification in other specialty areas that might fall under the overall C2 System Integrator scope, such as mobile payment options, customer websites, and sales networks.

    a. Please comment on this tentative delivery strategy, whether from the perspective of the C2 System Integrator, subsystem or service provider, or both. Please comment on which of the components listed above your firm would propose to provide directly or through a sub-contract or independent third party.

    b. Is the delivery strategy likely to provide benefits to the project such as overall risk reduction, minimization of whole-life costs, acceleration of schedule, and/or a better product? If so, please describe how. If not, please recommend changes to the delivery strategy and describe how those changes will better maximize innovation and provide benefits.

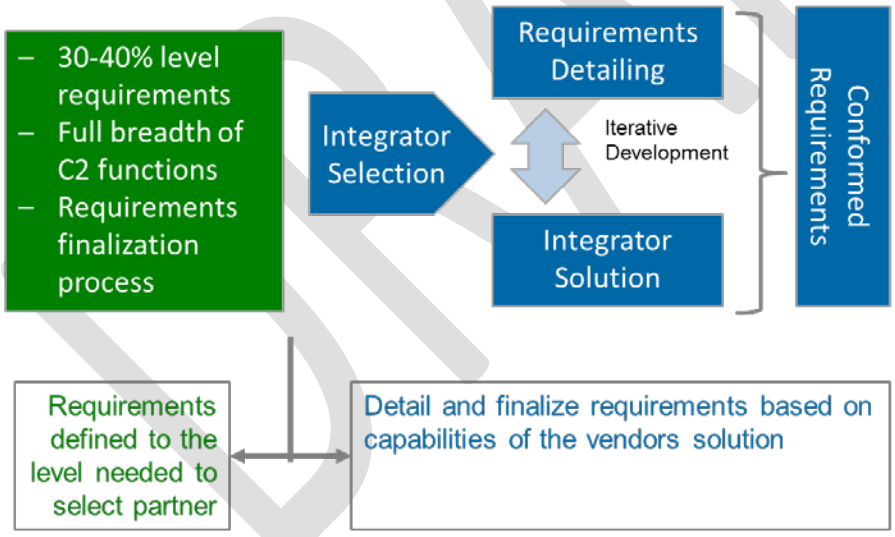
    c. Does the delivery strategy appropriately allocate the integration and interface risks associated with delivering and operating the C2 System? What are the key risks that should be borne by MTC? What are the key risks that are most appropriate to remain with the private sector? What risks should remain with the public sector, and how could they best be managed?

d. Are there any other components of the C2 System Integrator role that should be carried out by prequalified providers? If so, how will this approach help meet MTC's objectives as stated in this RFEI?

e. Does the delivery strategy as described above expand or limit potential teaming capabilities? Does it increase or reduce competition relative to a conventional design-build-operate-maintain delivery where the proposer defines its own team, if any?

f. What would you consider to be a reasonable timeframe to deliver an operating C2 system, and what would be your recommended phasing or staging strategy?

2. MTC is considering a delivery strategy that would present potential C2 System Integrator bidders with a high-level set of system requirements that would cover all aspects of system operation, but would only be to the first or second level of definition (representing roughly 30-40% of the engineering work required to complete the detailed requirements). For example, requirements related to reporting would describe that reports would be required, and would in general specify the types of reports required (e.g. ridership, revenue, audit, security, etc.), but would not specify details of what is to be provided in the reports. Such details instead would instead be determined through an iterative requirements finalization process with the System Integrator, MTC, partner transit operators, and consultant to align requirements with the capabilities of the integrator's solution as illustrated below:




The concept behind this delivery strategy is to look at ways of reducing new development work by entering into a dialogue with the C2 System Integrator to identify opportunities to use existing solutions or off-the-shelf software to reduce cost, risk or time. This would allow MTC and the partner transit operators to make informed decisions as to where new development investments should be made or where an alternative approach may satisfactorily address a fundamental need even if somewhat differently than originally anticipated.

Potential C2 System Integrators would be asked to provide an approach and a range of prices for implementation. After award, the contractor selected as the C2 System Integrator would work with MTC and the partner transit operators to finalize the system design and provide a final price for delivering the system that is within the price range proposed prior to award.

a. Please comment on this tentative delivery strategy. Is it a model that is of benefit and is likely to succeed, and does it present an acceptable risk profile to potential bidders? What provisions could be included in the contract to ensure that the successful integrator will deliver the project within the established range of prices and adequately meet the stated functional requirements?

b. Would a "design competition" prior to contractor selection be preferable to selection based on a range of prices? Under this approach, a solicitation and a selection process would be followed to identify two to four qualified C2 system integrators, and a small stipend provided for the integrators to establish a working version of their system to demonstrate how it would meet the C2 requirements.

c. Would incentives, such as shared savings where the final price is lower than the mean or median proposal price, be an appealing addition to this delivery strategy? Please describe any other incentives MTC might wish to consider.

d. How much time should be allowed for finalizing system requirements after award, and what potential does this approach offer to accelerate schedule, deliver a better product or reduce risk for both the System Integrator and MTC?

3. Clipper® equipment has primarily been provided by Cubic through MTC's DBOM contract with Cubic. MTC is considering having the C2 System Integrator identify two or more equipment suppliers from a list of prequalified equipment suppliers (see Section 6.4 for detail on that process) that will be supported through C2 back-end integration. Please comment on this tentative delivery strategy. Is it a model that is of benefit and is likely to succeed, and does it present an acceptable risk profile to potential bidders?

4. Mobile applications are increasingly in demand by customers, but the landscape and providers in this area are constantly changing. Recognizing that C2 will operate for many years and that mobile technology will continue to evolve, what approaches should be considered for both provision of C2 mobile applications and integration with mobile applications provided by others, considering not only fare transaction processing, but also mobile sales of products to reduce demands on other sales channels? What are the potential risks with opening up C2 to third party mobile providers not provided by the integrator, how could these risks be mitigated, and what would the C2 System Integrator's role be in maintaining the consistency, performance and security of those applications?

5. What is the appropriate contract term for the potential C2 System Integrator contract? Should the C2 CSC have a different contract term? Will extending or reducing either contract term allow for more appropriate sharing of risk with the private sector? Do you recommend a different delivery model than those proposed in this RFEI for the C2 System

Integrator or the C2 CSC Operator? If so, what are they and what would be the appropriate term for that/those contract(s)?

6. C2 is expected to be a flexible system that will evolve over time and at all times remain current. As such, MTC, the partner transit operators, consultants and third party developers may have a need to not only use the system, but also directly maintain and update certain elements, create derivative works, open up certain interfaces to third parties, provide some elements as open source software, and maintain the right to transfer the operations and maintenance of the system to a new Contractor at the end of the contract term. To support these needs, what software and intellectual property licensing models would you propose? Would you have any concern with granting and causing your subcontractors to grant MTC a nonexclusive, royalty-free, irrevocable, perpetual, assignable license to use, copy, modify, create derivative works based on, publish, or disclose C2 software (including without limitation source code and source code documentation for such software) for the benefit and operation of the C2 project, where MTC may exercise its license through a sublicense to a third party, without need for your further approval? If so, please explain. What restrictions would you propose be applied to any pre-existing software provided for C2?

7. MTC is considering requiring the C2 System Integrator to guarantee payment to partner transit operators of fares for rides taken on their systems using C2, perhaps subject to an annual cap. Would that be an acceptable risk for the C2 System Integrator to take on? Please comment.

8. MTC is considering alternative approaches for the CSC that could potentially include contracting with a third-party CSC operator to operate customer service systems provided by the C2 System Integrator; contracting with a third-party CSC operator both to provide the customer service systems and to operate the CSC itself; working closely with the C2 system integrator to integrate those systems with the core fare collection systems, or having the systems and services be provided directly by the C2 System Integrator. What are the potential advantages, disadvantages and risks associated with these potential approaches? Which of these approaches, or which alternative approach, might best support MTC's goals for C2 customer service as stated in this RFEI?

9. To what extent could or should the C2 system integrator and/or customer service provider be involved in the marketing, public education, or messaging regarding a new fare collection system, particularly if the new system requires or encourages changes to customer behavior? What (if any) methods or techniques have you used to identify customer needs and expectations, design or configure fare system elements to meet those needs, and accommodate the needs of special communities such as senior, disabled, unbanked, low-income, limited English proficient, and bicycle users?

### 10.5.2 Funding and Financing Questions

1. MTC has used Key Performance Indicators (KPIs) in the past to incentivize excellent service to Clipper® customers, MTC and partner transit operators. For key projects with

critical timeframes, MTC has also used financial bonuses and penalties to incentivize timely performance. MTC would also consider sharing cost savings as a result of contractor-initiated value engineering or process improvements. Please comment on the relative strengths and weaknesses of these contractual incentives and penalties if MTC's goal is excellent service to C2 customers and key stakeholders. Are there other incentives or penalties that MTC should consider, and if so, what are their relative strengths and weaknesses in light of this goal?

2. Given the delivery approach and available funding sources, is a cost incentive payment mechanism appropriate for the C2 System Integrator?

### 10.5.3 Life Cycle Concept Questions

1. The draft Life Cycle Concept assumes that multiple payment gateways will be supported with credit/debit transactions routed to a specific gateway based on partner transit operator. In some cases the C2 back end will need to communicate with multiple payment gateways depending on the operator, and in others the operator may communicate directly with the gateway without going through the C2 back end. Does this propose any particular technical or operational challenges?

2. The use of open and standardized interfaces, architecture and commercial, off-the-shelf (COTS) hardware and software is fundamental to C2, but fare collection systems deployed to date have in practice embraced open standards only to a limited degree, often confusing the adoption of true open standards and architecture with the provision of vendor-specific interface documents. Which industry standards do you believe could be applied to C2 and why? What do you see as the opportunities to use commodity or COTS hardware and devices in lieu of purpose-built transit fare collection devices?

3. In an account-based system, there is the potential to associate multiple forms of fare media with a single account, such that a rider might use a card one day, a phone the next day, and a watch or other technology another day, with all transactions posted to the same account. Is this a feature that you have or are exploring, and, if so, what advantages, disadvantages and risks does this concept pose from a customer, operations and financial controls perspective? Are there any additional risks or disadvantages in a gated, tap-in/tap-out transit operation – e.g., one form of media used to tap-in and another to tap-out, or two different customers accessing the same account?

4. Recent experience with account-based systems has highlighted certain weaknesses and risks such as first tap risk, reliance on a robust online communications network often operated by third parties, challenges with obtaining real-time transaction authorization in the times normally specified in these systems, limitations on transaction information available to customers at the point of use, and challenges with managing list sizes. What provisions can be considered by the partner transit operators to mitigate against first tap risk or management of large action lists? What do you see as the strengths, weaknesses and operational of a "post-pay" model where verification that the account is funded may not be

confirmed until after the fare transaction has occurred? How can any negative impacts on revenue or operations be mitigated?

5. Consideration is being given to implementing a "hybrid" system that would combine the best features of card-based operations (e.g. immediacy of authorization) and account-based operations (e.g. ability to centrally manage business rules and accept a variety of tokens). What do you consider to be the key advantages and disadvantages of card-based and account-based operations? From your perspective, how feasible is a hybrid approach and how would you define it considering that it could range on one end of the spectrum from writing a small amount of data to the C2 media, to running parallel operations of both card and account-based technologies on the other end of the spectrum? If both card- and account-based operations were supported, how would you reconcile transactions if both card-based payment media and account-based payment media were tied to a common central account (e.g. if a customer used both a C2 card and mobile phone for payment)?

6. How do you see tokenization of C2 fare media being implemented in both account-based and card-based operations, and what advantages and disadvantages does tokenization provide?

7. Clipper is considering limited use (LU) contactless fare media and is interested in knowing how LU tickets could be supported in an account-based, multi-agency system considering that these tickets would not likely be registered to a rider's account.

8. A key risk in any fare collection system, particularly an account-based system, is dependency on the communications network that is often provided by third parties.
    a. What communications architecture would you recommend? Would your system support a mix of communications networks with some provided through by the partner transit operators with a back-end site-to-site interface, and others with a direct connection to the C2 back-end?

    b. What performance requirements would need to be met by the communications network to support your solution given the need to communicate with buses, garages, rail stations, vending machines, gates, handheld validators, and other devices?

    c. Where would elements of the system require redundant communications to maintain operations without interrupting passenger flow?

    d. How would your system monitor device communications performance to maintain operations and mitigate against first tap risk and other impacts? How would your system provide notification to the entity responsible for the communications network segment (i.e., C2 operator or possibly a partner transit operator) of communications issues?

9. For selected partner transit operators, fare collection devices may need to first interface with an individual partner transit operator's proprietary, equipment-level back-end system, and from there to the C2 back end. Direct communications between the C2 back end and the

devices is not anticipated. Does this pose any specific concerns or challenges with respect to the operation and performance of C2?

10. BART operates a distance-based fare system where customers tap in and tap out at faregates. During peak periods individual faregates can process in excess of 30 persons per minute, and the fare for a trip can be in excess of $12. In account-based operations how would your system handle fare payment and mitigate risk of loss where the customer a) has insufficient funds in their central account to enter the system, or b) has sufficient minimum funds to enter the system but insufficient funds to pay for the full trip and exit the system? How would that process function in the event that the communications network was unable to reliably or consistently support real-time transaction authorization? How would that process function in the event of a long term (hours or days) communications interruption?

11. Are there options available for C2 customers to add value while in the fare paid zone of a gated rail system that would not require the installation of extensive infrastructure such as add-value machines?

12. The partner transit operators would like to self-manage fare prices and business rules to the extent possible. What level of self-management would be appropriate, what functions should be centralized, and what levels of control should be in place?

13. Given the experience to date with the use of open payment in the transit industry, what are your views on how applicable this technology is on a going-forward basis, particularly considering the emergence of new mobile options and token-based payment methods, and concerns and challenges regarding maintaining PCI compliance? How will proliferation of Europay MasterCard VISA (EMV) Contactless affect open payment?

14. It is anticipated that C2 will include certain financial and reporting functions such as general ledger, accounts receivable, accounts payable, maintaining a chart of accounts and reporting. What is your preferred accounting/financial system technology and/or package solution for supporting these types of features, and what are the main tradeoffs from your perspective of using an off-the-shelf accounting package, a hosted package, or a custom solution? In your system, how are accounting functions integrated with payment media management, account management, point of sale, settlement, order management, cash management, banking, collection, billing, credit card processing system reconciling, and reporting?

15. Clipper® is currently provided through a DBOM contract with Cubic. That contract currently terminates on November 2, 2019 and contemplates at least a nine-month transition to a successor system operator leading up to that date. One option MTC is interested in exploring is having the C2 System Integrator take over current Clipper® system operations and maintenance while also designing and implementing C2. Is that a viable operational strategy? If so, please describe the benefits and risks of that approach and what would be needed in any transition strategy to support such a handover.

16. A major challenge for C2 is to effect the transition of customers from Clipper® to C2 with the minimum disruption possible. This is complicated by the fact that installation of two sets of equipment (old and new) would be very challenging and potentially infeasible for

some operators, yet those same operators would need to accommodate for a period time both customers with "old" Clipper® cards and new C2 media. What approaches should be considered to minimize transition disruption? Should consideration be given to migrating existing Clipper® accounts to C2, or should customers set up new accounts in C2 and simply use up their old Clipper® funds? What are the main customer impacts that will need to be considered in the transition strategy?

17. Rail and ferry operators in the Bay Area currently operate fare collection equipment (validators, faregates, vending machines, add-fare machines, etc.) that will not be feasible to replace in C2. How would the C2 System Integrator see integrating C2 with agencies such as BART and SFMTA (Muni) that currently maintain a comprehensive fare collection system infrastructure?

18. Some regional transit operators are not currently participants in the Clipper® system but may provide service into areas where the local transit agencies are equipped to accept Clipper®. What features or functions should be considered in C2 to accommodate transfers from partner transit operators that are equipped with C2 validation devices to other regional transit operators that are not (and vice versa)? Examples include transfers from VTA or BART to Capitol Corridor or the Altamont Corridor Express services that are not currently equipped to accept Clipper®.

19. Many bus operators are deploying advanced onboard systems that interface all onboard devices with a common communications platform, while other bus operators have no communications platform. How would communications options for different types of bus operators be provided?

20. Handheld inspection and fare payment devices continue to be a challenge to procure and maintain in fare collection projects. What opportunities and risks do you see to using readily-available iOS, Android or other devices for fare inspection and, in some cases, fare processing?

21. Each partner transit operator will need to be able to validate fare sales and use on their system against that reported by the central system. How would your system support this?

22. Increasingly services and products are available "as a service". Examples include software, data storage, and business process as a service. Which of the capabilities identified in the draft Life Cycle Concept could MTC consider acquiring "as a service" and why?

23. Customers can currently use Clipper® cards to pay for parking at certain partner transit operator parking facilities, and the region is interested in using C2 for bikeshare and other select third-party services. What has been your experience with including such third-party services in a fare collection system and how realistic is it to expect a transit fare payment system to handle these ancillary services? What are the key trade-offs or impacts to be considered such as cost, delivery time or risk?

24. The C2 retail network will play an important role in the successful adoption of C2 by transit users in the Bay Area; however the approach of providing dedicated hardware reload devices is not being considered due to the cost and effort associated with installing and

maintaining them. C2 is instead considering either a "bring your own device" approach where a secure sales and reload application is loaded on a tablet computer provided by the retailer, or using a third party gift card or other point of sale network service. What are the opportunities and challenges associated with both of these options, and what does the integrator envision as the best approach for C2 to maximize retail coverage throughout the Bay Area? Are there any specific concerns or challenges with the "bring your own device" concept?

25. What mechanism do you recommend for offering targeted, time-limited, promotional fares? In the context of special family or group fares, what are the technical options, if any, to confirm that families or groups are traveling together? For example, are there any options for families or groups to link their accounts to qualify for special offers when they travel together?

#### 10.5.4 Cost and Risk Questions

1. Describe how either or both of the delivery strategies described in questions 1 and 2 under 10.5.1, Procurement and Contractual Questions, could be leveraged to reduce costs, speed delivery, or both. Are alternative delivery strategies more likely to reduce costs or speed delivery of the C2 project? If so, please provide examples, where possible, of analogous projects and their cost and/or schedule savings from such delivery model(s).

2. How either or both of the delivery strategies described in questions 1 and 2 under 10.5.1, Procurement and Contractual Questions, compare to individually procuring all components for the system (i.e., one DBOM)? Please discuss design costs, operating/maintenance/lifecycle costs, and schedule implications.

3. For each project component, are there any technical changes to the respective scope of work that would yield cost savings and/or schedule acceleration while still achieving MTC's objectives? If so, please describe.

4. MTC and the partner transit operators are interested in understanding opportunities for reducing the lifecycle cost of the C2 program. What are the main cost drivers for this type of fare payment system, how does your solution collect data on those to better monitor them, and how does it help minimize them? What mechanisms or incentives should be considered to promote efficiencies and cost savings over the life of the system?

5. What opportunities do you see for using third-party and open source applications to deliver C2 more effectively?

### 10.6 Conflict of Interest

Identify any conflicts of interest, based on a review of MTC's Organizational Conflict of Interest Policy (see reference documents), and describe how such conflicts were and/or will be mitigated for purposes of this RFEI. If none, state "Not Applicable."

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## 11.0 MTC's Standard Procurement Policies

Respondents are advised to review the following specific MTC and Clipper®-specific policies and agreements, as they are likely to be included in or factored into the terms and conditions of any contract resulting from any future procurement issued by MTC:

1. Disadvantaged Enterprise Program
2. MTC's Organizational Conflicts of Interest Policy
3. MTC Resolutions 3866 and 3983
4. Amended and Restated Clipper® Memorandum of Understanding
5. Applicable Federal and State Contracting Requirements
6. Draft Life Cycle Concept

Links to these documents are provided in the Reference Documents section of this RFEI.

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## REFERENCE DOCUMENTS

| Reference Documents | Link |
|---|---|
| **Funding and Governing Statutes/Agreements** | |
| Amended and Restated Clipper® Memorandum of Understanding | |
| **Informational Documents** | |
| Draft C2 Concept of Operations and Lifecycle Concepts | |
| **MTC Resolutions** | |
| MTC Resolution 3866 | |
| MTC Resolution 3983 | |
| **MTC Procurement Documents** | |
| Disadvantaged Business Enterprise (DBE) Program | http://mtc.ca.gov/sites/default/files/DBE_Triennal_Report_FY_13-14.pdf |
| Organizational Conflicts of Interest Policy | |
| Applicable Federal Requirements | |
| | |



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Technical Memorandum

# C2 Concept of Operation and Lifecycle Concepts

## DRAFT for RFEI

Prepared for the Metropolitan Transportation Commission (MTC)
by IBI Group
The ALCO Group Ltd, ALINC Consulting Inc., HDS Consulting Ltd, The Transport Group, Wardley Consulting Group
March 17, 2016

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# Client Approval

| | |
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# Table of Contents

# Table of Contents (continued)

## List of Figures

# 1 Executive Summary

## 1.1 Introduction, Goals and Principles

This document presents the Draft Concept of Operations and Lifecycle Concept (the Concept) for the next generation Clipper® (C2) automated fare collection (AFC) system. C2 will be a customer-focused, cost-effective fare-collection system that supports a modern, consistent, and seamless transit experience in the Bay Area providing a flexible platform for improving future regional efficiencies delivered through a collaborative partnership between operating agencies, the Metropolitan Transportation Commission (MTC), and the private sector. Its primary purpose is to describe in narrative format the *capabilities* C2 will need to provide in order to meet these goals—that is, describing "what" functions and services will need to be delivered, but not specifically "how" they are to be built and delivered. The "how" will come later in the form of technical requirements; system designs; and, ultimately, the hardware, software, systems, people, and operations required to deliver, operate and maintain C2.

Goals defined for C2 to-date include the following:

1. Provide excellent, proactive **customer service** that is efficient, intuitive and familiar.
2. Ensure transparent, efficient, and cost-effective program **governance** that minimizes risk
3. Support **data-driven operations** that are flexible, responsive, efficient, and reliable

Key principles embodied throughout the Draft Concept supporting those goals include the following:

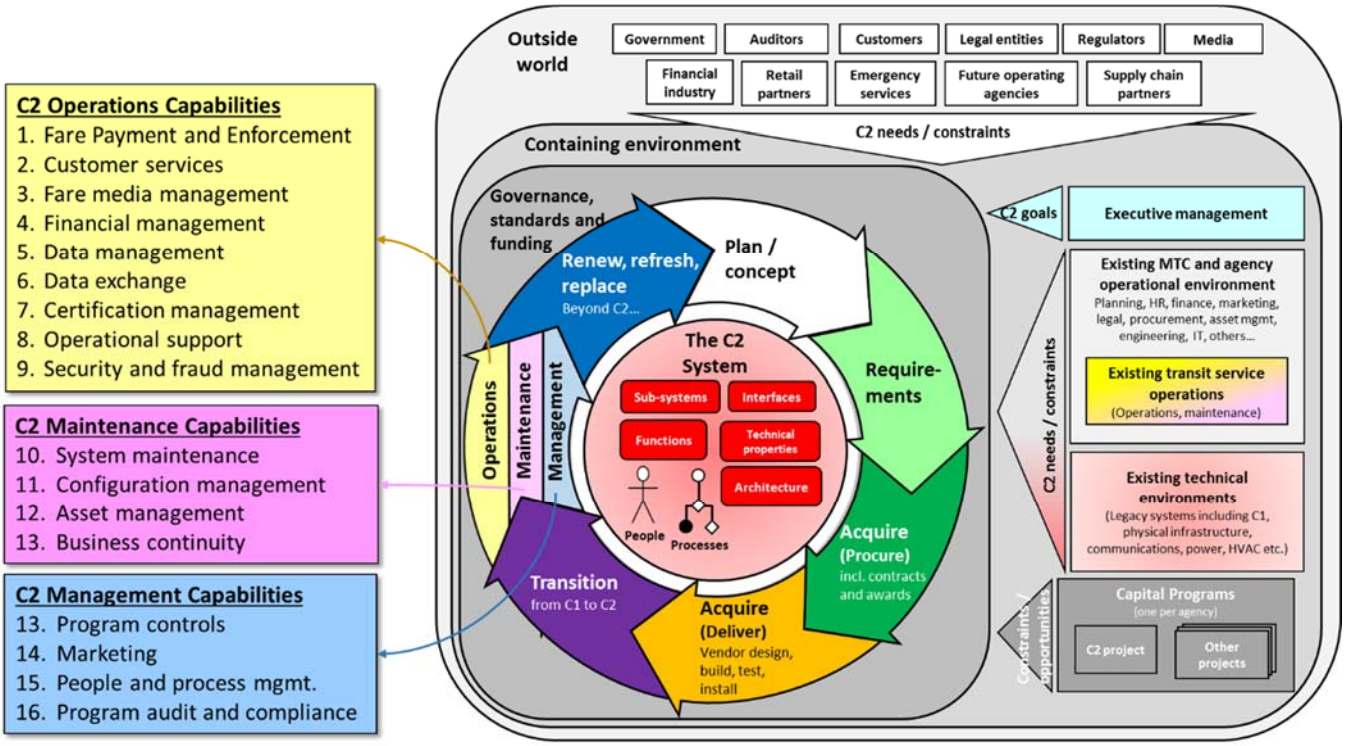
- Provide **self-serve options** for customers to purchase fare media and obtain customer support in order to manage demands on staffed facilities.
- Manage the impact on customers and the partner agencies of moving from the current Clipper® system to C2.
- Make improvements needed to address customer issues, improve system management and transparency, and provide greater flexibility to accommodate new and emerging technologies.
- Provide greater capabilities for the partner agencies to manage their own fare rules, provide consistent customer service, make better use of data, and provide choices in equipment.
- Recognize that C2 will continue to grow and evolve over time, and that fundamental provisions should therefore be put in place to allow staged replacement of systems and devices over time to reduce the risk and impact of a "forklift" system replacement in the future.
- Support proactive management of C2 through automation and data-driven decisions.
- Provide a system that balances innate desires for the latest and greatest technologies with the practicalities of cost, risk, and complexity.

## 1.2 The Lifecycle Concept

This Concept of Operations and Lifecycle Concept document goes beyond typical fare collection concept of operations documents that are often little more than descriptions of the physical elements of the system to be provided and/or that focus on the initial build of a system without due consideration for all of the activities that need to occur later in the life of the system. It is

intended to provide a point of reference for later design and development activities, as well as act as a "living" document that can evolve as needs and requirements are refined over time.

The diagram below represents the body of information contained within the Concept.

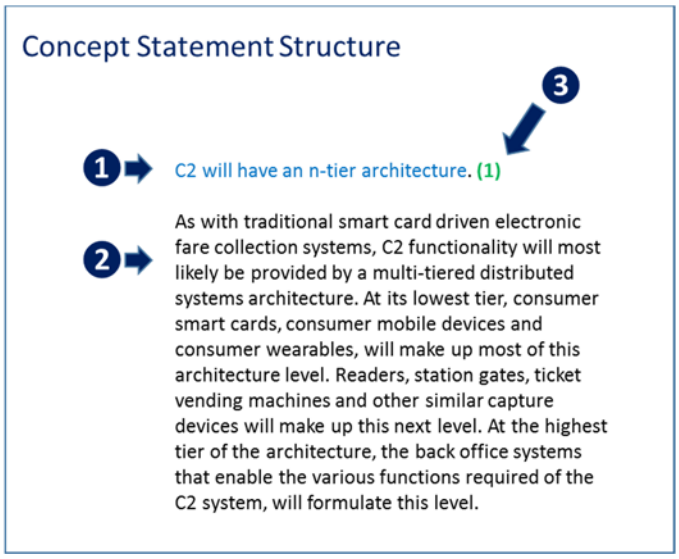



The boxes to the left represent the fundamental, or top-level capabilities, C2 will need to deliver organized in terms of operations, maintenance, and management. These have been further decomposed into more detailed capabilities as described in the body of the Concept and will form the basis for subsequent development of technical, functional, and other requirements.

The "containing environment" describes the full scope of C2 that will need to be delivered, considering not only the functions, services and systems to be provided by the C2 systems, but also how C2 fits within the program environment of MTC and the partner agencies. The larger "outside world" box acknowledges that C2 will need to interact with many outside actors and entities. Ultimately these interactions will form the basis for interface requirements and specifications documents.

## 1.3 Concept Statements

This Concept document contains a series of concept statements organized around operations, maintenance, management, and lifecycle concepts. The general structure of each of these are as follows:




1. Each concept begins with a summary statement of a key attribute to be delivered by C2.
2. Below the summary is a narrative description of what that concept is expected to be or provide
3. These are codes related to current levels of certainty around the concept: **(1)** identifies a concept with a high degree of certainty; **(2)** identifies a likely assumption at this time and **(3)** identifies a risky assumption where there are still decisions to be made.

The concepts and capabilities as described will form the basis for the system requirements, and will be traced throughout the design, development and testing of C2 to confirm that at all points in the process the expected outcomes are being achieved.

# 2 Project Background

Through partnership with the regional transit agencies, and in coordination with the public and other key stakeholders, the Clipper® Executive Board is planning for the development, implementation and operation of the second generation Clipper® regional fare payment system (C2).

The current vendor contract for the Clipper® program expires in 2019, and its equipment and back office are due for replacement. Updates to the system are required to sustain the program. The participating operators (partner agencies) are seeking a new contract, new technology, and a more effective level of service while preserving the reusable components and the brand of the current program. They are seeking a smooth transition, a cost effective solution, and a collaborative vendor relationship for continued future success.

This section provides background information for the Clipper® Next Generation Fare Collection System project to provide context for the C2 concepts included.

## 2.1 Clipper® History

Originally called Translink, the Clipper® system began operation in the Bay Area in 2002 and has been expanding to all participating agencies through a phased implementation. Over the next several years the system became available to more and more transit customers throughout the region, gradually gaining participation and market share. In 2010 Translink was rebranded as Clipper® and participation climbed more dramatically; by 2013 the Clipper® partner agencies began preparation for a next-generation electronic fare collection system.

Across the Bay Area as of 2014, Clipper® was accepted at approximately 4,700 bus validation devices and over 800 fare gates and other rail validators. Customers could load value or fare products at nearly 700 ticket vending machines.

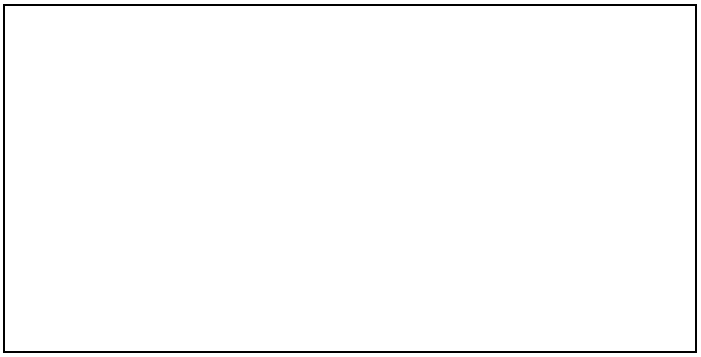


Figure 1: Clipper® program partner transit agencies

Today, over 1.4 million Clipper® cards are in circulation, making 700,000 trips per day across 20 transit agencies throughout the Bay Area including AC Transit, Bay Area Rapid Transit (BART), Caltrain, Golden Gate Transit & Ferry, San Francisco Municipal Transportation Agency (SFMTA), San Mateo Valley Transit District (SamTrans), Valley Transportation Authority (VTA), San Francisco Bay Ferry, Marin Transit, Fairfield and Suisun Transit (FAST), VINE Transit (Napa County), Solano County Transit (SolTrans), Vacaville City Coach, The County Connection (CCCTA), Tri-Delta Transit, WestCAT, WHEELS, Petaluma Transit, Santa Rosa CityBus, Sonoma County Transit. Two additional partner agencies, Union City Transit and the Sonoma-Marina Area Rail Transit District (SMART) are expected to launch in 2016, bringing the total number of partner agencies to 22 and making Clipper® available to 95 percent of all transit customers in the Bay Area.

The current Clipper® system reliably supports over 100 fare products, calculates transfer discounts between agencies and handles complex payment functions. This includes a variety of operator-specific fare policies including flat fares on some services, distance-based fares on others, tap-in only with free exit, and tap-in/tap-out; all of which co-exist and operate in the system. The region also operates a variety of employer and institutional programs and

is considering how to integrate other services such as parking, paratransit, and other services to help riders in the Bay Area move effectively and seamlessly through the region.

Much of the Clipper® infrastructure is designed to require little ongoing maintenance. The current system design also emphasizes quick fare payment and auto-load features, promoting efficient boarding and convenience. While the strengths of the Clipper® system have provided the Bay Area today with a sound fare payment system, there are several opportunities for expansion, improvement and wholesale modernization. To continue supporting the mission of Clipper®, MTC and the regional agencies will build on the current successes of and implement C2.

The original system was supplied by ERG Transit Systems (now Vix Technology) who were responsible for providing all of the fare collection devices and back-end transaction processing, reporting and customer service systems. Cubic Transportation Systems (Cubic) now operates and maintains the system which over time has evolved and now represents a blend of the original ERG systems, software and equipment, and CTS-supplied systems, software and equipment. Additionally, agencies such as BART maintain their own fare collection equipment and systems with Clipper® devices integrated into that equipment. C2 is not intending to replace that equipment, and instead expects that any new C2 components will be integrated and work with existing transit operator infrastructure.

## 2.2 C2 Project Motivation

Today's Clipper® is generally well-liked by Bay Area transit customers and highly regarded among industry professionals. With more than 700,000 transactions processed on a typical weekday and a high customer satisfaction rate, the current system functions soundly. However, designed nearly two decades ago, the Clipper® system in place today was one of the first contactless transit payment systems implemented in the United States, and the technology landscape has changed since then with technological advances bringing capabilities able to significantly enhance the user experience for both the transit customer and the agencies managing the system.

Generally, the desire to bring Clipper® into the next generation is two-fold. First, there is a strong desire to improve functionality with the purpose of enhancing the customer experience and usability. Second, at nearly twenty years old, the system is in need of a full scale analysis to determine which components of the system are working well and which need to be refreshed, redesigned or improved.

For example, one of the major drawbacks of the current system is the lack of real-time information and support for both the customer and the agencies. Today, funds added to the customer's account could take days to be reflected on the fare media. This can produce justifiable frustration when a customer attempts to pay a transit fare knowing they have already added funds online but finding out at the point of payment that the funds have not yet reached their Clipper® card. Additionally, transit agencies are looking for ways to provide real-time operational support to improve the services they provide. The process to reflect fare rule changes is cumbersome and time-consuming and an improved design would better allow MTC and its partner agencies to effectively manage change.

Furthermore, the Bay Area has a worldwide reputation for being at the forefront of technology innovation, and is often one of the first communities to embrace technology revolutions. However, the Clipper® system today is based on an outdated architecture with proprietary data and interface formats that limit the flexibility, evolution, and development of the current Clipper® system. The region has expressed an interest in procuring a transit fare-payment system reflective of its innovative culture and able to adapt to a changing technological landscape. Developing a system concept grounded in this vision will allow for a C2 system able to utilize the current technological choices of the customer (e.g., mobile apps) with an eye to help position the system to be more responsive to new solutions that may present themselves years after C2 has been implemented.

# 3 C2 Overview

## 3.1 C2 Purpose and Goals

### 3.1.1 C2 Purpose

Based on the analysis performed in developing this document, the following overall purpose statement for C2 has been developed, using the C2 'vision' statement as its starting point:

"The next generation Clipper® system (C2) is a customer-focused, cost-effective fare-collection system that supports a modern, consistent and seamless transit experience in the Bay Area, providing a flexible platform for improving future regional efficiencies, delivered through a collaborative partnership between operating agencies, MTC and the private sector"

### 3.1.2 Clipper® Program Goals

The Clipper® Memorandum of Understanding (MOU) defines the following seven top-level program goals:

1. Provide an intuitive, efficient and familiar experience
2. Provide excellent, proactive customer service
3. Create a transparent, consistent, inclusive and timely decision-making process
4. Govern the program efficiently and cost-effectively
5. Ensure that accurate and complete data is available to support decision making at every level
6. Ensure program flexibility and responsiveness
7. Ensure operational efficiency and reliability

## 3.2 The C2 Lifecycle and Whole-System Context

All systems have a lifecycle, or a series of stages through which a system passes, including those necessary to plan, design, procure, build, test, install, operate, maintain, and eventually dispose of the system.

C2 has the following lifecycle stages:

- **Planning/Concept** in which key C2 concepts are developed. This stage started with the planning phase efforts and produced this concept document.
- **Specifications** in which requirements (technical and business) are developed based on the concepts, and specifications are generated to hold the requirements and allow C2 to be acquired and delivered.
- **Acquisition**, which is the end-to-end set of activities that delivers C2 ready for transition to the operational environment. Acquisition is comprised of two main stages, procurement and delivery, defined as follows:
    - **Procurement** in which the specification is released to the market with the request for proposals documents and a preferred C2 system integrator is selected and contracted with.

- **Delivery** in which the chosen vendor converts the description of C2 held in the specification into outputs (typically hardware, software, and documentation) that have been proven to operate as required through testing and are installed in the operational environment but are not yet in use.

- **Transition** in which the delivered C2 system is transitioned to revenue operations, and the original Clipper® system is phased out of operations.
- **Operational** in which C2 is operated, maintained, and managed in a live revenue environment
- **Renew, refresh, replace** in which C2 (or parts of C2) reaches the end of its life and is renewed, refreshed, and replaced, either whole or in part.

The **C2 system** includes the sub-systems arranged in an architecture with interfaces between them, each with different functions and technical characteristics. The system also includes the people and business processes that enable it to meet its requirements.

All stages of the C2 lifecycle and the system itself will be governed by the defined program **governance** agreements**,** any applicable **standards**, and program **funding** arrangements. C2 itself will live within a complex multi-agency **containing environment** that places goals, needs, and constraints on the C2 system throughout its lifecycle. The containing environment itself is situated within an **outside world** of customers, auditors, regulators, and other external stakeholders that also place needs and constraints on C2 throughout its lifecycle.

This document provides more than just a Concept of Operations. While it does include operation concepts, it also includes concepts across the entire lifecycle, including maintenance, management, acquisition, transition, and renew/replace/retire. The following diagram summarizes this lifecycle concept and whole-system context described above.

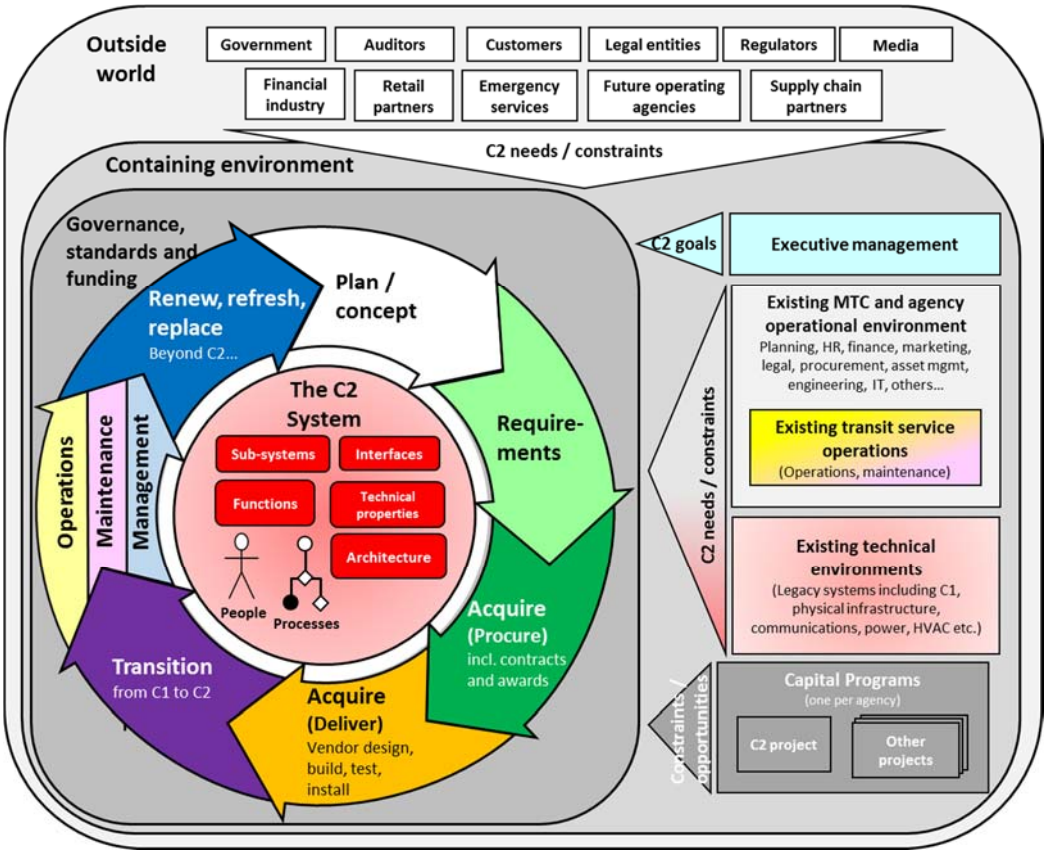
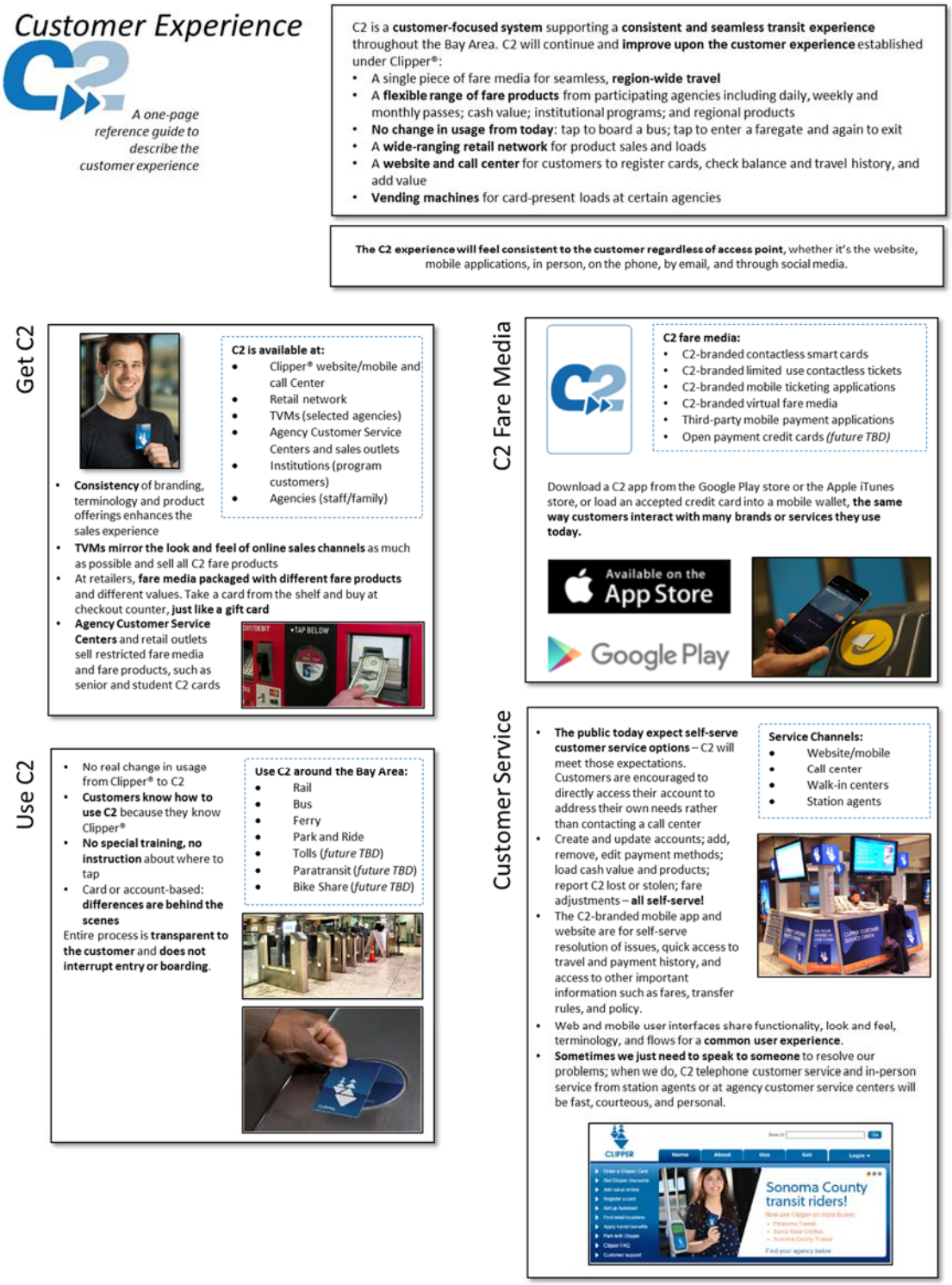



Figure 2: C2 Lifecycle and Whole-system View

## 3.3 Customer Experience Summary

C2 is a customer-focused system that builds on the successes of Clipper® to achieve a consistent user experience, regardless of geographical region, customer type, mode of travel, or customer service channel. The following figure describes the customer experience envisioned for C2 in the areas of obtaining and using the various forms of fare media accepted in the system, and the types of customer service available to the customer.



## 3.4 C2 on a Page

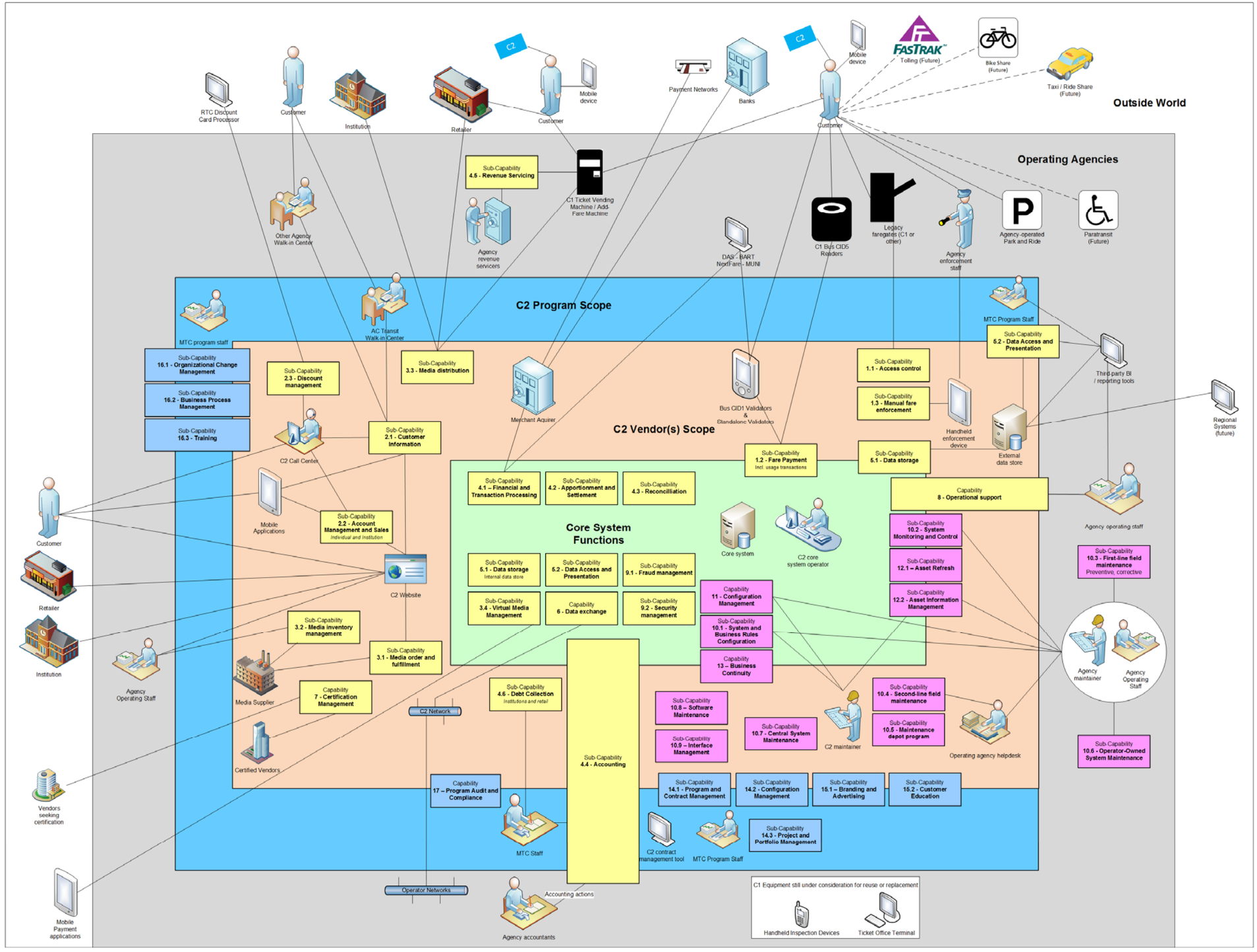
The diagram on the following page provides a rich picture of C2 that provides a useful tool to help understand C2, the capabilities that comprise it, and the major systems, and actors that will either be part of it or interface to it.

The diagram depicts the major capabilities required from C2 and are shown in three colors, which also match the color-coding on the Business Functions diagram later in this document:


Capabilities shown straddling two or more layers are a shared responsibility of those layers it straddles.

The figure consists of five layers, working out from the center:

1. **Core System (GREEN layer)** – This layer consists of operational and maintenance capabilities that will be delivered through a C2 core system. These functions represent the heart of C2.
2. **C2 Vendor Scope (ORANGE layer)** – The C2 acquisition strategy recommends a multi-vendor delivery coordinated by an overall systems integrator. Items in this layer represent capabilities for which various C2 vendor(s) are responsible. The Core System layer is a subset of the C2 Vendor Scope.
3. **C2 Program Scope (BLUE layer)** – Items in this layer are part of the overall C2 scope and are typically, but not exclusively, the responsibility of staff from the Clipper® Contracting Agency (currently MTC). This layer includes program controls, change and business process management, training and customer education, and branding and marketing.
4. **Partner Agencies (GRAY layer)** – This layer largely consists of the partner agency (transit operator) staff who will work with C2, including accountants, maintainers, station staff, enforcement officers, and revenue maintainers. It also includes any legacy equipment reused in C2 or systems for which an agency is responsible.
5. **Outside World (WHITE layer)** – This outermost layer includes customers, financial institutions, retailers, and other actors who use or participate in C2 but are not connected to a C2 system integrator, MTC, or any of the partner agencies.


Outside World
RTC Discount Card Processor
Customer
Institution
Retailer
C2
Mobile device
Payment Networks
Banks
FASTRAK
Tolling (Future)
Bike Share (Future)
Taxi / Ride Share (Future)
Operating Agencies
Other Agency Walk-in Center
Sub-Capability 4.6 - Revenue Servicing
Agency revenue servicers
C1 Ticket Vending Machine / Add-Fare Machine
DAS - BART NextFare - MUNI
C1 Bus CID5 Readers
Legacy faregates (C1 or other)
Agency enforcement staff
Agency-operated Park and Ride
Paratransit (Future)
C2 Program Scope
MTC program staff
AC Transit Walk-in Center
MTC Program Staff
Sub-Capability 6.2 - Data Access and Presentation
Third party BI / reporting tools
Regional Systems (future)
Sub-Capability 16.1 - Organizational Change Management
Sub-Capability 16.2 - Business Process Management
Sub-Capability 16.3 - Training
Sub-Capability 2.3 - Discount management
Sub-Capability 3.3 - Media distribution
Merchant Aquirer
Bus CID1 Validators & Standalone Validators
C2 Vendor(s) Scope
Sub-Capability 1.1 - Access control
Sub-Capability 1.3 - Manual fare enforcement
Handheld enforcement device
External data store
C2 Call Center
Sub-Capability 2.1 - Customer Information
Sub-Capability 1.2 - Fare Payment
Incl. usage transactions
Sub-Capability 5.1 - Data storage
Capability 8 - Operational support
Agency operating staff
Sub-Capability 4.1 – Financial and Transaction Processing
Sub-Capability 4.2 - Apportionment and Settlement
Sub-Capability 4.3 - Reconciliation
Core System Functions
Core system
C2 core system operator
Sub-Capability 10.2 - System Monitoring and Control
Sub-Capability 10.3 - First-line field maintenance
Preventive, corrective
Mobile Applications
Sub-Capability 2.2 - Account Management and Sales
Individual and Institution
Sub-Capability 5.1 - Data storage
Internal data store
Sub-Capability 5.2 - Data Access and Presentation
Sub-Capability 9.1 - Fraud management
Sub-Capability 12.1 – Asset Refresh
Sub-Capability 12.2 - Asset Information Management
C2 Website
Customer
Retailer
Institution
Sub-Capability 3.4 - Virtual Media Management
Capability 6 - Data exchange
Sub-Capability 9.2 - Security management
Capability 11 - Configuration Management
Sub-Capability 10.1 - System and Business Rules Configuration
Capability 13 – Business Continuity
Agency maintainer
Agency Operating Staff
Sub-Capability 3.2 - Media inventory management
Sub-Capability 3.1 - Media order and fulfillment
Media Supplier
Agency Operating Staff
Capability 7 - Certification Management
Sub-Capability 4.6 - Debt Collection
Institutions and retail
Sub-Capability 4.4 - Accounting
Sub-Capability 10.8 – Software Maintenance
Sub-Capability 10.9 – Interface Management
Sub-Capability 10.7 - Central System Maintenance
C2 maintainer
Sub-Capability 10.4 - Second-line field maintenance
Sub-Capability 10.5 - Maintenance depot program
Operating agency helpdesk
Sub-Capability 10.6 - Operator-Owned System Maintenance
C2 Network
Certified Vendors
Capability 17 – Program Audit and Compliance
Sub-Capability 14.1 - Program and Contract Management
Sub-Capability 14.2 - Configuration Management
Sub-Capability 15.1 – Branding and Advertising
Sub-Capability 15.2 - Customer Education
Vendors seeking certification
MTC Staff
C2 contract management tool
MTC Program Staff
Sub-Capability 14.3 - Project and Portfolio Management
Operator Networks
Accounting actions
Agency accountants
Mobile Payment applications
C1 Equipment still under consideration for reuse or replacement
Handheld Inspection Devices
Ticket Office Terminal

## 3.5 Technical Concepts

This section provides an overview of the potential systems architecture and technical structural framework of the C2 system.

### 3.5.1 The Fare Payment Technical Landscape

With electronic payments technology rapidly evolving, and the convergence of payments with mobile and wearable appliances, the technical framework for C2 will be based upon an approach of open systems and open architecture to enable modularity, flexibility, and adaptability. The underlying foundation of the open systems and open architecture approach is to build a C2 infrastructure that will adapt to the continuing evolution of technology. The use of open public, non-proprietary interfaces and standards will provide the mechanism from which to achieve this approach, when and where available.

The technical framework is also based upon the policy and operating environment in which C2 will need to exist. Each transit operator maintains its own fare policy and products designed to serve the needs of its customers. Some agencies operate a pay-on boarding system, some operate a distance based system, and some are open proof-of-payment while others are gated. While stored value represents the “common regional currency” currently used by many Clipper® users, employer passes and other products exist as well to fulfill the needs of specific customer market segments and these must be supported by C2. Additionally, fare policy in the region continues to evolve and new operator-specific, regional or other products and discounting structure are likely to emerge in the future that will need to be supported by C2.

As a backdrop to the technical framework, understanding the emerging trend in the customer’s everyday life of continued penetration of smart phones. This technology, as reported by IDC on July 23, 2015, represent approximately 75 percent of all mobile phones worldwide. According to a Gartner study on November 19, 2015, 84.7 percent of all smart phones are Android based with another 13.1 percent running Apple. As suggested in both reports, the percentage of smart phones will only increase.

Both Android and Apple utilize near field communication (NFC) technology for triggering payment, the C2 customer usage concept will be based on the use of mobile devices and wearable devices as one of the primary methods of fare payment, in addition to the continued use of plastic Clipper® cards. Further, with the introduction and deployment of mobile payment solutions such as Apple Pay, Samsung Pay, Android Pay, private label closed loop schemes, and others, customer mobile devices will likely become a mainstay in customer payments and may eventually supersede the customers’ plastic card.

Customers with smart phones will download and/or set up their mobile devices with an appropriate app from either the Google Play store or the Apple iTunes store, or the loading of an appropriate card into their phone’s wallet. Upon setup, the customer will be responsible for registering a payment account, funding a payment account, or including a valid payment card.

Upon successful registration and/or linkage of an appropriate payment means, a customer with an NFC-enabled smart phone, and the appropriate app or included payment card, can use their smart phone as a fare payment means. To facilitate payment, the customer would ensure the appropriate card is active on their phone, and present the NFC-enabled mobile device to a C2 validation device. If a valid fare product or sufficient balance is available, then the validation device will provide the customer with an appropriate tone and display message to allow entry. Once the customer has entered the system, the validation device will convey the entry to the back office system, and the back office system will update the customer’s account and, if the user has opted-in, send confirmation of the transaction via a communications method of their choice, e.g., email or text. The text and/or email will contain information such as the date and

time of the transaction as well as the geo-location of the validation, bus or route number, or station information.

If no valid fare product is available or balance is insufficient, then the validation device will signal an invalid tone and display an appropriate message. The back office system will be updated and the user will be sent confirmation of the failed entry, again on an opt-in basis. The customer will also be prompted to reload value into their account.

For loading, the customer will interact with the C2 mobile app if appropriate to facilitate a reload of the account.

The customer will be able to access their or account via a web-based interface that will provide the most recent 18 months of usage and load data. The web-based interface will allow for the customer to download the data in comma separated value (CSV) format or similar. The number of months of data availability shall be configurable by MTC and the partner agencies. The customer will also be able view these transactions on their mobile app. The retention of this information shall be subject to C2 policies and local, state, and federal laws as appropriate.

Institutional programs will also have access to participant usage data. The availability of this data to individual participants will be at the discretion of MTC, the partner agencies, and the institution, in accordance with applicable federal, state, and/or local laws.

With the new C2 system, front-line agency operators will most likely use similar or identical devices as those used today. This is, of course, dependent upon the type of device and an assumption that contractual terms can be worked out amiably with the existing hardware vendor for those applicable devices.

As a matter of course, as the validation devices could most likely be the same, bus operators, station agents and field personnel will rely upon the messaging of those devices. Fare inspectors such as those deployed by the SFMTA will be armed with smart phone-enabled mobile readers to validate a customer's fare media.

### 3.5.2 Technical Concepts

As previously discussed the C2 system will leverage several modern electronic payment aspects for its design and implementation. As evident by payment solutions such as Apple Pay, Samsung Pay, Android Pay, and others, the concept of a token-based identifier used as a trigger to facilitate payments is a viable payment method. Not only will this token-based approach be viable, but it will also provide MTC and its partner agencies a payment means that is less complex in device configuration and management, as well as much more secure with regards to payment information and privacy. The C2 system will be designed to utilize the best of breed solutions available. Each solution component will provide the C2 system with critical functionality that when integrated and implemented together will form the complete C2 solution.

The following sections discuss the infrastructure required to deliver this tokenized account-based solution.

#### *3.5.2.1 Account Concepts*

**C2 may be built on a hybrid card-/account-based model (2)**

Traditional payments in card-based automated fare collection (AFC) solutions and credit/debit payments utilize an account number that is stored and/or visible on a plastic payment card. A common example is a credit or debit card that both displays the account number visually on the card and contains the number in the magnetic stripe and/or embedded chip. If these cards are lost, the individual who lost the card is potentially vulnerable to fraud and financial risk, and the agencies or merchants subject to chargeback disputes and financial loss.

Further, with regards to fare collection specifically, card-based solutions require significant software configuration of remote devices, such as fareboxes or readers, to facilitate payment via tariff rules. This configuration of device software, otherwise referred to as fare rules or business rules, across a large population of deployed devices requires significant overhead to maintain and operate.

The concept of a tokenized account-based solution is where a payment can be facilitated via a card or other compatible electronic device where the actual account number is masked from such potential fraud, and the business rule or fare policies are processed in the back office away from the capturing device. Offloading this processing from the device can minimize dwell times and facilitate more expedient customer access.

Although this pure account-based approach has some merits, it also potentially places an agency at some level of financial risk. Specifically, a pure account-based system relies on real-time communications and a very high availability network. Given the number of transit operator participants, variety of communications networks in place, variety of fare policies in place (including distance-based fares with tap-in/tap-out operations), and fundamental need to process high volumes of passengers, implementation of a region-wide, real-time communications network is likely to be challenging. Managing first tap or first ride risk, managing the authorization process, and managing valid/invalid media or product lists are considered to be among the top technical challenges of C2.

For this reason, C2 is considering potential approaches that would combine the best features of a card-based operation where authorization is determined at the point of use, yet all transactions still reconcile to a single account to support the flexibility that account-based operations provides. A combined card- and account-based hybrid system approach may provide the opportunity to leverage the benefits that exist with a card-based system, such as device display of product validity or remaining balance, and the optimization that comes with an account-based system. In this approach some data is written to the card at the time of use. The card is linked to an account held in the back office, and both the data on the card and the account in the back office will be used to reconcile the account.

This hybrid approach will need to account for an environment where single tap-in and tap-in/tap-out uses exist in parallel. In the tap-in/tap-out scenario, station devices will display the traveler's remaining balance or product validity from reading the limited information available on the card.

### The C2 system will include an Account Management function (1)

The C2 system will include an Account Management function that allows for flexible, adaptable, configurable, and accessible information to both partner agency and MTC personnel, as well as controlled and filtered access to limited customer information for customer use. Data will be available to users with online access via the web and mobile devices. The Account Management function will be the primary interface for C2 Customer Service personnel, and a primary point of information for C2 customers for recent transaction history. The Account Management function will provide immediate availability of data once received, and transactions will be categorized as pending until all clearing and settlement has been completed for the system.

As with other C2 functions, the account management function will be built with open interfaces to facilitate the integration of other components and systems. This could include parking systems, FasTrak®, or other designated transportation-related systems.

C2 will also include a central account database function. In a card-/account-based hybrid system, it will not be necessary to immediately synchronize card and account data as the core data will all be processed at the central system; however, there may be a requirement to retain some transaction and account data on the card for customer convenience.

Each token will be linked specifically to an account. The account will also be linked to a funding source. The funding source can be a credit/debit card, checking account, or other similar funding source; regardless, the fare is calculated after the ride has been taken.

The system framework will allow for both prepay and post-pay transaction processing. To mitigate risk of post-pay transactions, C2 will be enabled with mechanisms to neutralize tokens. The tokens can be temporarily or permanently disabled. Further, as this is a hybrid approach, certain data will still be required on the plastic or virtual card. This data will allow for tag-on/tag-off uses to enable validation devices to identify and take appropriate action on plastic cards or virtual card accounts with insufficient balance.

When authenticating tokens, C2 will, at a minimum, utilize cryptographic mechanisms equivalent to or exceeding those of AES 128 or AES 256 cryptographic mechanisms. The cryptographic mechanisms will authenticate and validate tokens whether offline or online. The devices will be configured to scale up to public key authentication mechanisms such as elliptic curve or similar, without a hardware or processor upgrade.

### C2 will use tokens as account identifiers (2)

The C2 system will utilize electronic identifiers, or “tokens”, as representation of accounts. Each token will be uniquely derived and cryptographically authenticated prior to any fare payment transaction. For plastic and/or paper radio frequency identification (RFID) tokens, the plastic or paper ticket will contain a static serial number that can be used as the token identifier if the appropriate cryptographic authentication mechanisms are in place. For wearable devices, the token can be either electronically generated and stored or derived from the embedded components on the device (e.g., secure element). For bank issued cards, the C2 program will collaborate with the issuers, if deemed necessary, utilizing proprietary bank card schemes to determine if an appropriate interface is possible.

The authentication mechanism for these tokens will utilize a minimum of AES 128 cryptographic mechanisms for validation. Session-based derived cryptographic keys will be required for each transaction.

The token-based solution will allow for more expedient processing and should enable for the decrease of dwell time, e.g. by using the token to authenticate an account against a local whitelist. With a token-based system, simpler readers can be sourced and may include commercial off the shelf (COTS) devices.

The C2 system may provide a standard token identifier scheme that can be unilateral across various media types. Media types may include NFC, ISO 14443, and BLE type technologies.

### C2 will utilize multiple sub-accounts on each account (3)

A C2 master account is linked to the customer’s primary funding source. Each master account can have multiple sub-accounts, and C2 will allow for one or more tokens, in the form of plastic or virtual media, to be assigned to each sub-account, configurable at the master account level.

There are possible financial risks, operating and fraud scenarios associated to the use of multiple unique tokens per a single sub-account. For instance if, say both a phone and card were associated with a single sub-account, two people could conceivably travel at the same time which could create fare computation challenges, particularly for tap-in/tap-out operations. Further discussion at a regional level will be needed regarding this topic.

### C2 will support both post-pay and prepaid functionality (2)

The C2 system shall allow for both post-pay and prepaid scenarios. The post-pay scenario allows for customers to register a master account with a payment source. Upon usage of any C2

media linked to the account, the customer's payment source will be charged. For the prepaid scenario, customers will be required to load value onto their C2 media prior to its usage. As this is a hybrid system, minimal data will be written to the media, which will be synchronized with the back office account-based system. Risk profiles will be required to delineate which products are made available in the pre and post-paid use cases.

### C2 will include a Trusted Service Manager function to distribute virtual C2 cards/tokens to mobile and wearable devices (2)

The C2 system will be deployed with a trusted service manager (TSM) function, if necessary, to enable distribution of virtual C2 cards/tokens on mobile and/or wearable devices. The TSM will allow the C2 system to work with mobile devices. The TSM will be provided with open interfaces that allow for simplistic integration with other service components. The TSM together with the Key Management and Account Management functions will enable the generation and distribution of virtual cards.

#### *3.5.2.2 System Architecture Concepts*

### C2 will have an n-tier architecture (1)

As with traditional smart card driven electronic fare collection systems, C2 functionality will most likely be provided by a multi-tiered distributed systems architecture, similar to the one depicted in Figure 3. At its lowest tier, customer smart cards, mobile devices, and wearable devices will make up most of this architecture level. Field devices including card readers, station fare gates, ticket vending machines, and other similar devices comprise the next tier. Partner agency systems occupy the next tier, with the highest tier of the architecture including the back office systems that enable the various functions required of the C2 system.

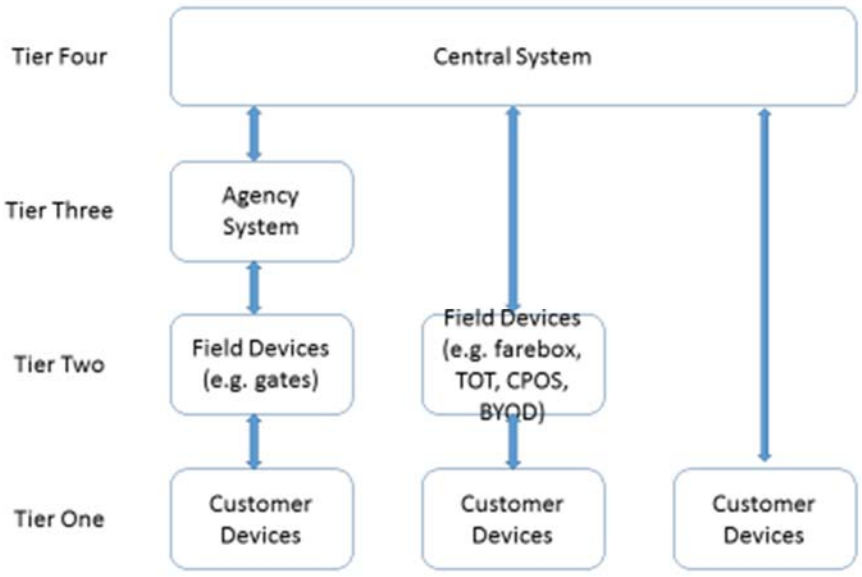



Figure 3: Conceptual C2 N-tier networked Systems Architecture

### C2 will utilize a near real-time communications network (2)

The C2 system is currently conceptualized as a hybrid card-/account-based system where the benefits of being able to immediately determine fare validity through media-validator interaction

is combined with the flexibility of an account-based solution. For hybrid systems, the plastic and paper cards and tickets, as well as any compatible mobile or wearable devices, are regarded as tokens. Tokens interact with compatible NFC and ISO 14443 validation devices deployed on vehicles and in stations to allow for the processing of fare payment transactions. For an account-based system, tokens are used as the unique identifiers from which to process payment transactions. The underlying infrastructure required for this processing is a near real-time network infrastructure for the delivery and conveyance of transactional data.

Network components will be provided by both the vendor and by the partner agencies, with the overall network ensuring high performance and high availability in a disparate control environment.

Where field devices are installed on buses, each bus shall be equipped with a high speed, high bandwidth communications mechanism, likely based on cellular communications that may either be dedicated to C2 or shared with other mobile applications. The intent is that this would provide "near real time" communications but not be relied upon to provide consistent, real-time authorization of transactions. A secondary communication mechanism will be a high speed, high bandwidth WiFi device at transit garages or other locations for batch data transmissions as needed. For station devices, all components will be connected directly to the back office transaction processing system located at the partner agency and from there to the central regional back office, or directly to the central regional back office depending on the preferences and network architecture of the agency.

### C2 will define and utilize open standard interfaces (1)

An underlying premise of the C2 system is the definition and utilization of open standard interfaces. Each C2 sub-system will be deployed with an interface and interface documentation that allows for the integration of the component with another system. As C2 will be a modular system, each component of the overall system will utilize standard open interfaces to interface and integrate. Customized and proprietary interfaces will be avoided. This use of standard interfaces will enable the use of different devices from multiple vendors. This will be supported by a certification process that all products (hardware and software) must pass in order to integrate with the C2 system. Further, C2 will develop a defined list of de facto standards based upon industry standards and open interfaces.

### C2 will seek to utilize cloud solutions where feasible and cost effective (1)

Fare payment systems are normally procured as multi-million dollar solutions consisting of hardware and software deployed at agency locations. The C2 system architecture will utilize, where available and cost effective, cloud driven technical attributes to minimize capital intensive investments in hardware infrastructure.

### C2 will include multiple Test, Development and Production platforms (1)

Unlike the C1 environment, the C2 system will require the availability of multiple system environments. These environments will support test, development and production platforms.

The C2 system will be implemented and delivered with multiple environments to allow the MTC and the partner agencies the ability to thoroughly test new aspects of a system prior to initial launch and throughout the lifecycle of the C2 system.

#### *3.5.2.3 Device Management Concepts*

**C2 will control and configure all field devices from the core system. (1)**

All field device configuration impacting the processing of C2 cards or accounts will be controlled from the central system. Configuration will include key distribution, action list management, cryptographic algorithm updates, key rotation and other functions. As C2 will be primarily an account-based system, minimal software updates will be required of the device when fare policies or tariff rules change.

The C2 system will allow for the configuration of fare calculation related business rules via web-driven interfaces. These configuration elements will be directly linked to the back office infrastructure, and will allow for the staging, testing and implementation of new fare policies and tariff rules.

#### *3.5.2.4 Transaction Processing Concepts*

**C2 will include a transaction processing function (1)**

The C2 core transaction processing function will accept and consolidate all authenticated and captured transactions from front end devices and process those transactions according to the business rules/tariff rules of the C2 partner agencies.

**C2 will include a Fare Rules Engine with the capability to consolidate, aggregate, and appropriately settle fare payment transactions (3)**

The C2 Fare Rules Engine will have the capability to calculate settlement; however, the current concept is that the financial management function will perform allocation/settlement functions.

In the event the Fares Rule Engine were used for settlement, it would work in conjunction with the transaction processing function to consolidate, aggregate, and appropriately settle fare payment transactions between all of the respective agencies. The Fare Rules Engine will also enable flexible transfers that are time and date based as well as enable capping of fares, based upon rules configured in the Fare Management function. As fares are calculated after utilization, the C2 system can process on a post-pay basis or on a pre-pay basis. For pre-pay transactions, funds can be loaded into a patrons account and held. For a post-pay transactions, authentication and authorization can also occur after the journey has completed.

#### *3.5.2.5 Key Management Concepts*

**The C2 system will utilize a Key Management function for the management, generation, storage, and secured distribution of C2 application keys (2)**

The Key Management function will provide an open, secured interface to core C2 components. The C2 Key Management function will be secured within a trusted security domain of the C2 infrastructure. C2 components will access the Key Management system when necessary to perform key distribution, rotation, authentication, and other necessary security functions. Access to the Key Management system may be direct or via agency-specific intermediary systems. The method of access may vary by agency and available infrastructure of that agency.

The Key Management function will be capable of AES 128 cryptographic algorithms and higher. The Key Management function will secure all transactional based security from an end to end perspective. The mechanisms will also support authentication, privacy, and data integrity.

MTC will own the keys generated by the system.

#### *3.5.2.6 Fare Management Concepts*

**C2 will provide a fare product management function for creating, configuring, and distributing fare products (2)**

As with existing smart card based fare collection systems, the C2 system will provide MTC and its partner agencies the capability to create, configure, and distribute fare products based upon their tariff rules through a Fare Management function. The Fare Management function will accommodate period passes, ride-based passes, and stored value fare products. This function will enable more flexible ticketing products that are easily defined and changed. The Fare Management function will also allow for "open payment" transactions, if this option is exercised by MTC and the partner agencies. Open payments in this context refers to the acceptance of contactless credit/debit transactions compatible with the C2 infrastructure.

#### *3.5.2.7 System Security Concepts*

**C2 system will provide end to end security (1)**

This security will utilize cryptographic mechanisms for securing all communications and the payloads contained within the communications. This security scheme will preferably be architecturally separate from the Key Management function utilized for transaction integrity. As all network components may not be under the direct C2 vendor control, cryptographic mechanisms that secure the critical transaction payload between the capture device and the central system back office will be implemented. This payload protection will allow for the delivery of the payload through agency-specific systems if necessary, while still providing a high degree of confidence in the integrity of that specific payload.

**The C2 system will provide secured partitioned access to authorized personnel (1)**

User groups may include customer service staff, accounting staff, partner agency operational staff, and many others. Access profiles will be created for multiple user groups as defined during the requirements gathering phase. Customer service information will also be controlled and filtered by agency-specific security permissions. As the C2 system will be designed to comply with all federal, state and local laws, as well as PCI DSS standards, all access will be restricted to a subset of information. The restricted information will also be made available only through partitioned segmented data access.

**C2 system will provide for anonymity and be in compliance with all relevant laws (1)**

The C2 system will be implemented in accordance and compliance with all federal, state, and local laws regarding privacy in effect during the time of system installation and operation. As the balance of personal privacy and public safety is essential in minimizing the potential financial liability of the public transit agency, the C2 system will be enabled to provide anonymity to its traveler participants on certain data, if not in conflict with any prevailing federal; state; or local statute, court order, or public safety threat. Information and data shall be accessible only in a secured manner to the proper authorities and under specific conditions. The C2 system will also allow for the existence of anonymous physical card distribution if deemed necessary at the time of system install.

#### *3.5.2.8 Credit/Debit Gateway Concepts*

**C2 system will include a centralized credit/debit gateway, but will also accommodate agencies wishing to use their own (3)**

The cost of accepting credit/debit cards is continually increasing from the fees associated with the processing of credit/debit card transactions to the capital required for hardening of the transaction acceptance and processing infrastructure for PCI and EMV compliance. With the low margins on transit fares, the costs of accepting credit/debit payments are beginning to be financially untenable to cash-strapped public agencies.

To mitigate some of these costs, it is recommended the C2 system be deployed with a centralized credit/debit gateway for the processing of C2 credit/debit transactions. This gateway will process all credit/debit transactions from C2-specific sales points that are not processed otherwise by a transit operator directly. This gateway will also process all web and mobile credit/debit transactions for the C2 program.

The credit/debit gateway provider will also be responsible for providing solution where all Primary Account Numbers (PAN) are tokenized and processed in a way that is transparent to customers.

Some operating agencies, such as BART, already operate their own credit/debit gateways, and C2 will be designed to accommodate agencies who wish to continue using their own gateways in two ways: either have the C2 back-office communicate with that gateway on behalf of the agency, or have credit/debit transactions continue to be processed directly by that agency with required reconciliation with the C2 back-office.

#### *3.5.2.9 Media Distribution Concepts*

**C2 will distribute both physical and electronic media (2)**

The Media Distribution function will be tightly coupled and integrated with the core C2 system components to enable this distribution. The Key Management function will facilitate all distribution of media. Distribution can take the form of plastic, paper, or digital electronic formats. Within the digital electronic formats, there will be two potential options that are not mutually exclusive for C2. Digital electronic distribution can occur via (1) a Trusted Service Manager (TSM) secure element (SE) path or (2) as a Hosted Card Emulation (HCE) path.

The TSM function will only be required for mobile delivery channels utilizing an SE component. HCE can also be utilized as a parallel channel with TSM or as an alternative to TSM.

It is anticipated for the initial rollout of the C2 system during transition, the primary distribution will take the form of virtual C2 cards distributed to mobile handsets and wearable devices. This will be complemented by the physical distribution of plastic and appropriate paper media through third-party retailers and enabled ticket vending machines. Paper media in this case would be in the form of limited-use contactless tickets, if selected by the region. The system framework will allow for the use and inclusion of limited-use media.

### 3.5.3 Technical Properties

This section discusses the key technical properties expected of the C2 system.

Technical properties are often referred to in Systems Engineering as the non-functional characteristics of the system. Distinct from the functional characteristics (which describe what the system must do), the non-functional characteristics describe a measure of how well those functions should be performed (e.g., how quickly, how reliably, etc.)

Non-functional characteristics include the common "-ities" such as reliability, availability, maintainability, expandability, usability, and flexibility. They also include topics such as security, and environmental characteristics. As such, the concepts in this section will form the basis of the non-functional requirements and will be incorporated into the system specifications.

#### *3.5.3.1 Reliability concepts*

**C2 will be procured with measurable metrics (1)**

As this will be a service based contract, the C2 system will be procured and operated with measurable parameters such as mean time between failures, mean transactions between failures, system availability, uptime, etc. C2 will monitor all components and automatically report on all metrics and performance.

#### *3.5.3.2 Availability Concepts*

**C2 core system vendor will provide a system that allows a high target availability uptime of the core system (2)**

C2 core system vendor will provide a system that will allow a high target availability uptime of the core system. The core system is comprised of the tightly integrated, centralized functions of the fare collection system. These include the transaction processing system, the credit/debit gateway, the Key Management system, the Fare Management system, and numerous other components.

**C2 will have highly available field devices (1)**

As with other fare collection systems, C2 is a distributed n-tier architecture system that relies upon working devices on vehicles and at stations for the processing and capture of fare payment transactions. The C2 system will have highly available front end devices and hybrid-related read/write data elements to ensure minimal revenue loss. This will require field service support and staffing from the vendor. As the C2 procurement will be bundled into smaller packages, separate contracts will need to adhere to standardized availability requirements. This is required to ensure consistent customer experience and availability.

#### *3.5.3.3 Maintainability Concepts*

**C2 will seek to be easily and simply maintained by its operators (1)**

As maintenance costs typically account for a significant proportion of system lifecycle cost, it is generally desired that any system is simple to maintain.

C2 is comprised of a large number system assets, distributed across a wide geographic region. The maintenance concept (see section 4.3) is that first-line maintenance will be performed by partner agencies with the C2 vendor providing second-line maintenance through a maintenance depot program. This approach means partner agencies will require trained maintenance staff who can respond to maintenance issues on an appropriate timescale, perform routine maintenance actions such as restarting failed devices, and diagnose and replace faulty devices with working devices from their own spares banks.

Consideration should be given as to whether this concept is 'simple' for smaller operators who may not have their own maintenance teams, or whether an alternate model is preferable for them.

#### *3.5.3.4 Data Integrity and Security Concepts*

**C2 will include cryptographic mechanisms that allow for the verification of data accuracy and integrity (1)**

The C2 system will be designed and implemented with a configurable and scalable security scheme. This scheme will utilize cryptographic mechanisms that authenticate users and session based-cryptographic mechanisms, as well as checksums such as hashing algorithms, MD5, or cyclic redundancy check (CRC) used to verify data was not corrupted in transmission.

The C2 system will be designed and architected to be PCI and EMV compliant. Any system thread that accepts EMV-related payments or other credit/debit card payments will be PCI/EMV hardened.

#### *3.5.3.5 Accessibility Concepts*

**The C2 system will be designed in a manner consistent and compliant with all current existing federal, state, and local laws on accessibility (1)**

Accessibility requirements change over time, so the vendor will be responsible for ensuring their implementation is compliant to the latest laws at the time of system design acceptance. C2 will also be appropriately accessible for customers with limited English proficiency.

#### *3.5.3.6 Expandability and Modularity Concepts*

**C2 will seek to offer flexibility to expand through a modular design (1)**

As traditional AFC systems are designed to be fit for a single purpose, the C2 system will be designed in a manner that allows for the efficient and effective delivery of an AFC system, while also designed and architected in a manner that allows for functional and technical expandability through a modular design. Examples of such expandability include paratransit, parking, FasTrak®, and BikeShare. The concept of a modular design will allow for the integration and incorporation of best of breed system components that will formulate the new fare collection system.

#### *3.5.3.7 Measurability Concepts*

**C2 system will allow for key metrics to be measured (1)**

As performance, effectiveness, and efficiency are key elements of a system, the C2 system will be designed and architected in a manner allowing for key metrics affecting the delivery of service to customers and operators to be measured in an objective manner that demonstrates the vendor's effectiveness.

#### *3.5.3.8 Environmental Concepts*

**All C2 components will be designed to minimize unnecessary EMI (1)**

All C2 components will be designed to minimize unnecessary electromagnetic interference (EMI) interference. All components of the C2 system should be deployed with an appropriate level of EMI shielding.

#### C2 will withstand the typical shocks and vibrations expected in an operational transit environment (1)

The vendor will verify the shock and vibration limitations of the equipment or any part of the equipment are not exceeded. The design and construction of the equipment will be such that the usual shock and vibration levels experienced during transportation by rail, truck or airplane will have no damaging effect on the equipment. This assumes no special precautions are taken other than solid anchoring of the cabinet and special packaging internally to prevent damage.

#### C2 will withstand the typical weather conditions found in the Bay Area (1)

C2 will need to take account of local weather conditions particular to the Bay Area. Temperatures can vary widely, devices must be designed for prolonged exposure to direct sunlight, many devices are exposed to a marine environment, and certain areas experience higher than average levels of fog and moisture.

## 3.6 Program Governance, Funding and Standards

### 3.6.1 Program Governance

The Clipper® program is governed according to a Memorandum of Understanding (MOU) signed by MTC and the partner agencies. The MOU includes the following program governance aspects:

- Partner agencies' (transit operators') Clipper®-related responsibilities
- MTC's Clipper®-related responsibilities
- Contracting Agency Clipper®-related responsibilities
- Executive Board and Executive Director Clipper®-related responsibilities
- Process for amending the Clipper® Operating Rules
- Clipper® cost and revenue allocation

The MOU is periodically updated, in accordance with the updates processes defined in the MOU, and the current version of the MOU should be referenced for the most up-to-date program governance roles and responsibilities.

#### C2 will be governed in accordance with the Clipper® Memorandum of Understanding (1)

The term of the Clipper® MOU continues until June 30, 2025 and, therefore, the MOU governs all lifecycle stages of C1 and will apply to all lifecycle stages of C2 occurring before that date.

#### C2 will be operated in accordance with the Clipper® Operating Rules (1)

The Clipper® Operating Rules identify and define MTC and partner agency responsibilities and key system operating policies, including policies that serve as the basis for the Clipper® Cardholder License Agreement. The Clipper® MOU defines that proposed changes to the Operating Rules require a consultation process with MTC and the Partner Agencies, but that final authority on approving changes is delegated to the Clipper® Executive Board.

The Clipper® Operating Rules are generally considered to be working well under C1, and the expectation is that C2 will continue to be operated in accordance with the Clipper® Operating Rules.

**The Clipper® Operating Rules will require changes to accommodate the new capabilities and technologies offered by C2 (2)**

The Clipper® Operating Rules are currently based on the capabilities and technologies within the C1 card-based fare payment system. C2 will bring new capabilities and technologies to the Clipper® program (including the potential for an account-based fare payment system) and as such the Operating Rules will require revision where necessary.

As well, fare policy is expected to evolve over time, and C2 must include capabilities to readily add new local and regional fare products and business rules.

### 3.6.2 Program Funding

The Clipper® program is funded from a variety of sources, including but not limited to:

- Federal funding sources, including various Federal Transit Administration programs, and Federal Highways Administration programs including the Congestion Mitigation and Air Quality Improvement Program (CMAQ) and the Surface Transportation Program (STP)
- State funding sources, including State Transit Assistance and California cap-and-trade
- Local funding sources, including bridge tolls, local sales tax, and revenues
- MTC and partner agencies fund aspects of the program (both capital and operating) from their own funding sources
- Revenues generated by individual and institutional patrons through fees associated with some transactions, most commonly a card replacement fees and card load fees charged under Clipper® Direct
- Some revenues are generated through a commission charged to the partner agencies as an invoiced expense

Program funding is finite so opportunities to minimize lifecycle cost are important.

**The program will seek to minimize the lifecycle cost of C2 through analysis, operational data collection, and mechanisms to incentivize program performance and efficiencies**

Potential opportunities may include the collection of a rich set of operating data under C2 that in turn can be used to support ongoing opportunities for lowering lifecycle cost, contractual mechanisms for incentivizing vendor performance and efficiencies, and operating rule changes for incentivizing operator and MTC performance and efficiencies.

### 3.6.3 Use of Standards

Following published standards within technology programs can offer efficiency and risk management advantages through alignment with models proven effective for services and technology across multiple industries. Standards can offer efficiencies of scale, increase the longevity of investment, and reduce the risks of discontinuity that commonly occur due to proprietary approaches; therefore, it may be desirable for C2 to follow certain published standards.

**C2 will seek to follow published standards where the potential benefits outweigh the risks (2)**

In order to support quality processes the C2 program will seek to identify and adopt relevant standards. Standards can be identified through engagement with the market via the marketing sounding and/or acquisitions processes, along with internal program research and analysis. In

designing the C2 program, opportunities for adopting such standards should be assessed and identified.

Once adopted, the degree of adherence to standards should be periodically assessed and reported on by the C2 system integrator, with oversight from the Clipper® Contracting Agency.

Example standards may include, but are not be limited to:

- **ITIL 2011**, a set of practices for IT Service Management that focuses on aligning Information Technology (IT) services with the needs of business
- **International Financial Reporting Standards** (IFRS) for accounting practices
- **Emerging Smartcard Alliance (SCA) Reference Architecture** for transit fare payment systems
- **Security standards** for networks, databases, encryption, key management, etc.
- **ISO/IEC 14764:2006** for Software Engineering: Software Life Cycle Processes (Maintenance)
- **SO/IEC/IEEE P24748** – Life Cycle Management
- **ISO 55000/1** for Asset Management
- **MIL-STD-2155(AS)** – Failure Reporting, Analysis and Corrective Action System (FRACAS)
- **ISO 15288** for Systems Engineering
- **MIL-HDBK-61A** for Configuration Management

# 4 Operational Concepts

## 4.1 Capabilities of the C2 System

Through the acquisition of the current Clipper® system ("C1"), MTC and its Partner Agencies (the transit operators) have gained the ability to perform certain actions[1], such as distributing fare media cards, selling fare products electronically, and settling fares among the transit operators. Such actions represent the operational "capabilities" that MTC and the transit operators have acquired through C1.

Through the acquisition of C2, MTC and the transit operators can also expect to gain certain operational capabilities, some of which will be brand new for C2 (because they were not provided through C1 today), while some maybe enhanced versions of those capabilities already acquired through C1.

The capabilities desired from C2 during its operational phase have been identified and grouped by three types: 1) operations, 2) maintenance, and 3) management. They are appended to the C2 lifecycle and whole-system diagram below.

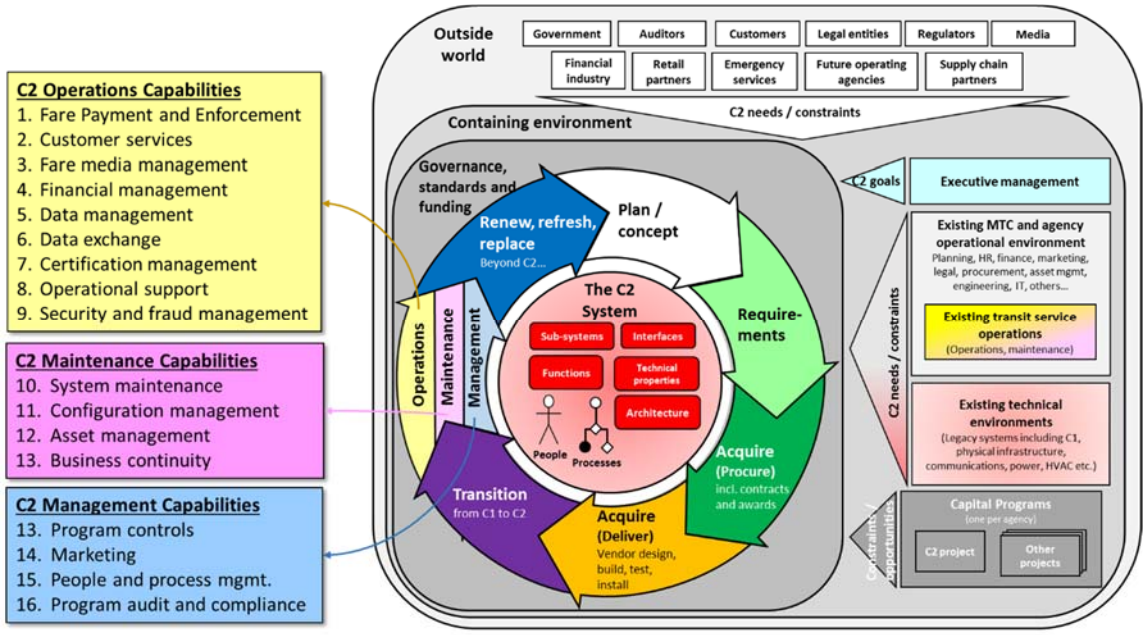



Figure 4: Lifecycle and Whole-system View of C2

Given that **capabilities** are defined above as "an enduring ability to achieve a particular business outcome during the operational phase of a system [and]… typically require a combination of organization, people, process and technology to be achieved" it is therefore possible to identify and describe the **business functions** that enable the capability to be realized. By identifying and describing the business functions required to realize the capabilities, we identify and describe what is required from C2—in other words, what C2 must deliver.

The capabilities required from the acquisition of C2 are described in the table below, along with the key business functions within each. The following table provides an overview of key C2 business functions.

[1] Under the C1 contract, most actions are performed by the C1 vendor on behalf of MTC and its Partner Agencies.

Table 1: Key C2 Business Functions Organized by Capability

| **Capability Type** | **Capability** | **Sub-capabilities** A logical decomposition of a capability | **Key Business Functions** necessary to realize the capability[2] |
|---|---|---|---|
| Operation | 1. Fare Payment and Enforcement | 1.1 Access control<br>1.2 Fare payment<br>1.3 Manual fare enforcement | • Control access to fare-controlled areas or services through gates or other means<br>• Enable customer to pay fares in order to access fare controlled areas or services<br>• Manual fare inspection and enforcement of patrons within fare-controlled areas or services |
| Operation | 2. Customer Services | 2.1 Customer information<br>2.2. Account management and sales<br>2.3 Discount Management | • Provide information to customers<br>• Manage accounts for individual and institutional customers<br>• Sell fare/products to individual customers<br>• Process applications for discounted travel |
| Operation | 3. Fare Media Management | 3.1 Media and distribution management<br>3.2 Media order fulfillment<br>3.3 Media Inventory management<br>3.4 Media distribution<br>3.5 Virtual media management | • Enable customers, operating agencies and institutions to order fare media<br>• Fulfill fare media orders<br>• Manage inventory of fare media<br>• Distribute fare media through TVMs etc.<br>• Generate and distribute virtual fare media |

[2] Functions may be performed by MTC, Partner Agencies, and/or C2 system integrator(s). Refer to business functions diagram in Appendix D for proposed responsible parties.

| **Capability Type** | **Capability** | **Sub-capabilities**<br>A logical decomposition of a capability | **Key Business Functions**<br>necessary to realize the capability[2] |
|---|---|---|---|
| Operation | 4. Financial Management | 4.1 Financial and transaction processing<br>4.2 Apportionment and settlement<br>4.3 Reconciliation<br>4.4 Accounting<br>4.6 Debt collection | • Process sales and usage transactions<br>• Request and collect funds from banking partners<br>• Manage chargebacks/bad debt<br>• Apportion and settle funds between operating agencies, and manage operational cost sharing<br>• Reconcile C2 system, including revenue, orders, accounts, and investigate discrepancies<br>• Perform accounting, including management of general ledger and accounts receivable and accounts payable<br>• Provide data to support financial audits and reviews of financial controls<br>• Perform asset depreciation and lifecycle cost analyses<br>• Collect debt from C2 debtors<br>• Manage financial programs |
| Operation | 5. Certification Management | None | • Certify vendors wishing to become certified<br>• Perform ongoing quality checks of certified vendors<br>• Decertify non-compliant vendors |
| Operation | 6. Operational Support | None | • Collect and provide real-time operational data, such as gate throughput, to operators<br>• Collect and provide historical operational data, for planning purposes<br>• Perform operational intervention, such as opening all fare gates in an emergency |
| Operation | 7. Data Management | 7.1 Data storage<br>7.2 Data access and presentation | • Store historical data<br>• Provide access to, and presentation of, stored data |

| **Capability Type** | **Capability** | **Sub-capabilities**<br>A logical decomposition of a capability | **Key Business Functions**<br>necessary to realize the capability[2] |
|---|---|---|---|
| Operation | 8. Data Exchange | None | • Exchange data internal to C2 and with systems external to C2 |
| Operation | 9. Security and Fraud Management | 9.1 Fraud management<br>9.2 Security management | • Identify potential fraud and support investigations<br>• Manage access hotlists<br>• Manage system security |
| Maintenance | 10. System Maintenance | 10.1 System and business rule configuration<br>10.2 System monitoring and control<br>10.3 First-line field device maintenance<br>10.4 Second-line field device maintenance<br>10.5 Maintenance Depot program<br>10.6 Operator-owned field device maintenance<br>10.7 Central system maintenance<br>10.8 Software maintenance<br>10.9 Interface management | • Configure system parameters, including user-configurable business rules<br>• Monitor and control system devices<br>• Perform first-line field device maintenance<br>• Perform second-line field device maintenance<br>• Manage the maintenance depot program, including repairing and returning faulty devices<br>• Maintain operator-owned field devices<br>• Maintain central systems, including databases and networks<br>• Maintain software, including preventive, corrective and adaptive maintenance<br>• Manage interfaces through an Interface Management Group |
| Maintenance | 11. Configuration Management | None | • Identify and record system configuration<br>• Report system configuration<br>• Implement approved changes to system configuration |
| Maintenance | 12. Asset Management | 12.1 Asset Refresh<br>12.2 Asset Information Management | • Plan for and perform asset refresh<br>• Maintain information on all C2 assets, including location, status, and repair history<br>• Track spares and warranty information |

| **Capability Type** | **Capability** | **Sub-capabilities** A logical decomposition of a capability | **Key Business Functions** necessary to realize the capability[2] |
|---|---|---|---|
| Maintenance | 13 Business Continuity | None | • Plan for Business Continuity<br>• Monitor for Business Continuity situations and readiness<br>• Perform Business Continuity actions and return to normal operations |
| Program Management | 14 Program Controls | 13.1 Program and contract management<br>13.2 Configuration management<br>13.3 Project and portfolio management | • Monitor vendor performance<br>• Manage program risks<br>• Coordinate regional business rules<br>• Manage vendor contracts and CDRLs, including dispute resolution<br>• Manage vendor invoices<br>• Oversee and audit configuration management process<br>• Manage C2 project portfolio and individual projects |
| Program Management | 15 Marketing | 14.1 Branding<br>14.2 Customer Education | • Manage C2 website and social media<br>• Manage C2 brand and advertising campaigns<br>• Develop and publish customer education material, and collect customer feedback |
| Program Management | 16 People and process | 15.1 Organizational Change Management<br>15.2 Training<br>15.3 Business Process management | • Oversee organizational change management associated with C2 through its lifecycle<br>• Develop, perform and undergo training for operators, maintainers and others<br>• Define, optimize and manage C2 business processes |
| Program Management | 17 Audit, financial control and compliance | None | • Undergo audit by external bodies<br>• Audit C2 vendors<br>• Achieve, maintain and report on external compliance requirements |

## 4.2 Operation Concepts

This section holds concepts related to the operation of C2, during the operational phase.

### 4.2.1 Fare Payment and Enforcement

The following diagram highlights the fare payment and enforcement capabilities and associated business functions. These are further described in the following sub-sections and related concepts

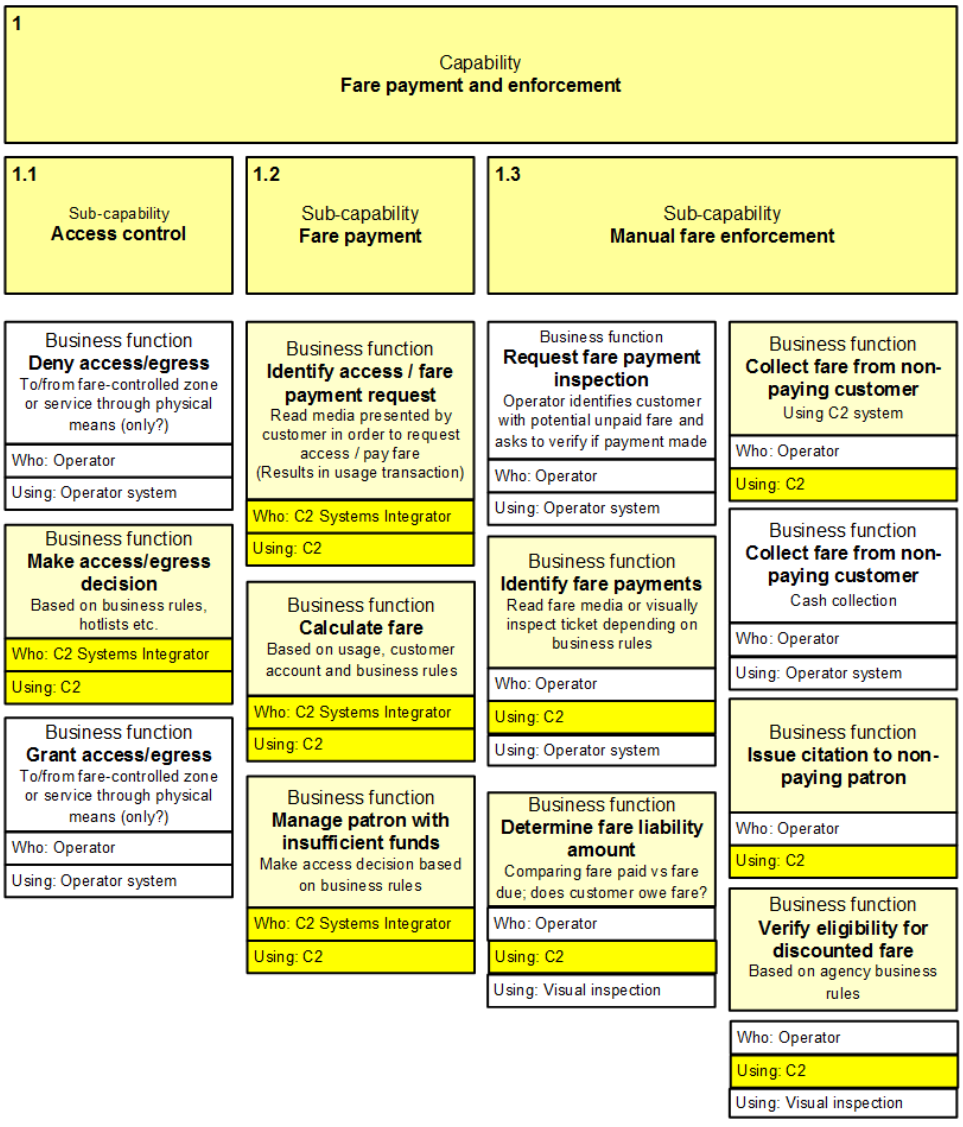



Figure 5: Fare Payment and Enforcement Capabilities and Associated Business Functions

#### *4.2.1.1 Access Control*

Transit service in the Bay Area encompasses gated rail environments, such as BART, un-gated rail environments, such as VTA light rail service, numerous bus systems, such as AC Transit and MUNI, and ferry services, such as that offered by Golden Gate Transit. Each of these operational environments presents a different set of requirements and challenges for fare

payment. The C2 fare payment system must accommodate these requirements and allow transit operators to implement their individual fare policies and business rules regardless of the operating environment.

### C2 will enable individual operators to continue implementing their own business rules for access to fare-controlled zones and services. (2)

C2 Partner Agencies will be able to configure the C2 fare system to implement their individual business rules and fare policies for revenue service and operation, including but not limited to policies for:

- Hours of service
- Base fare
- Discounted fare and eligibility
- Reduced fare and eligibility
- Peak and off-peak fares (time-based fares)
- Time-based transfers between services and agencies
- Time-based passes
- Stored ride passes
- Fare capping
- Free travel for employees and other designees
- Single-agency passes
- Multi-agency passes
- Rider classifications and eligibility
- Inter and intra agency transfers
- Loyalty and reward programs
- Special products for institutions and social services

### C2 will enable customers to use a variety of media to pay fares (2)

C2 will enable customers to use the following media to gain access to the system:

- **C2-branded smartcards** – Contactless smartcards branded with the C2 logo; distributed through the C2 program
- **C2-branded virtual fare media** – Downloadable credential that resides on a customer's device or wearable technology allowing device or wearable to emulate a C2-branded smartcard.
- **Third-party issued mobile payment applications** – Payment applications such as Apple Pay™ and Google Wallet that allow a customer's device to emulate a credit card.
- **C2-branded mobile ticketing applications** – Downloadable applications for customer's mobile devices providing for the purchase of cash value and pass products and the payment/validation of fares.

Customers will present their media to a C2 reader on a farebox, fare gate, reader, platform reader, or other C2 fare payment device to request entry in to the system. The C2 device and/or the C2 system will identify the account associated with the media presented by the customer and determine whether or not to allow the customer to access the system.

### C2 will include the ability to accept open payment contactless bank cards; however, such a feature may not be enabled at C2 go-live (3)

C2 will include the ability to accept open payments from contactless bank cards at the point of fare payment, as a means of accessing the system, but discussions are continuing as to such a function's scope and timing for implementation. The advent of tokenized payment technologies, coupled complexity and cost of maintaining PCI and EMV compliance for all fare payment

devices has raised questions about the merits of adopting contactless bank cards particularly as new mobile and other applications are emerging.

#### *4.2.1.2 Fare Payment*

**C2 will deduct fares from customers' accounts *after* they have entered a fare-controlled zone/service or in a manner that does not impede passenger throughput (3)**

Once a customer has presented fare media to a C2 device and has been granted access by the C2 system, the C2 system will determine the fare payment due from the customer based on the applicable fare policy and business rules. The fare payment or product usage will be deducted from the C2 account associated with the fare media used by the customer to access the C2 system. The payment process flow will be transparent to the customer and will not interrupt the access or boarding process

**C2 will enable customers using mobile ticketing application to pay their fares *before* entering a fare-controlled zone/service. (2)**

A customer using a mobile ticketing or mobile payment application on their device may activate a ticket or execute a fare payment before presenting their fare media to a C2 device. The customer will present their mobile device to a C2 device that will verify the appropriate payment or product usage has occurred and grant access upon verification. The payment process flow will be transparent to the customer and will not interrupt the access or boarding process

**C2 will enable customers to pay fares *without establishing* a registered C2 account. (3)**

Customers will have options for anonymous fare media. The C2 system will determine the fare payment due from the customer based on the applicable fare policy and business rules. The C2 system will deduct payment directly from the customer's mobile payment application (or financial entity-branded contactless card). The payment process flow will be transparent to the customer and will not interrupt the access or boarding process

**C2 will continue to enable customers to use their Clipper® cards to pay for parking, with potential for future expandability beyond that (1)**

Customers can currently use their Clipper® cards to pay for parking at BART stations and SFMTA parking garages, and C2 should continue to support that. C2 will also support the potential for a future expansion of this functionality to other regional services such as BikeShare, paratransit, or other services considered to be an appropriate use of C2.

#### *4.2.1.3 Fare Inspection and Enforcement*

Fare inspection and enforcement is a critical component of any fare collection system helping ensure customers are validating tickets prior to boarding a C2 vehicle. It is especially critical in a barrier-free environment.

**Fare inspectors will use a C2 mobile application to verify fare payment via a customer's C2-branded smart cards and virtual fare media (2)**

Fare inspectors will use a C2 application on a mobile device to read a customer's C2 fare media (C2-branded smartcards and C2-branded virtual fare media) in order to determine if the customer has paid the appropriate fare or validated a ticket prior to using a partner agency's service. Upon request, C2 customers using a C2-branded smartcard or C2-branded virtual fare media will present their fare media to a fare inspector, security officer, or other C2 agency staff.

(Rather than a C2 mobile application, it is also possible that a dedicated handheld device could be used)

### Fare inspectors will use a C2 device to verify fare payment via third party-issued mobile payment application (2)

Upon request, C2 customers who have gained access to the system using a mobile payments application, such as Apple Pay™ or Google Wallet, will present their mobile device to a bus operator, fare inspector, security officer, or other C2 operator staff for inspection via handheld device. The C2 inspector's device will communicate wirelessly with the customer's device to determine whether the customer's ticket, pass, or fare payment is valid.

Device validation in the C2 system will never require the handling of a customer's mobile device.

### Fare inspectors may use visual inspection or a device to verify fare payment via C2-branded mobile ticketing applications (2)

Upon request, C2 customers using a mobile ticketing application will display their active ticket on their mobile device to a fare inspector, police or security officer, or other personnel with fare inspection responsibilities.

The fare inspector may visually inspect features of the presented media and verify that the customer's fare payment or active pass product is valid and/or use a mobile device to perform the inspection. The C2 inspector's device will scan a security code on the customer's device or communicate wirelessly with the customer's device to determine whether the customer's ticket, pass, or fare payment is valid.

### C2 will support the issuance of citations to fare evaders (2)

In the event that a customer's fare payment is determined to be invalid, the fare inspector will issue a warning (verbal or written) or citation based on the governing rules of the C2 system on which the violation occurred.

Some operators, such as BART, do not allow agents to collect unpaid fares due to management decision or union rules.

### 4.2.2 Customer Services

The following diagram highlights the customer service capabilities and associated business functions. These are further described in the following sub-sections and related concepts.

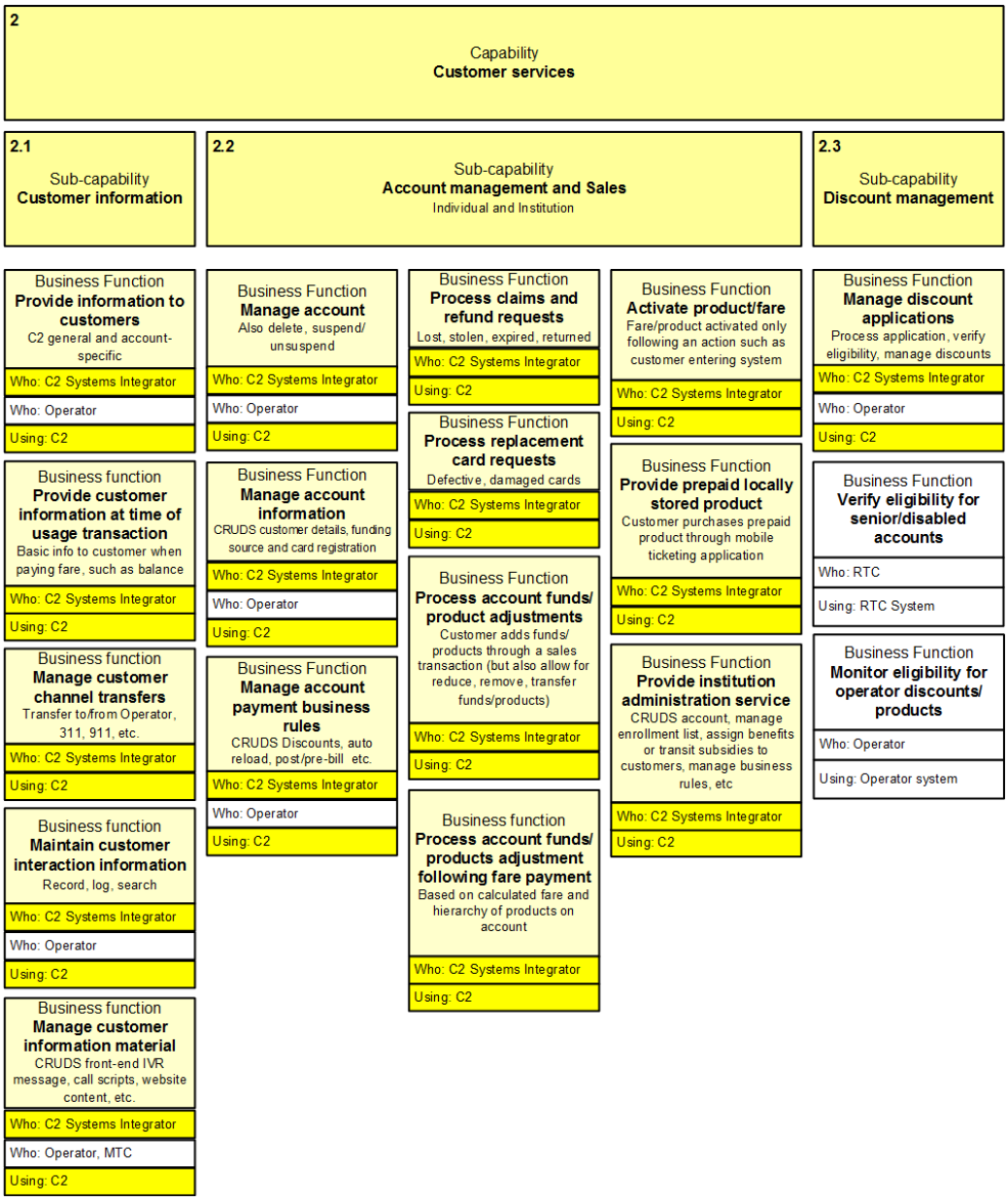



Figure 6: Customer Service Capabilities and Related Business Functions

#### *4.2.2.1 Customer Information and Account Management*

**C2 customer service will be provided via online, telephone, and in-person channels (1)**

- **Online channels** (mobile and website) will focus on self-service resolution of issues, easy access to transaction data and policy information, and convenience. An online service for institutional customers will be included enabling institutional self-service for managing participants and funding.

- **Telephone customer service** will focus on providing fast, courteous, proactive, and efficient customer service.
- **In-person channels** will focus on providing a broad range of assistance levels, tailored to the needs of the partner agency. In-person channels will include Agency Customer Service Centers and Station Agents.

While the capabilities of each channel will vary, customers will experience consistent levels of quality across all channels. C2 customer service will also provide for a seamless hand-off of issues between customer service channels when necessary to resolve issues.

### C2 will empower customers with self-service tools for information and account management purposes (individual self-service) (1)

C2 will seek to maximize the ability for customers to self-serve their own information and account management needs. Customers will be encouraged to directly access their account information via a secure online portal to address their own needs rather than contacting a call center. In support of this, C2 customers will be able to access the following functions through a variety of self-serve channels, such as mobile devices and personal computers:

- Create and update C2 accounts
- Associate/remove/modify payment methods
- Purchase C2 cash value and products
- Access customer service
- View C2 transaction history
- Report lost or stolen fare media, and freeze account
- Request fare adjustment

C2-branded apps and websites should also include direct links to fare and business rules information and should feature simple and short processes for key functions. All online and mobile user interfaces should feature common functionality, layout, terminology, process flows, and capabilities in order to achieve a common user experience.

### C2 will empower institutions with self-service tools for managing participants, assigning fare media to participants, and assigning/removing benefits (institutional customer self-service) (2)

Program administrators for institutional C2 customers will be provided secure access to an online account management function that will allow them to do the following:

- Link one or more funding sources to their C2 institutional account
- Manage participant lists (create/add/delete/modify)
- Assign fare media (or link C2 enabled mobile media) to participant, and update as needed
- Add or remove funding options from participant C2 accounts

### C2 will equip operator staff with customer service tools and configurable levels of system access to assist customers on site (1)

C2 will maximize the ability for Partner Agencies to fulfill a wide range of customer service needs at their facilities by providing a variety of options for data accessing and updating as identified in the table below.

| | Edit Capability | Read-Only Capability |
|---|---|---|
| **Full Access** | Access to all C2 account, transaction, and payment information<br><br>Able to issue fare adjustments, replacement products, block/unblock accounts<br><br>*Example user*: C2 Telephone Customer Service Representative | Access to all C2 account and transaction information. Ability to view account status (registered/ unregistered, blocked/unblocked)<br><br>*Example user*: Partner Agency Administrative Staff |
| **Limited Access** | Access to all C2 account and transaction information<br><br>Limited ability to issue fare adjustments and replacement products<br><br>Able to block/unblock account<br><br>*Example user*: Partner Agency Customer Service Center | Access to limited transaction information<br><br>Ability to view account status (registered/unregistered, blocked/ unblocked)<br><br>*Example user*: Partner Agency Frontline Operational Staff |

The available functionality and level of access will be configurable allowing Partner Agencies to match the capabilities and functions offered to their specific operational needs.

The ability to view and update data will be limited by the data available in the C2 data storage.

**C2 will provide fast, courteous, proactive, and efficient customer assistance through a customer service call center (1)**

Although online self-service options will be emphasized, many C2 customers will still need to access customer service and account management functions via telephone. Registered C2 customers will be able to access customer service for their C2 account via telephone without having to provide a card number, either via the key pad or verbally. The C2 system will enable the capturing of the reason for each call, the operators (if any) involved with the customer's issue, and other related information for tracking purposes. The C2 system will make this information available for business intelligence purposes where the data can be proactively analyzed to identify system issues or patterns of fraudulent activity.

The C2 call center contract will include quality assurance provisions and elective customer surveys to monitor and evaluate the performance of customer service representatives (CSRs).

#### *4.2.2.2 Discount Management*

**C2 will provide a discount application, verification and management service (2)**

C2 will enable customers to apply for fare discounts and will perform verification of discount eligibility. It will also support discount applications and/or verifications performed via the Regional Transit Connection (RTC) Discount Card Program, possibly through the continuation of an interface to the RTC Discount Card Processor (as is currently the case for C1).

C2 will also enable the management of such discounts, including the updating and revoking of discounts in the system.

### 4.2.3 Fare Media Management

The following diagram highlights the fare media management capabilities and associated business functions. These are further described in the following sub-sections and related concepts.

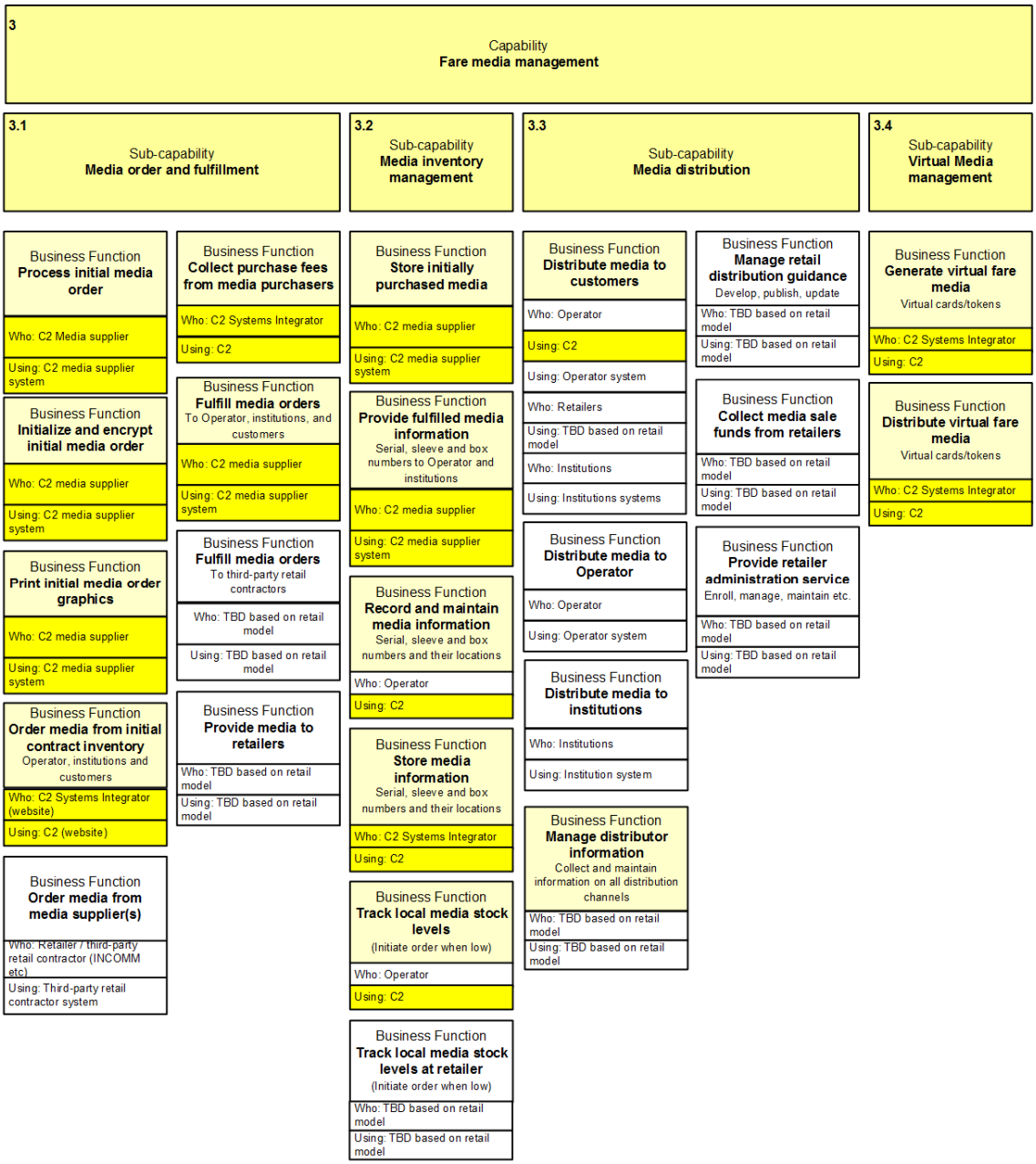



Figure 7: Fare Media Management Capabilities and Associate Business Capabilities

The overall goal of fare media management is to minimize the handling of physical cards and associated devices by MTC and the Partner Agencies. MTC does not currently have a warehouse to securely store large quantities of C2 cards; nor does MTC have the staff or security personnel required to securely transport large quantities of C2 cards. Further, MTC does not have a facility or staff to fulfill individual or bulk card orders for customers, institutions, retailers, nor do the Partner Agencies.

MTC and the Partner Agencies should take advantage of the unique capabilities of card manufacturers and third-party retail card and payment networks to provide quality, convenient service to their customers and reduce capital, operating, and maintenance expenses.

#### *4.2.3.1 Media and Distribution Contract Management*

**The Clipper® Contracting Agency will establish and manage the contract with the C2-branded media vendor (3)**

The contract to produce C2-branded smart cards will be established and managed by the Clipper® Contracting Agency.

**The C2 system integrator will establish and manage contracts with institutional clients (3)**

The C2 system integrator will be responsible for establishing, maintaining, and managing all contracts with C2 institutional clients, such as businesses, schools, universities, social service agencies, housing authorities, employment programs, and other groups that wish to provide C2 fare media and transit benefits to participants.

#### *4.2.3.2 Media Order and Fulfillment*

**The Clipper® Contracting Agency will purchase an initial inventory of cards from the media vendor, and card orders will be fulfilled from that initial inventory for customers, institutions, organizations, and Partner Agencies (3)**

The Clipper® Contracting Agency will purchase an initial inventory of C2 cards. The media vendor will create this inventory of C2 cards, which will be stored at the card manufacturer's secure facility. The media vendor will monitor its on-site inventory, and advise the Clipper® Contracting Agency when the inventory needs to be replenished.

**All C2 card orders, whether from individual customers, institutions, organizations, or Partner Agencies, will be processed via the same C2 website and fulfilled by the media vendor (2)**

C2 cards will be fulfilled by the card manufacturer (media vendor) as part of their contract to produce C2 cards.

The card manufacturer will receive and process all card orders from individuals, entities, and institutions directly through C2 as follows:

- C2 will communicate directly with the card manufacturer providing a daily list of orders. The C2 inventory tracking function will receive a daily confirmation that the previous day's orders were successfully fulfilled and a listing of the C2 card numbers/addresses that were shipped out. For individual card purchase or replacement orders placed online, MTC and the operators may choose to have the website automatically register individual cards to the customer account.
- The ordering thresholds for C2 users will be configurable allowing, for example, a large employer to have a higher maximum order amount than an individual customer.

#### *4.2.3.3 Media Inventory Management*

**C2 will catalogue and track fare media serial numbers throughout the lifecycle of each individual card, from manufacture to customer receipt (2)**

The card manufacturer will supply cards to the Partner Agencies for distribution to customers. The C2 system will track the location of all cards throughout the entire lifecycle of the card from receipt of shipment to the hands of the customer supporting the following processes:

- The card manufacturer will ship cards to partner agencies in multiple boxes, each with a unique box number and bar code. Each box will contain multiple sleeves of C2 cards, each with a unique sleeve number and barcode.
- As card shipments are received by Partner Agencies, the bar codes for each box will be scanned electronically, and the box and sleeve numbers will be stored in the C2 system indicating the cards are now within the custody of the receiving partner agency and no longer stored in the central C2 card inventory.
- When partner agencies load the sleeves of C2 cards into vending devices, or place them in the inventory safe at a sales outlet, the C2 system will update the inventory to reflect that the card(s) are now located in a particular revenue device/location.
- As partner agencies vend cards, the C2 system will indicate that the card is now in circulation, and no longer with the C2 operator device/retail location.

**C2 will record all purchase transactions of C2 fare media, C2 cash value, and C2 fare products (2)**

As partner agencies vend cards, C2 will indicate that the card is now in circulation and no longer with the operator device or retail location.

#### *4.2.3.4 Media Distribution*

**C2 will provide a variety of sales channels for the purchase of C2 fare media and fare products (2)**

C2 will support the following C2 sales channels:

- **Online options**, such as mobile applications or websites, will offer the purchase of C2-branded mobile ticketing applications, C2-branded contactless smart cards (by mail), C2 cash value, and C2 fare products via credit/debit
- **Unattended devices**, such as ticket vending machines, will offer the purchase of C2-branded contactless smart cards, C2 cash value, and C2 fare products via cash or credit/debit
- **Partner agencies' Customer Service Centers and sales outlets** will offer the purchase of C2-branded contactless smart cards, C2 cash value, and C2 fare products via cash or credit/debit
- **Telephone-based sales** will offer the purchase of C2-branded contactless smart cards, C2 cash value, and C2 fare products via credit/debit
- **Institutional C2 customers**, such as employers, social service agencies, or universities, may provide C2-branded contactless smart cards to employers, program participants, or eligible students, along with C2 cash value, C2 pass products, and/or transit benefits
- **C2 retail partners** will offer the purchase of C2-branded contactless smart cards, C2 cash value, and C2 fare products via cash or credit/debit

To the greatest extent possible, the C2 system integrator will seek to provide a consistent customer interface and customer experience across all C2 sale channels. Fare media and fare product pricing will be consistent across all applicable C2 sales channels.

**C2 will support a consistent customer experience by providing common functionality, layouts, terminology and C2 branding at all sales channels (2)**

C2 ticket vending machines (TVMs) will offer the capability of selling regional C2 fare products, regardless of which partner agency owns the TVM. Additionally, TVMs or other sales channels operated by a specific agency may sell products specific to that agency. In order to achieve a common user experience, the terminology, process flows, and capabilities of the TVM should, to the greatest extent possible, mirror that of the online sales channels.

Partner agency Customer Service Centers and retail outlets will offer a broad range of purchase options, including the sale of restricted fare media and fare products, such as senior C2 cards and student C2 cards.

Institutional C2 customers, such as businesses, social service agencies, schools, and universities, may purchase and issue C2-branded fare media to eligible employees, participants, or students. Program administrators for institutional C2 customers will be provided secure access to an online account management function that will allow them to purchase C2 fare media, associate fare media with program participants, purchase C2 cash value or fare products, and assign/remove C2 cash value or fare products to program participants.

**C2 customers will have convenient options to purchase C2 cards from retail outlets throughout the Bay Area with numerous available sales outlets in each of the service areas of all partner agencies (2)**

The Clipper® retail network will continue to play an important ongoing role in the successful adoption of Clipper®. The retail network is especially critical to Clipper® customers who use cash because those customers cannot purchase online, and there are a limited number of options available to them for purchases.

**The C2 retail model will be based on an application-based approach (3)**

The retail model will be based on a “bring your own device” approach where the retailer provide a cellular communications-enabled tablet or other device loaded with a secure C2 sales application. This app-based approach will allow sales devices to be installed without the need for extensive infrastructure and will also allow easy expansion and replacement of devices as technologies change.

**Partner Agencies will continue to be responsible for distributing C2 cards to their staff in accordance with the agency’s policy (1)**

Partner agency staff currently receive Clipper® cards from their agency in accordance with the policies of that agency. The partner agencies are responsible for identifying and managing the list of eligible recipients, and distributing and removing cards to/from those recipients. Under C2 this approach is expected to continue.

#### *4.2.3.5 Virtual Media Management*

**C2 will enable the sale and distribution of virtual fare media (3)**

C2 media distribution will also include virtual fare media that resides on a mobile or wearable device and uses the near field communications (NFC) capabilities of the device to emulate the function of a C2 card. As with physical fare media, the distribution of virtual fare media will be tracked by the C2 system, from creation to purchase. The Trusted Service Manager (TSM) function will allow the C2 system to distribute virtual fare media to “reader” devices in a secure manner with a record of all transactions.

### 4.2.4 Financial Management

The following diagram highlights the financial management capabilities and associated business functions. These are further described in the following sub-sections and related concepts.

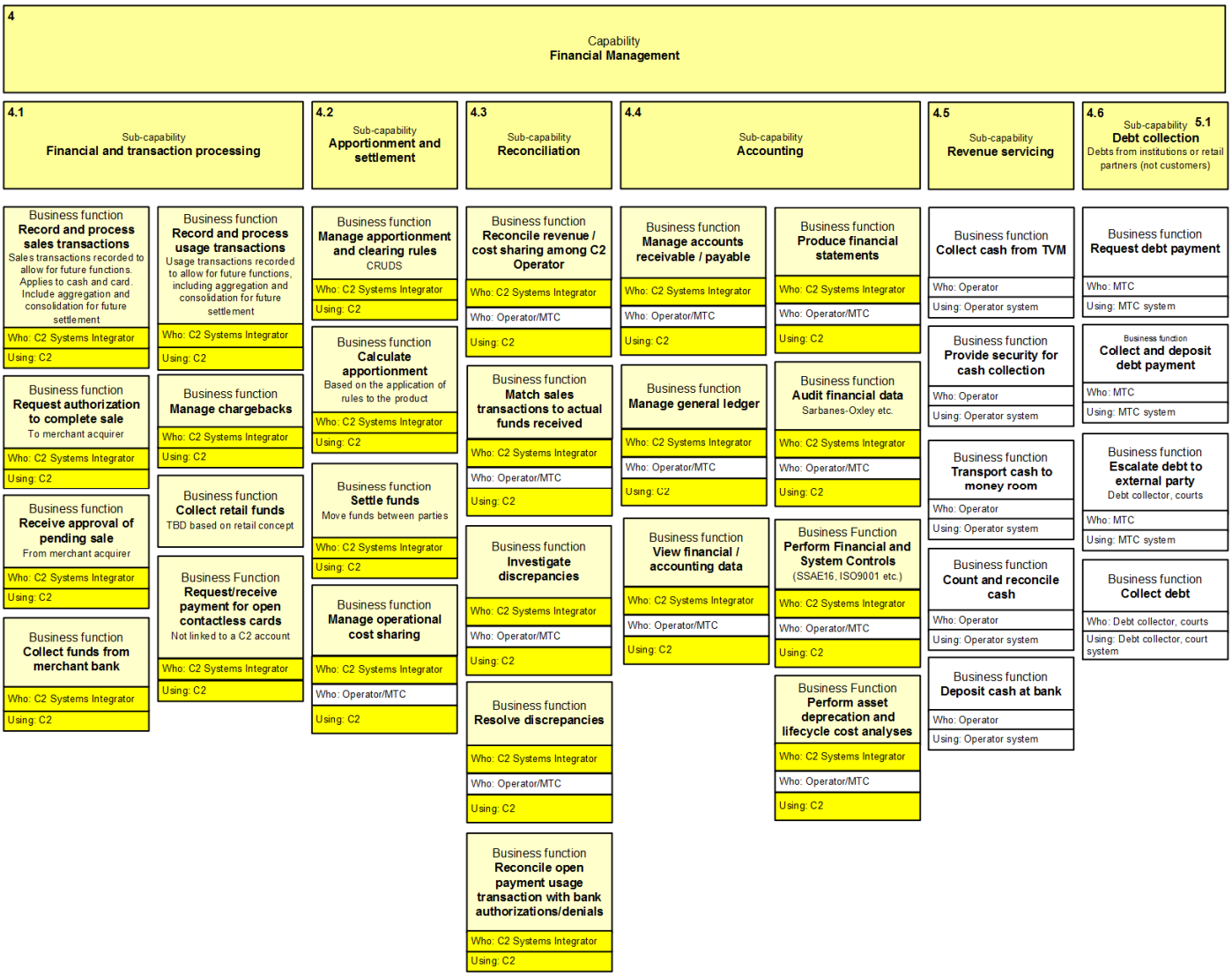



Figure 8: Financial Management Capabilities and Associated Business Functions

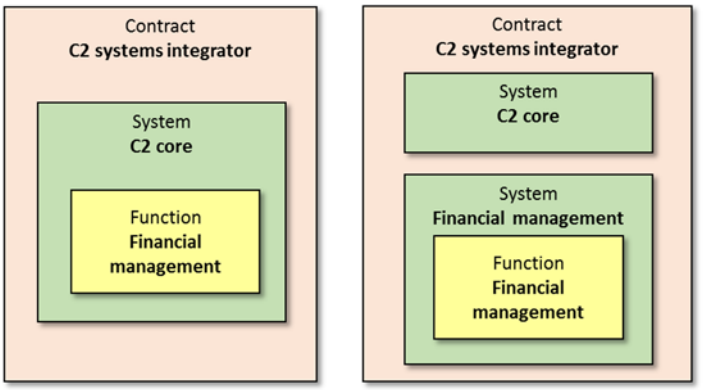
#### C2 will provide financial management functions to facilitate the performance of program financial processes and improve accountability and auditability (1)

C2 will provide flexible, configurable and expandable financial management functions that reduce the manual burden on the C2 program and partner agencies. Financial policies and procedures can affect both the partner agencies' costs and the customer experience and should be carefully considered and coordinated prior to implementation. The financial management functions required are:

- Financial statements
- Accounts receivable/accounts payable
- Financial reporting
- Reconciliation among C2 participants

- Reconciliation with banks and credit card issuers
- Reconciliation within the C2 system, including receivables, payables, and customer account balance totals reconciling to the trial balance
- Program auditing, to support partner agency and external audit procedures
- Financial performance reporting
- Asset depreciation and lifecycle costing
- Program liabilities, to allow for capital and operational cost-sharing among agencies in the future
- General ledger chart of accounts
- Configurable financial business rules
- Management of financial programs with institutional programs and stakeholders
- Management of customer financial programs, incentives, and fees

Such functions could be acquired as part of the C2 core system or through a separate commercially available financial management function procured as part of the core system contract[3], as depicted in the diagram below. *However, it is not the intention to mandate one approach over the other, in order to avoid constraining vendor design choice and ability to innovate.*




When financial policies and procedures affect both program/partner agency finances and customer experience, it will remain important to coordinate and find balance between any potential competing needs.

### The Clipper® Contracting Agency will be the primary user of the C2 financial management functions; however, information will be made available to each of the C2 operators (2)

The primary user of the C2 financial management functions will be the Clipper® Contracting Agency, but partner agencies will have responsibilities as well. Access levels can be defined, and user interfaces customized, in the system to facilitate performance of C2 financial responsibilities and reporting by appropriate parties.

### The existing C1 financial management processes will serve as the basis for definition of the C2 financial management processes, with improvements identified (2)

The existing processes are outlined in various C1 documents, which will be reviewed and confirmed by the C1 operators as the basis for definition for C2 system operation. However, with

[3] Or through a separate standalone contract, but this is not currently part of the acquisition strategy

enhanced functionality available through the C2 system and process improvements should be identified and considered.

**The C2 financial management functions should be expandable to accommodate financial processing for other programs in the future (3)**

The financial management functions should be expandable to include financial processing for other programs, such as FasTrak®, the Express Lanes Network, parking, last-mile providers, etc., and should allow for interfaces with other systems to facilitate data input in the future, as well as configurable business rules for allocating revenue and sharing costs for foreign transactions.

#### *4.2.4.1 Financial and Transaction Processing*

**C2 will enact fare policies, record all sales and use transactions, and process applicable credit card purchases for C2 sales at end devices (2)**

C2 will enact all fare policies, such as the value to be charged to a customer for purchase of a pass or the cost of an individual ride or transfer. Fare policies are envisioned to be identical in C1 and C2 at initial C2 launch; however, C2 will provide considerable flexibility to meet future agency fare policy needs such as time-based fares, accumulator passes, rider classes, etc. All sales and use transactions at C2 devices will be recorded in C2, and C2 will process credit card payment transactions through the designated merchant gateway(s) for collection of funds for sales and open payment transactions. In the event that credit card payment transactions are processed by a third party (e.g. a transit agency or retailer), C2 shall include the ability to reconcile sales against receipts from the third party.

**C2 financial management functions will calculate revenue allocation for the partner agencies, have the ability to distribute operating costs, and maintain the financial position of individual customer account (1)**

The financial management functions will consolidate all information required to determine the revenue allocation among partner agencies. Financially relevant information that will impact revenue allocation may include, but is not limited to, sales and use transactions from C2, bank fees, chargebacks, and customer refunds/adjustments, and may originate from various external systems or vendors. C2 may choose to distribute operating costs through the financial management function, and partner agencies may need to verify the cost distribution. Customer account financial information will be maintained by the C2 financial management function.

**Sales of C2 fare products (e.g., cash value, parking value, transit passes) and cards from external sources must be accounted for in the C2 financial management functions (2)**

C2 will record all product sales including those performed by third parties. The process of collecting funds from the third-party sales will provide the appropriate data to the C2 financial management function to enable revenue distribution among partner agencies and allocation of costs such as commissions and fees.

**C2 will provide a consolidated merchant gateway capability while still supporting partner agency-specific gateways. (2)**

In order to reduce the fees for credit card processing throughout the region, C2 will include the capability to support a consolidated merchant processing/gateway. However, it will also be able to accommodate multiple merchant processor/gateway services in the event that one or more partner agencies decide they want to use their own merchant processor/gateway.

The merchant gateway(s) utilized in C2 will include functionality to process chargebacks and send relevant chargeback information to the C2 financial management functions. C2 will provide

flexible and configurable fraud management capabilities based on chargeback information to enable blocking of an account, removal of disputed value, and other actions to reduce or prevent revenue loss.

**The C2 financial management functions will collect all financial data required for calculating revenue allocation and the flexibility for future collection of other cost-sharing data (1)**

The C2 financial management functions require detailed sales and use transaction information for calculation of revenue allocation and settlement among partner agencies. Other information required for revenue allocation, such as bank settlement and fees, card sales, chargebacks, refunds/adjustments, should be provided to the C2 financial management functions as well.

Flexibility should be provided for enabling automated interfaces in the future for C2 program cost elements, such as retail commissions, customer service provider fees, and other operational costs from external systems.

**The C2 financial management functions will provide various options for supplying financial data to the partner agencies (1)**

C2 should allow for financial data to be extracted in a variety of formats, including reports, raw data, and application program interfaces (APIs), so relevant information can be provided to partner agencies. Interfaces between the C2 financial management functions and the financial management functions of the partner agencies is not envisioned.

**The operating agency financial systems will be independently operated from the C2 financial management functions (1)**

Provided that all partner agencies use the same Chart of Accounts for C2, the financial systems in use at each partner agency do not need to be identical to the C2 financial management function. C2 financial management data can be supplied to the partner agencies to perform their internal business functions related to C2; the C2 system should accommodate an interface to integrate with external financial systems, should an agency desire the ability to automate data exchange. Access to the C2 financial management function may be given to partner agencies as needed to perform their C2 responsibilities. These divisions of responsibilities will be further defined during the technical specification development phase.

#### *4.2.4.2 Apportionment and Settlement of Funds*

**C2 fare policy will be implemented in C2 (1)**

Fare policies for sales and use of each fare product (e.g., cash value, parking value, transit passes) will be configured in C2. Current C1 fare policy will be replicated in C2 at initial C2 launch. The C2 system will provide considerable flexibility to meet future agency fare policy needs such as time-based fares, accumulator passes, rider classes, etc.

**The C2 financial management functions will enable users to configure financial business rules to enable the distribution of revenue and sharing of liabilities among C2 participants (1)**

The C2 financial management functions will be the single source for calculation of revenue allocation for the C2 program and will also be capable of calculating cost-sharing and allocation for the C2 program.

Revenue apportionment and settlement business rules will be fully configurable within C2. Each fare product (e.g., cash value, parking value, transit passes) may have unique business rules for distribution of revenue among participants, based on sales, use, or other formulas. Other types of transactions relevant to revenue sharing, such as chargebacks, credit card processing fees,

banking fees, and so forth, may also be applied to the revenue distribution calculation according to configurable formulas, and the C2 financial management functions will provide this functionality and flexibility.

Revenue settlement frequency in C2 will be configurable. Currently in C1, settlement is performed daily. MTC and the partner agencies will determine the frequency of revenue settlement (i.e., daily, monthly, other) for C2 prior to C2 implementation. C2 should be configurable to easily allow changes to the overall settlement frequency, as well as the frequency of inclusion of certain elements of settlement (e.g. some elements may be included daily, some included monthly). Exception transactions and manual adjustments will be handled by business rules. Initial revenue settlement frequency for C2 is to be determined.

C2 should also be capable of calculating the distribution program operating costs and liabilities, such as retail merchant commissions, customer service fees, and numerous additional costs that could be allocated and shared among partner agencies, according to configurable business rules. Each cost element may have unique business rules, and the C2 financial management function should provide significant flexibility for defining rules, formulas, and frequency for allocating costs among partner agencies. It is envisioned that, initially, C2 cost-sharing will be performed outside of the C2 financial management function.

The financial management functions will require access to C2 ridership and revenue data in order to calculate apportionment of revenue and costs, to support the settlement frequency for these activities.

**The Clipper® Contracting Agency will hold C2 accounts and enact funds transfer for C2 revenue settlement on behalf of the region (1)**

The Clipper® Contracting Agency may authorize the C2 system integrator to enact funds transfer with oversight and auditing from The Clipper® Contracting Agency or contract holder.

**The C2 financial management functions will provide flexibility to settle on a cash basis and receivables basis (1)**

Today the C1 program settles revenue with C1 partner agencies on a receivables basis. C2 will provide flexibility to settle based on cash and receivables, as well as a combination of the two approaches (e.g., sales and use that operators may settle on receivables while sales from a third party may settle on a cash basis). As part of the settlement, a reconciliation will be performed to verify the financial data reported.

**C2 will provide extensive reporting capabilities for the Clipper® Contracting Agency and its partner agencies to facilitate reconciliation and to investigate and resolve discrepancies (1)**

C2 will provide a set of reports customized to support financial business processes, with content and format to be defined by the Clipper® Contracting Agency and its partner agencies. C2 will also provide the capabilities for the Clipper® Contracting Agency and its partner agencies to modify the customized reports as well as to generate ad hoc reports. In order for financial reports to match core system data, the C2 system will provide near-real-time data updates. Reporting and reconciliation in C2 will enable tracking of orders from the creation through funds collection through fulfillment of the order.

#### *4.2.4.3 Accounting*

**C2 will hold a single General Ledger Chart of Accounts for C2 Financial Business Operations (2)**

The C2 General Ledger Chart of Accounts will be defined and maintained in the C2 financial management function. The Clipper® Contracting Agency will define the requirements for the C2

General Ledger Chart of Accounts with input from the partner agencies. The vendor will develop and maintain the General Ledger Chart of Accounts. Individual agencies may have different charts of accounts in their own financial systems, with a translation between the C2 General Ledger Chart of Accounts and the agency-specific chart of accounts, if needed to support data export. The General Ledger shall be generally accepted accounting principles (GAAP) compliant and shall include a trial balance.

**The C2 Financial Management functions will provide various levels of access to facilitate performance of financial management responsibilities by the Clipper® Contracting Agency and its partner agencies (2)**

The Clipper® Contracting Agency and the operators will have specified financial management responsibilities to support the C2 system, and staff assigned to perform these responsibilities. The financial management functions will provide various configurable levels of permissions and access to enable the Clipper® Contracting Agency and operator personnel to perform the appropriate C2 financial tasks.

**C2 will be audited annually, and the system design will facilitate the audit process (2)**

C2 will be audited annually, at a minimum, by the external auditors for the Clipper® program, and the audits will be performed using and in accordance with generally accepted auditing standards (GAAS). The design of the C2 Financial Management functions will provide easy access to data on C2 funds collection and disbursement, as well as cost-sharing, to facilitate Clipper® program auditing.

**C2 will enable appropriate financial controls (2)**

C2 will be in compliance with financial controls regulations, such as Sarbanes-Oxley and SSAE16. The vendor(s) will be responsible to engage appropriate measures to maintain and demonstrate compliance to appropriate regulations. The Clipper® Contracting Agency will perform audits of the C2 system integrator and vendor(s) as necessary in support of this compliance.

#### *4.2.4.4 Revenue Servicing*

**All Clipper TVM revenue servicing will be performed by partner agencies (2)**

The Clipper® program will not include in its scope TVM revenue servicing (cash collection from TVMs); this will be the responsibility of the operators and subject to their own work rules.

It is likely C2 will be required to provide some form of verification and accounting of the revenue collected from these TVMs, however, as part of its Financial Management functionality.

Only the operator or the party responsible for the revenue servicing or auditing should have control over who has access to TVM.

#### *4.2.4.5 Debt Collection*

**Debt collection under C2 will be the responsibility of the Clipper® Contracting Agency (2)**

It is assumed that debt collection will be wholly performed by the Clipper® Contracting Agency; however, C2 may support the debt collection process by providing reports as required.

### 4.2.5 Data Management

The following diagram highlights the data management capabilities and related business functions and actors. This capability includes key concepts for data storage, data location, analysis, presentation, exporting, and configuring data.

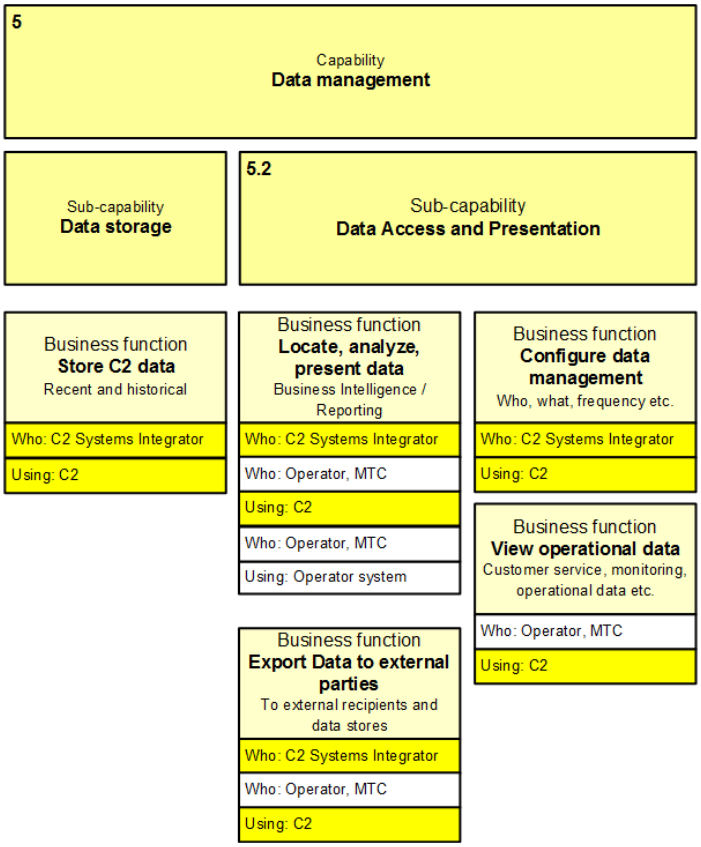
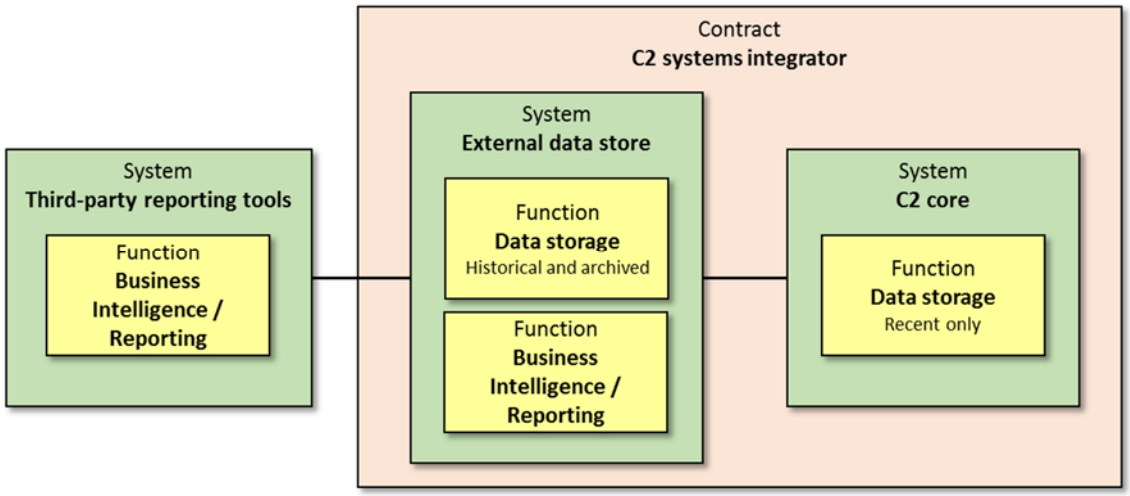



Figure 9: Data Management Capabilities and Associated Business Functions

A simplified conceptual functional architecture for data management is below.



#### *4.2.5.1 Data Storage*

**C2 will enable the storage of recent C2 data within the core system (1)**

C2 will store recent data in the core system. *Recent data* will include operational data such as customer account information, business rules and recent transactional data of a certain age.

As the recent data ages beyond a certain point, it will be considered *historical data* and moved to the external data store in line with relevant data retention regulations.

**C2 will enable C2 data to be stored and managed independently from the core system, without affecting core system performance (1)**

C2 will include an external data store that stores C2 data external to the core system. The external data store will be delivered as part of the C2 program, but will be architecturally, operationally, and contractually external to the core system. The external data store will store a mirror of the recent and historical C2 data held in the core system, in a manner that enables authorized users to query, locate, and retrieve stored data flexibly, quickly, and easily through reporting tools without affecting core system performance.

The external data store shall be capable of being maintained, upgraded, and disabled without degrading the functionality or performance of the core system.

**C2 shall include a system of record with a robust audit tracking capability (2)**

The data residing in C2 shall be the single, authoritative record of all Clipper® data—a decision must be made regarding which C2 sub-system is the system of record. C2 must provide robust audit tracking; further, records/files must not be overwritten without confirmation and posting to an audit log.

**C2 will not preclude data from other sources being stored in its external data store (2)**

The data needs of the region are growing. The need to enable the storing and analyzing of regional data means that C2 should be architected to allow regional partners to utilize its external data store to store their data in the future. This could potentially include C1 during any operational overlap phase, other MTC or partner agency systems, and regional programs operated by MTC or other parties, such as tolling.

**C2 will provide an external long-term data storage capability (3)**

C2 will enable the long-term storage of historical C2 data that has aged beyond the relevant data retention period. Such data will be moved to long-term storage in a manner that still enables searching should queries arise but does not need to provide for quick and flexible querying through reporting tools. Conceptually, this could be achieved through storage in slower to access data media (such as tape storage), although with the advances in cloud data storage technologies likely over the next decade, it is conceivable that the external data storage vendor may propose an alternative solution that allows for quick flexible access to *all* data stored.

**C2 will define a re-usable interface to the external data store (1)**

An interface between the C2 core system and the external data store will be defined to enable data to be transferred from the core system to the external data store. The interface will be designed to be re-usable for other future non-C2 data sources that might also export data to the external data store.

The re-usable interface shall be capable of being maintained, upgraded, and disabled without degrading the functionality or performance of the external data store or the core system.

### C2 will enable data storage configuration without the need for vendor change orders (1)

It is impossible to define now exactly what data needs to be stored over the life of C2. Therefore, to minimize whole-life cost, C2 should enable maximum flexibility to change the configuration of its data storage capabilities (both core system and external) without the need for a vendor change order. Potentially this could be achieved through the provision of a vendor service contract that includes data storage configuration within its scope, although other options will also be explored.

Configuration parameters will be defined during the C2 requirements phase, but could include what data gets stored, how frequently it gets pushed to the external data store, allowance for changes to data retention rules, and access permissions.

### C2 will enable data to be managed in line with data retention requirements (1)

C2 will enable the management of the data stored, both in the core system and the external store. Such management actions might include data purging (e.g., freeing up space in the data store or deleting obsolete data no longer required by the system, based on the age of the data or the type of data.), archiving (e.g., making a copy of the data that is purged) and deleting (e.g., removing the data from the data store without making an archived back-up). Such management actions will be controlled by the relevant data management and retention regulations.

### All vendors and partner agencies will store and manage all C2 data in accordance with all applicable regulations, statutes and policies (1)

C2 will also process and store all data in compliance with all relevant regulations, such as Payment Card Industry (PCI) security standards.

The Clipper® Contracting Agency, the partner agencies, and C2 system integrator/vendors will also have access to personally identifiable information (PII) in connection with the performance of their Clipper® program responsibilities and activities. PII is any information that is collected or maintained by a partner agency that identifies or describes a person or can be directly linked to a specific individual, including that individual's account. Examples includes name, address, phone number, and social security number.

The Clipper® Contracting Agency, the partner agencies, and C2 system integrator/vendors shall adhere to all relevant policies, statutes and regulations regarding the handling of personally identifiable information, including but not necessarily limited to:

- MTC Privacy Policy, in the Executive Director's Management Memorandum No. 323
- California Information Practices Act (Civil Code sections 1798 et.seq)

Any breach or potential breach of these regulations identified by the partner agency or C2 system integrator/vendors should be reported to MTC within two hours of discovery, as defined in the Clipper® Operating Rules.

#### *4.2.5.2 Data Access, Business Intelligence and Reporting*

The demand for transparency from federal, state, and local jurisdictions has become paramount in public transit. Transit agencies have been put under pressure to increase the frequency, volume and delivery options for their reporting. To assure compliance and on-going grants and funding, regulatory reports must be timely, accurate, and provide data in a variety of formats. Compounding this challenge is that information is often complex in an inter-agency organization. Managing reporting and the pertinent data are key capabilities provided in C2 that will support the generation and delivery of reports, including regulatory reports.

### C2 will enable partner agencies to access to agency-specific raw data, prior to any processing occurring (1)

Partner agencies will be able to access recent C2 data relevant to their agency before it undergoes any fusion or processing with other data. C2 will enable partner agency authorized users to locate and export from the system such raw, pre-processed data.

### C2 will enable partner agencies to access agency-specific processed data (2)

Partner agencies wish to access processed data down to the individual transaction level to support transaction-level reconciliation with partner agencies. C2 will enable partner agencies to quickly and readily access such operator-specific processed data.

### C2 will enable configurable access to its data (1)

While C2 is a regional system, access to all data it stores (including that in the core system and external to it) should be controlled through access permissions configurable by an authorized user. Examples of control might include ensuring only users from a particular agency have access to data from that agency.

### C2 will enable access to statistically representative samples of anonymized personal data (1)

C2 will hold a huge amount of data that can be used for planning and analysis purposes. Such data will include personal information, storage and access to which is subject to applicable privacy laws. C2 will enable authorized users to access statistically representative samples of suitably anonymized personal data.

### C2 will include basic Business Intelligence and Reporting functions in the core system but the ability to run queries against the core system will be highly limited to avoid impacting system performance (1)

C2 will provide a basic business intelligence and reporting functionality with the core system. However, the ability to run queries against the core system will be highly limited to avoid impacting system performance. Most queries will be run against the external data store instead.

The use of third-party reporting tools to access data stored in the core system will not be enabled to avoid potential system performance and integrity impacts.

### C2 will include Business Intelligence and Reporting functions with the external data store (1)

Authorized C2 users will have access to a business intelligence and reporting capability provided with the external data store. Such a capability will enable users to locate, view, and analyze stored recent data and generate reports.

To minimize whole-life cost, reports will be fully user creatable, configurable, and re-usable and will not require vendor input to create, replace, update, or delete.

### C2 will enable authorized users to access externally stored data using third-party reporting tools (1)

C2 will provide an open, flexible access to recent, historical, and long-term data stored in its external data store to authorized users with their own third-party reporting and analysis tools (not provided through the C2 program) via a defined, re-usable interface.

All such data access will be subject to appropriate security controls.

### C2 will enable its data to be exported to external parties, subject to security controls (2)

External parties will request C2 data—examples could include for financial or audit reporting purposes or senior management requesting data. C2 will, therefore, include a capability to export data from the core system in readily readable formats, including both its raw form and also in a report form. Such external exports will be subject to appropriate security controls to avoid creating security weaknesses—both in terms of technical and procedural measures. It is expected that only authorized users will be able to perform exports, following an approved request from an authorized user.

### C2 will enable authorized users to access read-only operational stored data through user-friendly interfaces (1)

To support the operation of C2, authorized users will require read-only access to certain operational recent data. Examples may include partner agency staff requiring access to customer account data; accurate and up to date information on customer service actions related to their agency, such as call volume, call purpose, and fare adjustments issued; partner agency maintainers requiring access to system monitoring and health data; and partner agencies requiring access to operational data such as faregate throughput. C2 will enable such authorized users to locate, view, and edit such data through user-friendly interfaces accessible both when connected to the system as well as remotely through an appropriately secure connection. Such user interfaces may include dashboards for presenting summary or aggregated data.

### C2 will support future access to historical data for transit applications developed by others (3)

BART is exploring the usage of “gamification” applications to encourage transit ridership. Such applications, which provide game ‘points’ for using transit and allows players to convert these points into fare products or value, would require access to historical data.

C2 will not preclude future access to historical data for transit applications developed by other authorized participants, subject to applicable privacy laws. Gamification access must be opt in for third parties to have data access.

### C2 will collect and make available data to support better customer, operational, and governance decision making (2)

C1 does not provide sufficient quality data to enable informed customer, operational, or governance decision making. To better support evidence-based decision making C2 will provide expanded capture and reporting of a wider range of data, with a focus on customer, capital, and operating costs and transactions.

Data may include vendor costs, MTC costs, partner agency costs and transactions with clear demarcation between cost types and sources. All such data would adhere to appropriate privacy and access requirements.

### 4.2.6 Data Exchange

C2 will need to exchange data between its sub-systems and with external systems controlled by another party. The diagram below left highlights the certification management business functions and actors.

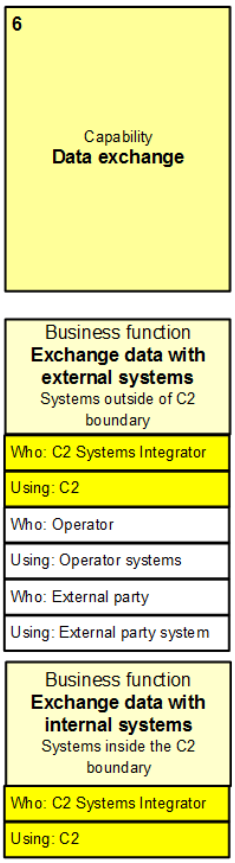



Figure 10: Data Exchange Capabilities and Associated Business Functions

**C2 will enable the exchange of information with external systems (2)**

C2 will exchange information through interfaces to external systems, potentially including BART'S Data Acquisition System (DAS) and RTC's Discount Card Processor.

**C2 will enable the exchange of information with internal systems (2)**

C2 is a system of systems, with several vendors expected to provide sub-systems and services that together constitute C2. C2 will need to enable information to be exchanged between such sub-systems as necessary to perform its functions.

### 4.2.7 Certification Management

The diagram below left highlights the certification management business functions and actors.

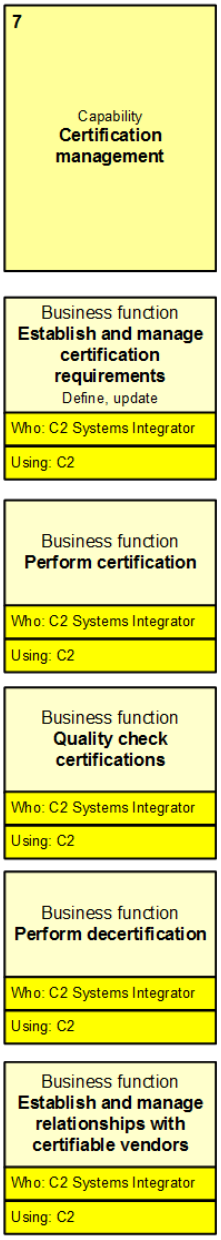



Figure 11: Certification Management Capabilities and Associated Business Functions

**C2 will include a certification program to certify third-party vendor products (2)**

The open architecture of the Clipper® program will provide the ability to certify multiple alternate hardware and software solutions for potential integration into C2. The definition and update of certification requirements will be managed as a discrete business function within C2 assuring that vendor solutions are certified to C2 requirements and that vendor certifications undergo a quality check.

Conformance to specifications will be required to achieve interoperability between devices for all media, reader hardware, antennae, software, and applications. Test specifications will be developed to verify compliance and adherence to certification requirements using established industry standards where possible, including, but not limited to, MasterCard® PayPass (or MasterPass), Visa payWave, American Express ExpressPay, as well as PCI requirements.

**C2 will provide a base certification management program, but partner agencies may elect to certify additional options (2)**

Partner agency-specific certifications may include communication networks, installation requirements and techniques, mobile apps, payment gateway, and agency-specific hardware procurement processes. The use of agency-specific options will require partner agencies to meet all C2 quality and certification program requirements to assure full interoperability with C2. Certification of the agency-specific certifications may be performed by a third-party certification manager or self-certified by the partner agency or the Clipper® program.

### 4.2.8 Operational Support

C2 will generate large amounts of data, both real-time and historical, that can be used to support and improve operator operations. The diagram below left highlights the operational support business functions and actors.

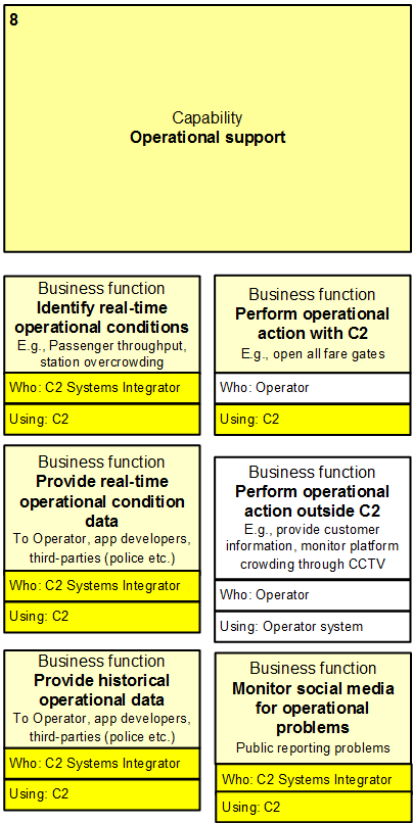



Figure 12: Operational Support Capabilities and Associated Business Functions

#### C2 will collect and make available real-time data to support operations (2)

Data collected by C2 can be used to support operational decision making in real-time. C2 will enable authorized users to define certain conditions that may be of operational interest. C2 will monitor its data, and, once such a condition arises, C2 will make the defined action, such as alerting a user (perhaps via email or text), or by passing an alert to another external system The system could simply provide the raw data to an external user or system, provide an alert when certain thresholds have been met (such as customer throughput), and/or provide a user interface (UI) that allows users to locate and view data held in the system.

At times of high customer throughput or station crowding, partner agencies could make more informed decisions on real-time customer communications strategies based on information provided by C2. Examples might include PA announcements and dynamic signs, customer alerts (e.g., text, email), social media (e.g., Twitter).

#### C2 will make available anonymized real-time data for third party web and mobile app developers (2)

Federal agencies including the National Weather Service and Census Bureau have shared their data publicly for years. Transit agencies like Washington Metropolitan Area Metropolitan Transit Agency (WMATA) hosts all regional transit data on its website in a way that developers could access.

Third-party developers could create websites, web apps, and smartphone apps to provide a way to plot the fastest, easiest trip using real-time ridership in conjunction with schedule data, alerts, fares and Google maps

#### C2 will collect and make available historical data to support operations (2)

C2 will store historical data and make it available for operational, safety and security planning and improvement purposes. Data collected could include transaction date/time, operator, station or bus garage, device id, route/run, fare media/product/concession use and sales, payment type (transit issued closed loop, bank issued, mobile phone), global positioning system (GPS), automated passenger counter (APC), schedules, and ridership data.

C2 will facilitate Operational Planning using historical data, such as the following:

- Management of bus/rail fleets and schedules
- Forecasting ridership and revenue
- Analyzing fare policy changes
- Planning service changes

- Planning for events and tourist
- Adapting to changes in ridership patterns
- Coordinating with partner agencies
- Identifying opportunities and issues proactively by analysing historical trends

### C2 will enable appropriately authorized users to improve or support safety and security through access to historical data (2)

This could include the following:

- Sharing data with emergency services, first responders, and government agencies
- Controlling fate gates, e.g., open all gates for fire/earthquake or other threatening conditions
- Participating in safety and security incidents, for example, helping to locate a specific person suspected of a crime or to support an AMBER alert for a missing child. This concept would need careful consideration of the privacy implications and legal requirements for accessing the data (warrants, court orders, etc.).
- Preventing fraudulent usage analysis to identify fraudulent usage patterns or behaviors, including fare evasion and discount abuse. Identification could be manual (a human reviews the data) or system-performed (the system scans the data and identifies potential issues—either automatically or when initiated by an operator).
- Supporting the creation of safety and security management plans dealing with peak periods and vehicle or station overcrowding

### C2 will seek to reduce operator workload by supporting integration with operational systems such as computer aided dispatch/automated vehicle location (CAD/AVL) (2)

- To reduce partner transit operator workload, C2 equipment could enable single sign-on to all on-board systems including the fare collection system, passenger displays, route/run/fare data, and the CAD/AVL system.
- Integration to on-board systems frees up the driver to focus on driving the bus. The driver simply taps their C2 Employee ID card to the reader and is signed on to all systems. C2 integration could eliminate multiple sign-on and input of operational data.

*Note*: Need to better understand which partner agencies have (or will have) CAD/AVL and how this might integrate the C2. This analysis will be performed during the requirements phase.

### The C2 system integrator will monitor social media channels to determine potential operational or maintenance problems (2)

The C2 system integrator will monitor the Clipper® social media channels for customers reporting operational issues that may require the vendor and/or the partner agencies to take operational or maintenance actions.

## 4.2.9 Fraud and Security Management

The diagram below left highlights the fraud and security management capabilities and associated business functions described in the concepts.

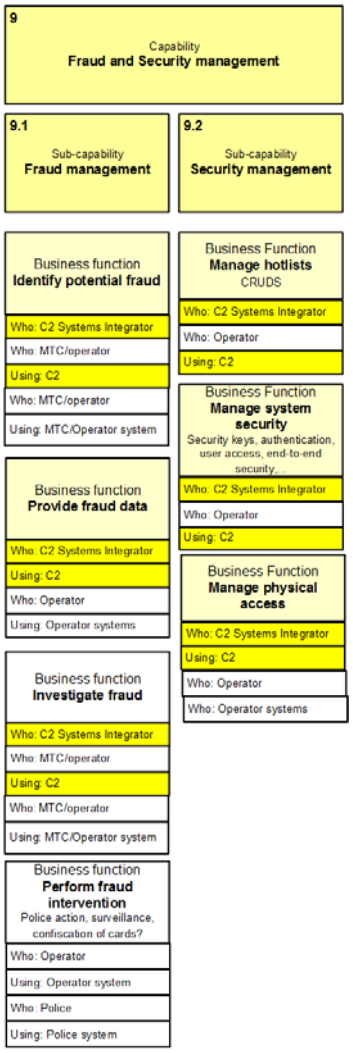



Figure 13: Operational Support Capabilities and Associated Business Functions

### *4.2.9.1 Fraud Management*

Fraud Management supports the prevention, education, and investigation of fraud-related matters. This includes the identification of fare evasion, organized fraud rings, computer fraud against partner agencies, distribution and sale of counterfeit fare materials, credit/debit card fraud, corporate fraud, and misconduct involving fare-related issues and employees.

**C2 will provide insight to partner agencies on sales, distribution, and use of fare products to proactively identify fraudulent action and enable fraud intervention (2)**

Fraud management techniques employed may include data mining and pattern recognition, including rules-based expert systems and machine-based identification of fraud characteristics. Statistical sampling may be employed to identify potentially rare fraud events.

**C2 will provide analytic tools and algorithms to identify fraud and provide deterrent and resolution of fraud events (2)**

C2 may employ advanced fraud prevention features utilizing tools and algorithms that have been successfully employed in the payment card industry. These may include, but are not limited to: Peer Group Analysis, which is used to detect individual patterns that begin to behave in a way different from patterns that had previously been similar, and Break Point Analysis, which operates on an account level to detect anomalous behaviour.

### *4.2.9.2 Security Management*

**C2 will provide a modern, flexible account flagging/hotlist capability (1)**

The C2 system will maintain a centrally located hotlist, or negative list, of blocked accounts. C2 devices may also store the hotlist/negative list locally, and receive updates from the centrally located list. The capability to query and edit the hotlist/negative list shall be limited to authorized users and devices only.

**The Clipper® program will consider potential security requirements for enhanced customer identification (3)**

Unlike airlines, transit systems are considered ‘soft readers’ for terrorism. It is conceivable that security requirements may be placed on transit systems to support enhanced security features such as passenger identification or screening of potentially hazardous materials.

The Clipper® program should, at a minimum, consider how such future requirements may (or may not) be accommodated.

**Requests to access physical assets could utilize a C2 card as means of identification (3)**

Access to physical assets, such as security doors and TVMs, will be decided and controlled by the partner agency/asset owner. While C2's primary mission is a fare collection system, C2 could potentially support such access by enabling a C2 card to be used for identification purposes.

## 4.3 Maintenance Concepts

Maintenance is the set of activities that ensure the Clipper® system continues to meet its functional and performance requirements throughout the operational phase. The maintenance phase runs concurrently with the system's operational phase.

The C2 maintenance capabilities are:

- **System maintenance** – system configuration, system monitoring and control, first and second maintenance, maintenance depot management, central systems, software and interface management.
- **System configuration management** – identifying and recording the items that comprise the system, reporting on the configuration of those items and implementing changes to those items.
- **Asset management** – refreshing system assets, and collecting and maintaining information on system assets
- **Business continuity** – providing continuity of service following significant unplanned events

### 4.3.1 System Maintenance

The following diagram highlights the system maintenance capabilities and associated business functions.

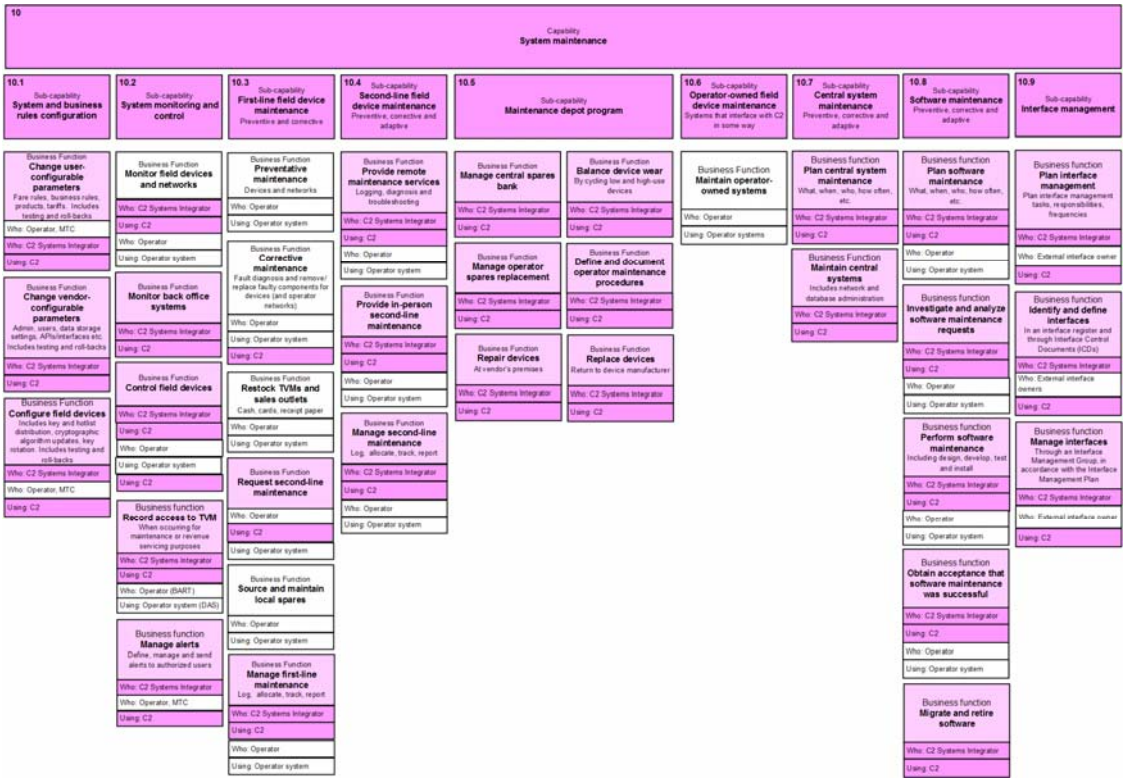



Figure 14: System Maintenance Capabilities and Associated Business Functions

#### *4.3.1.1 System and Business Rules configuration*

These concepts describe the configuration of the C2 system necessary to meet the initial and evolving needs of the region.

**C2 will enable authorized users to change certain parameters without the need for vendor involvement or change orders (1)**

Business rules such as fare rules, transfers, products, and security access lists are examples of parameters that might change relatively frequently over the operation of the system. In order to reduce whole-life cost, such parameters will be configurable by the appropriately authorized users without the need for software development and/or vendor change orders. Authorized users might include partner agency staff with appropriate rights to edit business rules. C2 should also include enabled authorized users to schedule a future 'effective date' for business rules, see history of previous rules, and roll back to previous versions.

**The C2 system integrator will still play a role in system configuration (1)**

Although C2 will enable users to make changes to certain parameters without vendor involvement or change orders, it is still anticipated the vendor(s) will be required to perform certain configuration tasks with the system, including changing system permissions such as user access, and configuring field devices including key and hotlist distribution, cryptographic algorithm updates, and key rotations.

The C2 system integrator should be prevented from configuring parameters that may impact operation conditions such as patron flow.

### The C2 system integrator and some partner agencies will perform field device configuration (2)

Field device configuration will include key and hotlist distribution, cryptographic algorithm updates, and key rotation. The C2 system integrator will be responsible for all field device configuration unless specifically requested otherwise by a partner agency. In order to avoid security breaches or damages to the Clipper® brand, partner agencies will only be permitted to perform field device configuration when they can provide adequate assurances on quality control to the Clipper® program.

#### *4.3.1.2 System Monitoring and Control*

### C2 will enable remote monitoring and control of connected field devices, while allowing partner agencies to continue their own local monitoring and control as desired (1)

C2 is distributed across a wide geographic region. To simplify maintenance and reduce costs, C2 should enable authorized central users to monitor and control the devices and networks connected to the central system, potentially including connected legacy C1 devices still operational under C2. The remote monitoring and control functionality should be available only to those partner agency or vendor staff who are directly responsible for the operation of C2.

Monitoring could include checking device status or health, and control could include opening or closing gates, powering down and restarting devices, and potentially more advanced controls such as two-way communications and control to allow a central operator to communicate with a person located at a field device and perform certain device functions remotely, such as issuing refunds.

Most partner agencies perform monitoring and control of their field devices independently of other partner agencies and MTC. Some operating agencies have staff, such as maintainers or station staff, on the ground who are well-placed to monitor and control devices without the program needing to incur costs to perform this function, and so some partner agencies may elect to perform monitoring and control activities themselves instead of C2, and not all field devices and agency systems may be available for central monitoring or control.

### The C2 system integrator will monitor all back office systems (1)

The C2 system integrator will be responsible for the monitoring of all back office systems it provides under the C2 contract.

### C2 may record when TVMs are accessed for maintenance purposes (2)

C2 should be capable of recording when TVMs were accessed for maintenance purposes. Records or event data related to TVM access will be managed by the applicable TVM control system.

### C2 will include an alert management capability (2)

C2 will issue alerts to authorized users when certain conditions occur. An alert management function should be included allowing authorized users to configure who receives what alerts through which channels under what conditions. Alerts could be sent to partner agencies, MTC, and/or the C2 system integrator.

Example alerts could include alerting a partner agency's first-line maintainer of a potential first-line maintenance intervention that is required, alerting station staff to operational conditions affecting safety and security at that station, alerting financial analysts to certain financial conditions, and alerting customer service personnel to conditions that might degrade the system's performance to customers.

Consideration should be given to avoiding 'alert fatigue' which can occur when too many alerts are received with insufficient ability to determine significant alerts from minor alerts.

#### *4.3.1.3 First-Line field device Maintenance*

**Partner agencies will perform first-line maintenance of all C1 and C2 field devices installed on their properties (2)**

This concept extends the approach to first-line maintenance from C1, and partner agencies will be responsible for preventive maintenance, corrective maintenance including fault diagnosis, and removal/replacement of faulty components, restocking TVMs, and requesting second-line support from the vendor.

The Clipper® Operating Rules define first-line maintenance as:

- Routine equipment checks
- Resolution of minor operational problems such as dollar bill jams and card dispensing jams
- External equipment cleaning
- Internal component cleaning and lubrication (distribution devices only)
- Running diagnostics tests
- Removal and replacement of depot maintenance devices and modules
- Labor for scheduled replacement of devices and modules

Some partner agencies may elect to instead source first-line maintenance services from a third-party, including, but not necessarily, the C2 system integrator.

**Partner agencies will be responsible for sourcing and maintaining their own C2 spares for first-line maintenance (3)**

If a Line Replacement Unit (LRU) fails, the partner agency will attempt to resolve the issue through first-line maintenance actions. If this fails to resolve the issue, the operator will be responsible for returning it to the C2 system integrator maintenance depot for repair/replacement.

When sending the LRU to the maintenance depot, the operator must replace the defective item with a functioning spare, and partner agencies will be responsible for sourcing and maintaining sufficient levels of C2 spares to meet their needs. Under this approach, partner agencies may elect to purchase C2 spares through the C2 contract and store them locally, or make arrangements for a third-party vendor (including, but not necessarily, the C2 system integrator) to provide them on an as-needed basis.

**C2 will provide a centralized maintenance management capability for first-line and second-line maintenance (1)**

C2 will enable the viewing and creation, schedule, allocate, track and report on maintenance actions, including preventative maintenance. It will allow first- and second-line maintenance to be tracked at both operator and system-wide levels. All partner agencies will be able to access the maintenance management function. Maintenance incidents will be able to be created manually by designated personnel using the maintenance management tool, as well as automatically based on device events and alarms received through the device monitoring system. The maintenance management system will have the capability to automatically generate emails and text messages when maintenance incidents are created or change in status.

**C2 will enable partner agencies to use their own Computerized Maintenance Management Systems (CMMS), should they exist to manage their first-line maintenance actions (3)**

A number of partner agencies (but not all) will have CMMS that are used to manage their first-line maintenance work. C2 will enable partner agencies to use these systems to manage their C2 maintenance work through an interface between C2 and the partner agencies' CMMS to avoid duplication of effort and information. In this instance, the partner agency's CMMS would remain their primary source of maintenance management information.

#### *4.3.1.4 Second-Line field device Maintenance*

**The C2 system integrator will provide second-line maintenance services for all C2 field devices (2)**

This concept extends the approach to second-line maintenance from C1, under which the vendor is responsible for second-line maintenance. Second-line maintenance is an action taken to resolve a defect that is preventing an LRU from performing its required function to the required level of performance that could not be resolved from a first-line maintenance activity. Such an action could be performed on-site or remotely through some form of second-line remote maintenance function.

The C2 system integrator would have responsibility for any required second-line maintenance provided by pre-certified C2 device manufacturers.

**C2 will enable partner agencies to perform their own second-line maintenance (2)**

BART, due to union rules, performs its own second-line maintenance. This approach is expected to continue for C2. Partner agencies will only be permitted to perform field device configuration when they can provide adequate assurances on quality control to the Clipper® program to avoid security breaches or damage to the brand caused by poorly-performed maintenance.

#### *4.3.1.1 Maintenance Depot Program*

**The C2 system integrator will provide a depot maintenance program for all C2-provided field devices (2)**

The C2 system integrator's depot maintenance program will include the provision of a central spares inventory, the replacement and repair of faulty components and supporting functions such as cycling low use and high use components to balance their rate of wear, and development of maintenance procedures for operating agencies.

To simplify the maintenance experience for partner agencies, the core system vendor will ensure sufficient spares for C2-certified device vendors are held in the central spare inventory, and will manage the contractual relationships with such vendors.

If an LRU fails, the partner agency will attempt to resolve issue through routine means such as restarting the device. If this fails to resolve the issue, the operator will replace the faulty LRU with one from their own spares inventory and will send the faulty LRU to the C2 system integrator for repair or replacement. The C2 system integrator will send a replacement LRU back to replenish operator's spares inventory and will then repair/replace the faulty LRU and place it back into their central spares inventory.

#### *4.3.1.2 Operator-owned field device system maintenance*

**Operator-owned systems that interface to C2 will be maintained by the owner (2)**

Several partner agency-owned systems will interface with one or more C2 systems. Such operator-owned systems may rely on data coming from C2 to perform fully their functions.

Examples include BART's DAS system and legacy fare gates and TVMs that will include a C2-provided fare reader integrated within them.

All such operator-owned systems that interface with C2 will be maintained by the owner of such systems and will not be the responsibility of the C2 program.

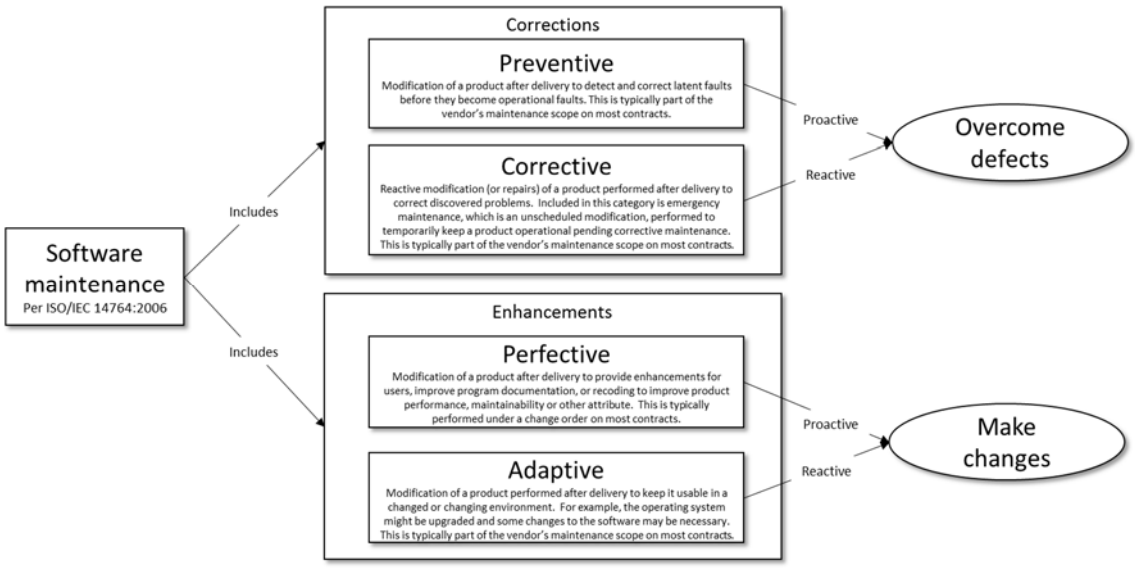
#### *4.3.1.3 Central System Maintenance*

**The C2 system integrator will be responsible for maintaining all central systems as a normal part of business (2)**

C2 system integrator will be responsible for maintaining the central systems, including internal networks and databases. Central system maintenance will include tasks such as database administration, performance tuning and network administration and problem solving.

#### *4.3.1.4 Software maintenance*

ISO/IEC 14764:2006 considers software maintenance to be comprised of four types as illustrated in the figure below.




**The C2 system integrator will be responsible for preventive, corrective, and adaptive software maintenance as part of its contract, with perfective maintenance done under change orders**

Software maintenance activities performed by the C2 system integrator will include the following:

- Plan and prepare for software maintenance
- Investigate and analyze maintenance requests to determine optimal response
- Perform the maintenance intervention, including development and testing
- Seek acceptance that the intervention was successful and that the maintenance intervention can be considered complete
- Software migration and retirement

Software will reside on central systems and field devices, and as such all systems will be subject to software maintenance tasks described here.

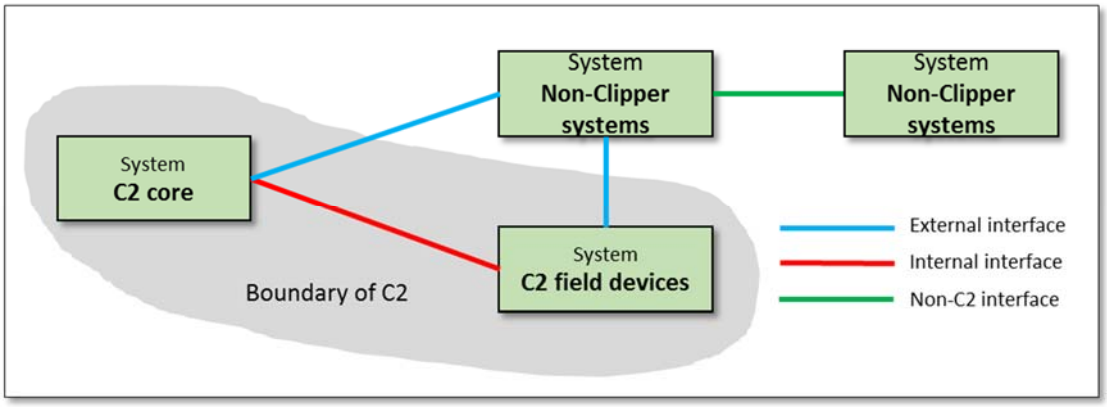
### Some agencies may wish to perform software maintenance tasks for field devices

Some partner agencies may wish to perform some or all of the above software maintenance tasks for certain field devices installed at their properties. Under this approach, close collaboration will be necessary between the C2 system integrator and the agencies, and the same quality standards that apply to the vendor should apply to the agency performing the maintenance.

#### *4.3.1.5 Interface management*

The C2 system will includes internal and external interfaces (see illustration below).

- **Internal interface** – some form of connection between two sub-systems delivered, operated, and maintained by different vendors under the Clipper® program
- **External interface** – some form of connection between two systems, one of which is delivered, operated, and maintained by the Clipper® program; the other of which is delivered, operated and maintained, by another party.




Interfaces typically represent risk to any program. This is particularly acute for external interfaces with two different system owners at either end. The owners must agree on how their systems will interface and, once operational, must continue to coordinate to maintain the interface through the lifecycle of the system

### All external and internal interfaces will be identified and defined by the C2 system integrator

The C2 system integrator will identify all external and internal interfaces in an Interface Register, and every interface identified will be defined in an Interface Control Document (ICD).

### All internal and external C2 interfaces will be managed by an Interface Management Group, chaired by the C2 system integrator, in accordance with an Interface Management Plan

The Clipper® Program will establish an Interface Management Group (IMG) responsible for managing all interfaces. The IMG will be chaired by the C2 system integrator but will include participation from the owners of all systems that interface with C2.

The C2 system integrator will develop an Interface Management Plan that describes how all internal and external interfaces will be managed. The interfaces will be managed in accordance with the plan.

### 4.3.2 Configuration Management

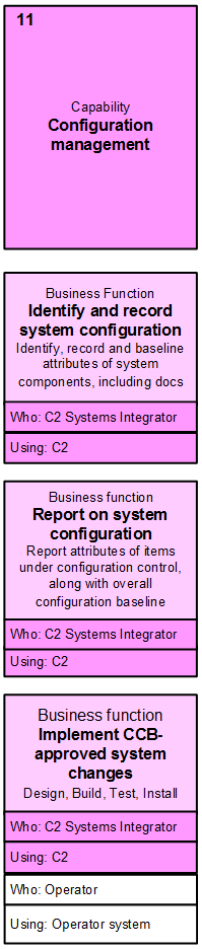



Figure 15: Configuration Management Capabilities and Associated Business Functions

Configuration Management is the overall process by which the system's configuration (including its hardware, software and related documents) is identified and baselined, and requests to change that configuration are evaluated and managed. It also includes reporting and auditing on the system's configuration.

Configuration Management is, therefore, both a maintenance process (identifying the system's baseline configuration and making changes to it), and a management process (controlling and assessing requests for change), so this capability appears in both the system maintenance and program management sections of this document.

The split of configuration management business functions is described below (pink are maintenance functions, blue are management functions).

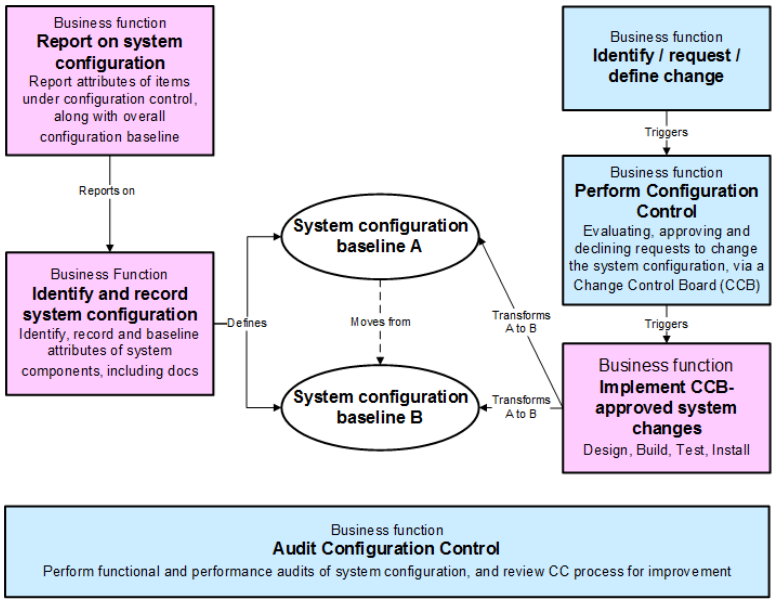



Figure 16: Split of Configuration Management Business Functions between Maintenance and Program Management

#### The C2 system integrator will identify, record, control, and report on the configuration of C2 (1)

C2 is a complex system formed of thousands of hardware and software components, with hundreds of related documents.

The configuration of the system includes the unique identification and version of each component, along with their functional and physical attributes and the links between them, at a given point in time. It also includes the related documents and any business rule configurations including fare tables and fare product configurations.

Under C2 the entire system configuration will be identified and recorded in an appropriate system. Once identified, the configuration will be 'baselined' and requests to change that baseline will be centrally controlled, reviewed, approved, and scheduled through a Configuration Management Program (see Program Management section).

### The C2 system integrator will generate reports on the system's configuration

The C2 system integrator will also generate configuration reports that provide the attributes of the items under configuration control, along with the overall configuration baseline at a given point in time.

### Changes to C2's configuration will be implemented in a controlled manner, and only after approved by the Change Control Board

Changes to C2's configuration will only be permitted after they have been approved by the Change Control Board (CCB), as part of the overall Configuration Management Program. Once approved, the responsible party will plan, design, build, test, and implement the requested changes.

In most cases the responsible party will be the C2 system integrator; however, in some instances some partner agencies, like BART, may wish to implement the change themselves. In this case the same quality controls on planning, designing, building, testing, and implementing the change will apply to the operator.

## 4.3.3 Asset Management

Clipper® is comprised of a hundreds of field devices connected to a central system, either directly or through intermediary systems such as BART's DAS. Currently operational field devices that play some role in Clipper® fare collection include:

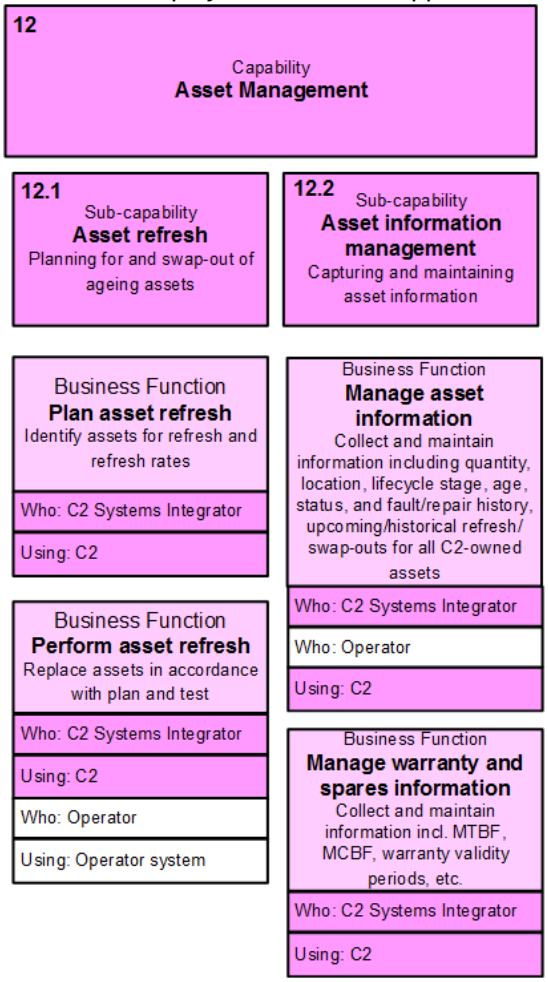



Figure 17: Asset Management Capabilities and Associated Business Functions

- Faregates
- Ticket vending machines
- Add-fare machines
- Clipper® card readers
- Ticket office terminals
- Handheld devices

There are several different vintages and vendors of the devices in operation, and some were purchased through the C1 contract, while others were purchased from the device vendor directly by the partner agencies. The field devices are at different stages of their lifecycle. Some have reached or are approaching the end of their useful life and are scheduled for or in need of replacement, while others still have a number of years of operational life left in them. Some will be replaced during the remaining operational stage of C1, while others will be replaced once C2 is operational.

All such devices are C2 system assets that need to be managed in the most cost effective and efficient manner possible. This section includes two key capabilities that will assist with the improved management of these assets, namely asset refresh and asset information.

The diagram above left highlights the asset management capabilities and associated business functions.

#### *4.3.3.1 Asset Refresh*

Asset refresh deals with understanding what Clipper® assets should be refreshed and when and the chosen asset refresh strategy will drive millions of dollars in capital and operating expense over operational lifecycle of C2.

**The C2 system integrator will develop an Asset Refresh plan (1)**

An asset refresh plan is typically describes what assets are subject to refresh and the refresh rates for each type. Refresh rates are typically influenced by the financial depreciation rates of the assets, their ability to continue meeting operating requirements as they age and their performance degrades, and the availability of next generations of devices. The C2 system integrator will develop the asset refresh plan in collaboration with the partner agencies.

**The C2 system integrator will be responsible for performing Asset Refresh, but some partner agencies may perform the refresh themselves (1)**

Once a refresh plan has been established, the C2 system integrator will be responsible for implementing the refresh in accordance with the plan. Some partner agencies may elect to perform the refresh themselves, depending on asset type. The Clipper® program or partner agencies may be responsible for funding the asset refresh; this will likely depend on asset type, refresh rates, and reason for refresh.

#### *4.3.3.2 Asset Information Management*

**C2 will maintain detailed information on C2 assets deployed within or connected to the system, including spares. (1)**

C2 will maintain a full inventory of all assets deployed within or connected to the system, including spares and those out for repair. Quantity, location, status, fault/repair history, refresh rates, and history will be maintained. The system will maintain an inventory of all devices and modules (to the LRU level) procured under, deployed within, or integrated with C2.

C2 will allow its users to locate asset information through a search capability and will provide clear presentation of that information along with the ability to export and import information easily, including external asset information systems maintained by partner agencies outside of C2.

Alongside asset information, C2 will also maintain warranty information warranty validity periods, manufacturer replacement status, and adherence of warranty for each device along with statistics such as mean time between failures (MTBF) and mean cycles between failures (MCBF).

Some C1 assets and partner agency-owned assets that directly or indirectly support the C2 system may not be included in the C2 asset inventory, and partner agencies may choose to manage these assets separately.

Asset device quantity information will support demand analyses, including those necessary to support planned operator fleet expansions and required numbers of local and central spares.

### 4.3.4 Business Continuity

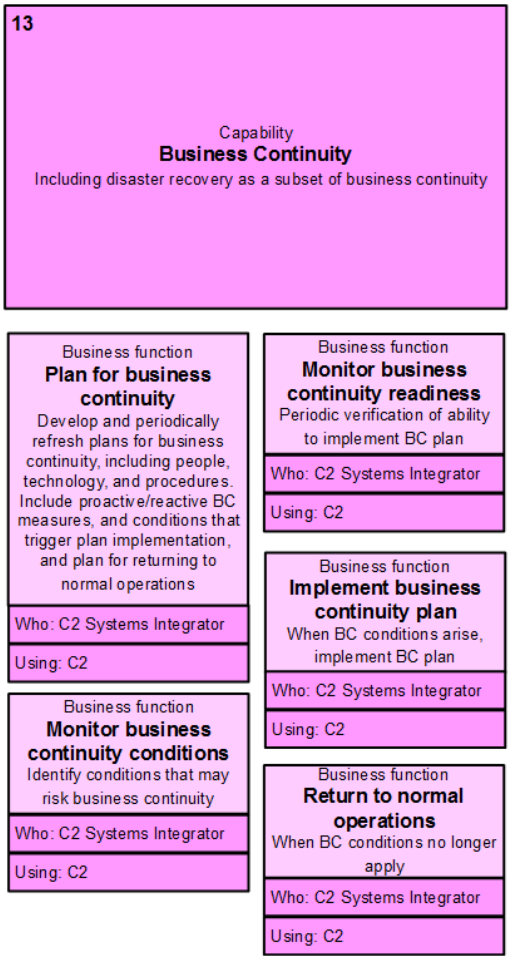



Figure 18: Business Continuity Capabilities and Associated Business Functions

Business continuity activities are the people, processes and technologies needed to ensure essential business functions continue to operate during an event or condition that threatens their ability to be performed. As a subset of business continuity, IT disaster recovery focuses on the IT activities needed to support business continuity. IT disaster recovery measures may include a physically remote instantiation of the IT system that can transitioned to at times of disaster.

A key driver of the nature, scale and cost of the business continuity plan will be the desired availability of C2's business functions. Certain mission-critical business functions (such as collection of revenue or data, or provision of customer service) will have a much higher availability requirement than other non-mission critical functions like asset management. C2's design will be driven by understanding these requirements—a higher availability requirement will require a more robust and expensive business continuity design than a lower availability requirement.

The figure to the left illustrates the business continuity capabilities and associated business functions. The figure below illustrates business continuity activities and the related operational state (e.g., normal operations, disaster recovery, etc.).

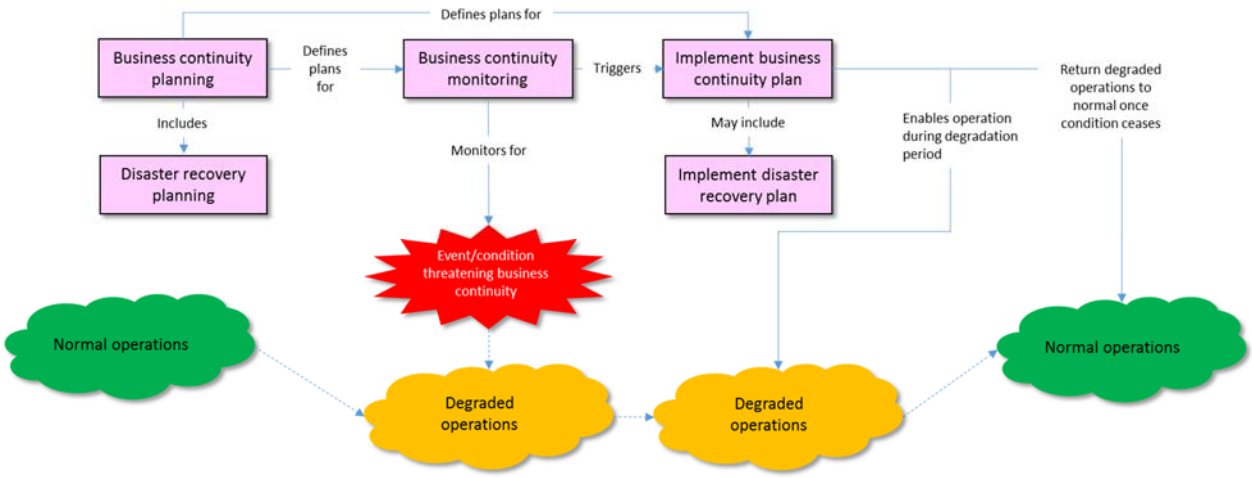



Figure 19: Business Continuity Activities and Associated Operational States

### The C2 system integrator will develop business continuity plans, monitor for problematic conditions, and implement the business continuity plan when necessary

The C2 system integrator will develop and periodically refresh plans for business continuity that allow the availability requirements of the system to be met. The plans will include the people, technology, and procedures; the proactive/reactive actions to be taken; the conditions that trigger the plan's implementation; and the parties responsible for each action, including partner agencies and MTC as appropriate.

The system integrator will also monitor for conditions that could trigger the enactment of the plan, along with periodically verifying its ability for the plan to be implemented.

When required, the system integrator will be responsible for enacting the business continuity plan, as well as returning to normal operations once the condition or event has ceased to occur or has decreased in severity to an acceptable level.

The business continuity plan will include plans for IT disaster recovery as necessary.

### 4.3.5 Maintenance responsibilities for Clipper® equipment

The Clipper® fare collection system is comprised of equipment owned and maintained by partner agencies, C1 devices that will remain operational during transition from C1 to C2, C1 devices that will remain operational while C2 is operational, and new C2 equipment that will be supplied through the C2 contract. Responsibility for maintenance of each type of equipment will need to be agreed as the program progress – but potential options are described in the figure below.

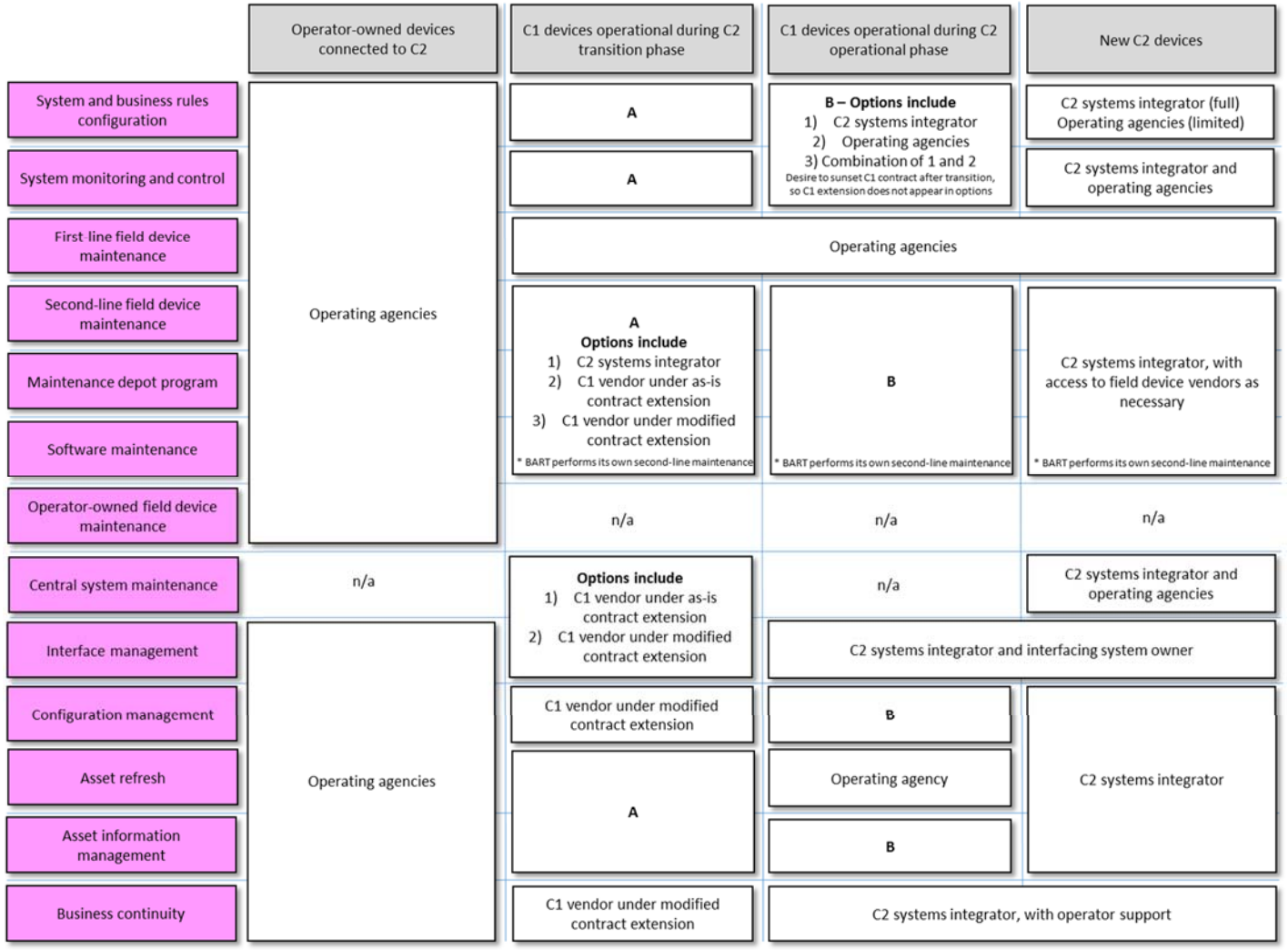



Figure 20: Potential Maintenance Responsibilities for C2

## 4.4 Program Management Concepts

This section holds concepts related to the program management of C2 during its operational phase. Program management includes the business functions necessary for the management and oversight of the program's operation and maintenance. As today with C1, it is largely expected to be performed by the Clipper® Contracting Agency (currently MTC), with some functions and support provided by the C2 system integrator and partner agencies.

Beyond the capabilities and business functions shown below, no further content is provided in this version.

### 4.4.1 Program Controls

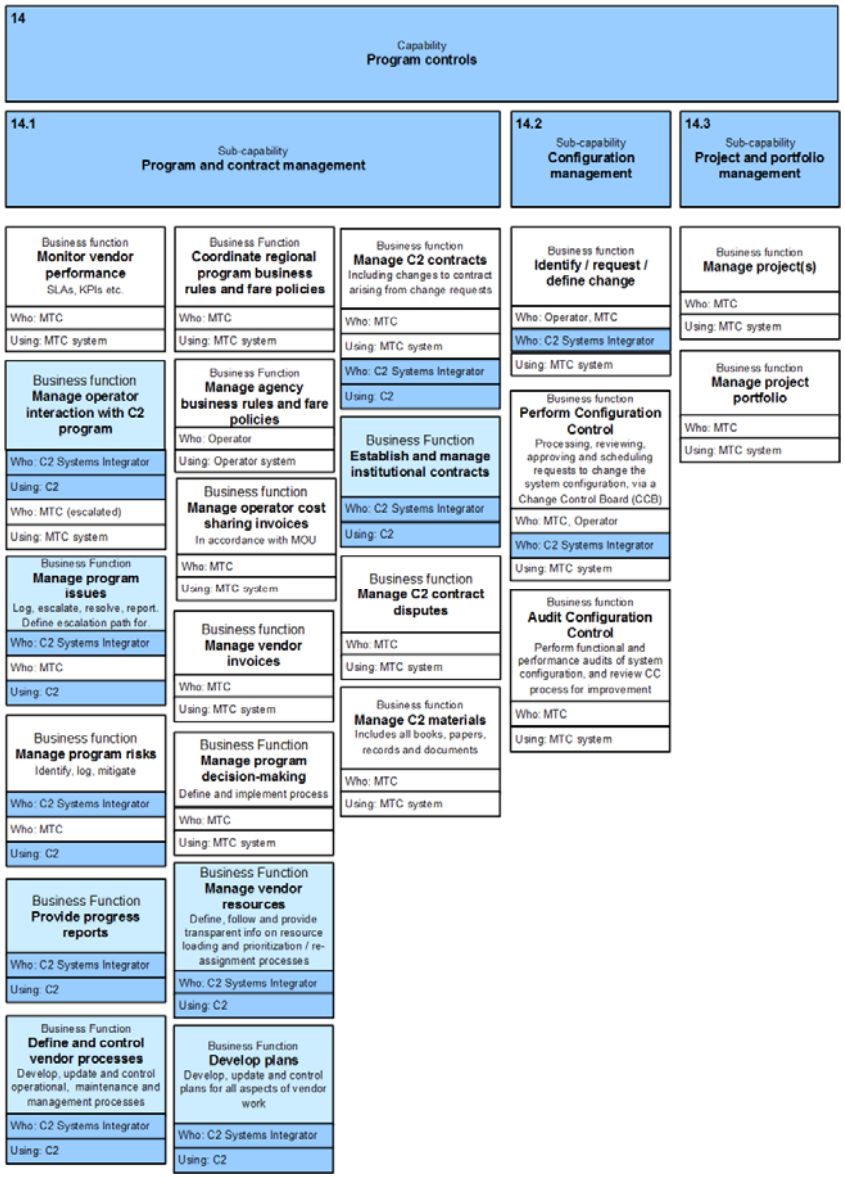



Figure 21: Program Controls Capabilities and Associated Business Functions

### 4.4.2 Marketing

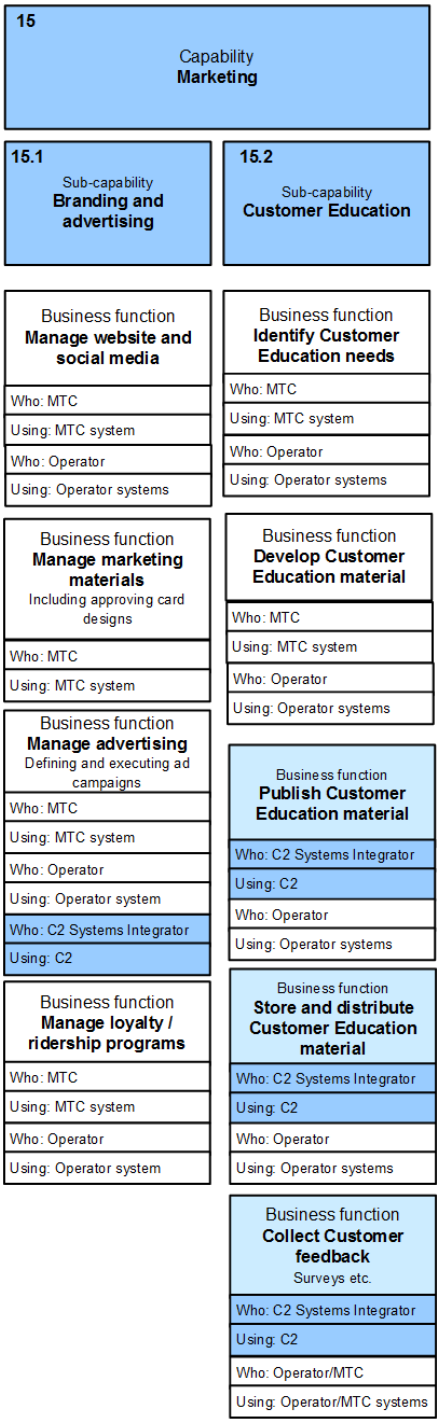



Figure 22: Marketing Capabilities and Associated Business Functions

### 4.4.3 People and Process Management

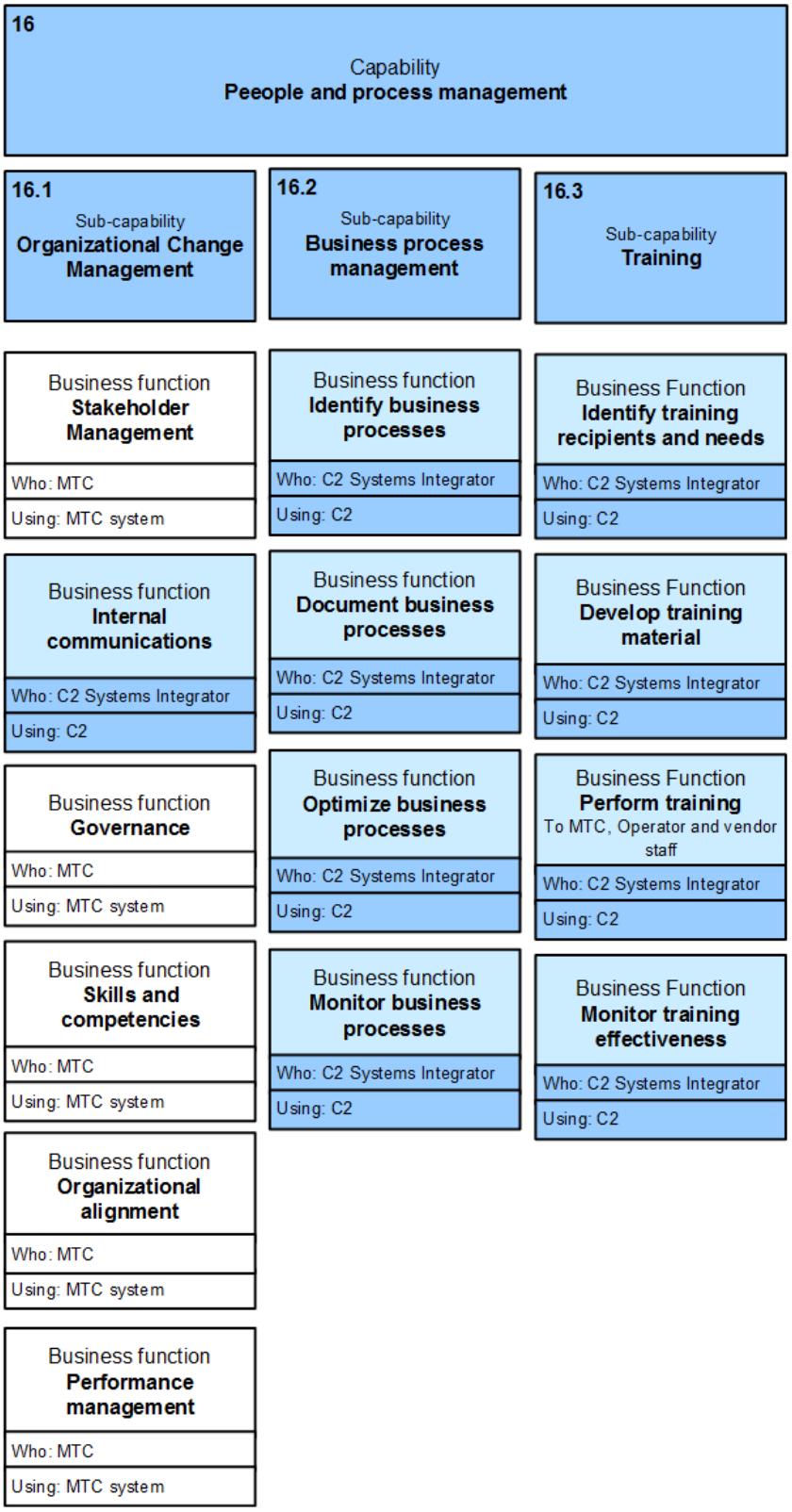



Figure 23: People and Process Management Capabilities and Associated Business Functions

### 4.4.4 Program Audit and Compliance

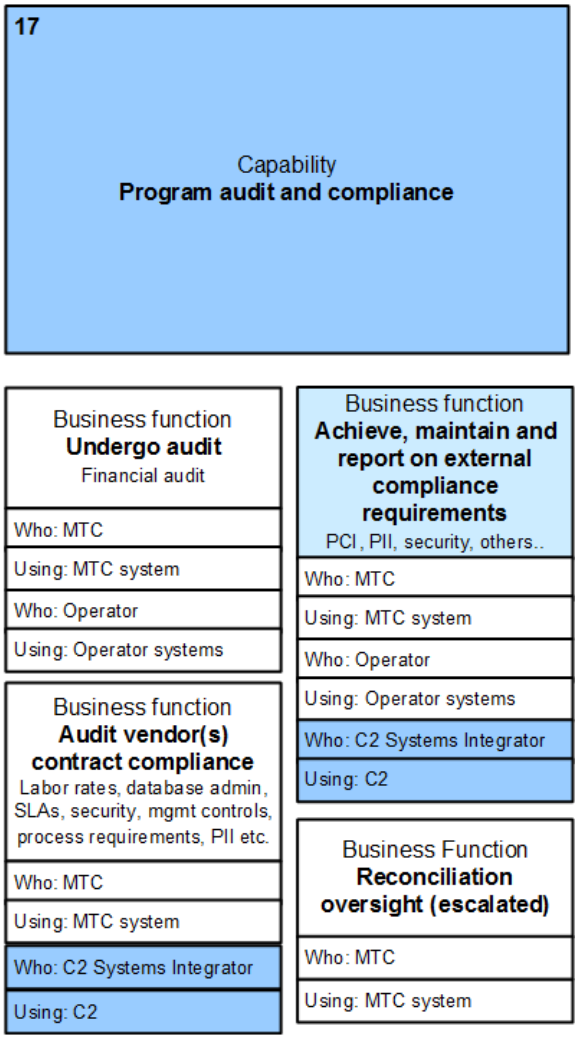



Figure 24: Program Audit and Compliance Capability and Associated Business Functions

# 5 Other Lifecycle Concepts

## 5.1 Key Acquisition Phase Concepts

This section provides a high-level summary of key acquisition concepts for the C2 system. In this context, acquisition refers to the end-to-end activities that deliver a system/sub-system ready for transition to the operational environment. Therefore, acquisition is comprised of two main activities: procurement and delivery.

This document is not intended to describe all aspects of C2 acquisition; a separate document will describe the acquisition strategy developed for C2, provide further detail on concepts described below, and define additional key procurement and delivery concepts.

**The preferred procurement model is for a single systems integrator/prime contractor responsible for the overall C2 design-build-operate-maintain (DBOM) implementation with a bench contract for pre-qualified vendors and suppliers**

Figure 25 *conceptually* illustrates the model. All functionality within the outer, black ring is within the integrator/prime DBOM contract, while individual functions would be contracted as required.

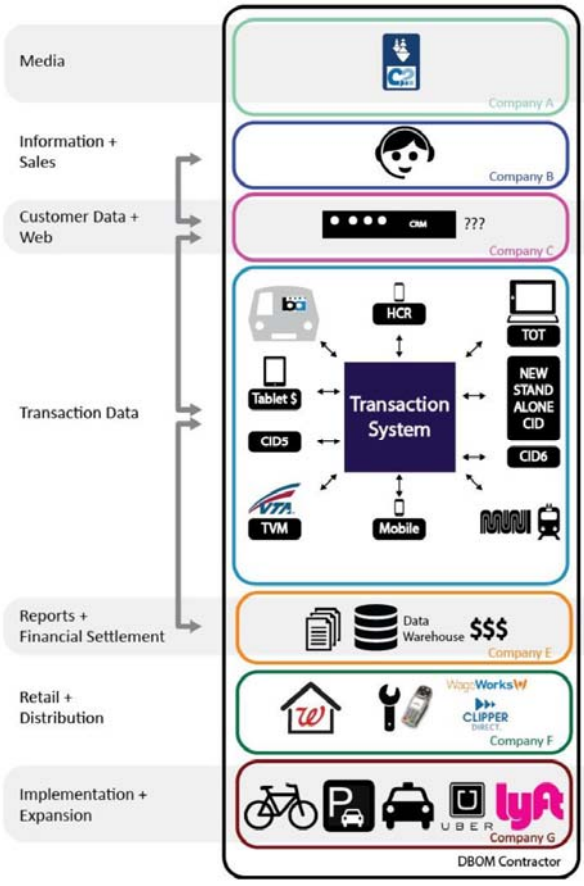



Figure 25: Key Acquisitions Phase Concepts *(Source: MTC)*

**C2 will be procured in a manner that enables the C2 system integrator to take over the C1 system functions at the end of the C1 contract**

The C2 system will be transitioned over time to ultimately replace the existing C1 system. In order to minimize the duplication of services between the two systems during this transition period, the C2 system integrator will be retained prior to the end of the C1 contract and trained appropriately so as to take over existing C1 services and facilitate a smooth transition. It is anticipated that the C2 system integrator will be prepared to take over C1 operational functions, such as the call center, card supply and fulfillment functions, and financial reconciliation and administration, at the end of the C1 contract.

Existing field equipment maintenance and support provided by the C1 vendor shall continue or may be transitioned to the partner agencies.

**The Clipper® Contracting Agency will pre-qualify a shortlist of sub-systems/C2 function providers**

In order to ensure that the C2 system requirements and functions are delivered and performed by the most qualified vendors with the most appropriate skillsets for the various C2 system

functions, the acquisition strategy will isolate certain specific C2 system functions and requirements and undertake separate and early procurement activities to either identify a shortlist of qualified specialist vendors or contract with individual specialty contracts as appropriate for specific C2 system functions.

This strategy will encourage best-of-breed vendors for specific functions and provide the Clipper® Contracting Agency and the partner agencies with greater flexibility to make adjustments over time to respond to technology changes, system upgrades, and customer demands. This strategy can also recognize the different lifecycles of the system functions and isolate those components or functions most likely to require modifications over the life of the C2 system contract. Examples of such components or functions include website development, call center, interactive voice recognition (IVR) systems, new field equipment, and maintenance.

The Clipper® Contracting Agency will assign the integration and schedule risks associated with multiple vendors to the C2 system integrator. The Clipper® Contracting Agency and the partner agencies will require the C2 system integrator to include one of more of these shortlisted specialty vendors on their team. In doing so, the C2 system integrator will select their preferred candidate from the shortlist and establish their own contractual relationship with their preferred candidate accepting the integration and scheduling risks associated with combining the work of both the C2 system integrator and vendor(s) under one contract.

This strategy will enable the Clipper® Contracting Agency to maintain a bench of equipment suppliers and require the new C2 system is designed, tested, and implemented in such a way so as to accommodate equipment from several equipment vendors for future procurements. This will provide on-going competitive tension amongst equipment vendors over the life of the contract while also encouraging innovation.

### The C2 system integrator will be required to include technology refresh planning and delivery as a core part of their service

The C2 procurement strategy includes procurement concepts to support and sustain a current and responsive C2 system throughout the life of the C2 system. As such, continuous upgrades and enhancements to various system components and functions including software, systems, field equipment, and maintenance contracts, for example, will be included in the procurement documentation as a vendor requirement.

The terms of the procurement, including system requirements and vendor deliverables, as well as the evaluation of vendor submissions will combine to reinforce this objective and the consequent obligation on the part of the Clipper® Contracting Agency, partner agencies, and the system integrator to work cooperatively to ensure the C2 system performs well over its life and remains as current as possible given technical developments. Proponents will be required to provide an initial technology roadmap along with regular opportunities for the Clipper® Contracting Agency/C2 system integrator reviews of relevant advances in technology within their proposals that illustrate a standard and required periodic system refresh. Gain share type incentives could be used as incentives for the C2 systems integrator to encourage ongoing investment in the increased functionality of the system and/or more effective ways to run the system.

### Certain C2 capabilities may be delivered “as a service”

It may prove more effective to deliver some C2 capabilities as a service rather than as a traditional system procurement. Initially, “as a service” offerings were cloud-based software services whose functionality was delivered over the internet, often through a self-serve subscription model. Typically most associated with software as a service (SaaS), the “as a service” industry has grown and now encompasses many types of services including but not limited to software, storage, desktop, disaster recovery, marketing, business process, and

security (variously known as XaaS). In traditional delivery models, these services require infrastructure that might not be part of an organization's core business. With XaaS, the infrastructure is already in place via the internet, and the desired services can be outsourced.

One example where XaaS could be considered is the C2 data warehouse. Rather than requiring the C2 systems integrator to provide a data warehouse and its associated elements, incurring costs for software licensing and hardware, this functionality could be acquired as a service, through cloud-based data storage, reducing administrative burden and cost, while promoting greater interoperability with other systems, greater levels of customization, and, in some cases, accelerated updates to functionality, all while ensuring that all users are operating on the current platform.

**The C2 contract will include Key Performance Indicators (KPIs) linking poor vendor performance with financial repercussions and termination options.**

KPIs will be identified and articulated in the C2 contract(s) to provide incentives for performance above a specified standard and support the assessment of vendor performance. To facilitate their effectiveness, KPIs must be established at such a level so as to have a meaningful impact, either incentive or abatement, for the C2 system integrator.

The C2 acquisition strategy will not simply rely on termination provisions within the contract to deal with unacceptable performance but will also establish contract provisions linking poor performance to financial repercussions that will increase over time if poor performance continues. Termination of a contract can only be used as a last resort where there is no potential for improved performance.

The degree to which financial penalties can be applied depends on specific vendor responsibilities, the ability to clearly establish performance measures, and the degree to which the C2 system integrator is invested in the new C2 system. Similarly, the degree to which vendors can be exposed to such financial repercussions is in part tied to the procurement delivery model and the extent to which the system components and/or functions are disaggregated across procurement streams.

## 5.2 Key Transition Phase Concepts

This section describes transition, the migration of operations from C1 to C2. Transition begins when customers can first use C2 and ends when C1 is no longer available for use by customers. The C1 system is fully operational in the Bay Area, so the migration to C2 cannot happen simultaneously and immediately for all partner agencies and customers. This results in a period of mixed use of the C1 and C2 systems as the transition occurs.

### 5.2.1 Transition Goals

Several goals have been identified for the Transition from C1 to C2:

- Simple for customers, MTC, and the partner agencies
  - Maximize utilization of C1 cards in C2
  - Robust reload network during transition to achieve desired C2 penetration
  - Back end complexity could be acceptable if it simplifies the customer experience
  - Single customer service point of contact (from customer perspective)
- Minimize risk while balancing cost, schedule, and quality of transition
  - Brand and reputational risk
  - Technical risk

  - Commercial risk
  - Financial risk
- Cost effective
  - Maximize re-use of equipment where feasible
  - Minimize functional, operational and management duplication

### 5.2.2 Transition Concepts

At the highest level, the critical question for transition is "How can C1 be smoothly transitioned to C2, while ensuring the ongoing availability of C1"? The following key concepts have been developed in response to this question.

**The Clipper® program will seek to adopt a single reader approach during transition, unless the cost and risk of doing so outweigh the benefits (3)**

The preferred transition approach for the customers, cards, and end-devices involves upgrading or replacing existing Clipper® card readers to be able to process both C1 and C2 cards.

This approach is preferred because it allows the C1 card to be re-used in the C2 system. While it requires the upgrade or replacement of all existing readers to dual C1/C2 capability prior to transition start, this work can be done in parallel with the development and testing of the C2 core system.

The result is that once the system and equipment is ready for C1/C2 transition, the primary task remaining is to migrate customers to C2 operation. Once the majority of customers are using C2, the C1 system can be retired.

**The program will transition from C1 to C2 in three phases: 1) Pilot, 2) Soft Launch, and 3) Full Deployment, during which the current fare policies and products of C1 operators will be replicated in C2 (1)**

The new C2 system should be designed with maximum flexibility for future fare policies. However, to facilitate the customer messaging during transition, the current fare policies and products available on C1 will be offered in C2.

The **Pilot** phase will include a small number of partner agencies and multiple modes. The Pilot should include a select group of customers and operator employees, testing all features of the core C2 system and all fare media/payment options. The goal of this phase is to confirm that the C2 system operates as expected in production.

The **Soft Launch** phase will expand C2 use to all partner agencies, but will limit the number of customers who have access to C2 fare media/payment options by limiting the number of sales locations and distribution of C2 mobile apps/virtual cards. C2 functionality needs to be available at all buses, and on at least one fare gate aisle per rail station; however, depending on the transition approach selected, it is possible that C2 functionality will be available at all end devices. It is recommended that new C2-only partner agencies wait until this phase before introducing C2 on their systems (Note: this concept to be revisited following the selection of the preferred transition approach). The goal of this phase is to confirm that the C2 system operates as expected in production on a larger scale than the Pilot and validate that all partner agencies have their internal processes and procedures in place to support C2 operation.

The **Full Deployment** phase will include the availability of C2 functionality on all devices in the region and marketing and outreach activities to convert customers from C1 to C2. The full C2 retail sales and reload network will be in place. Once the majority of customers (more than 80

percent, to be determined by MTC and partner agencies) have migrated to C2, the C1 system will be shut down.

### The C1 vendor will be asked to extend certain elements of operations and support during transition (2)

It may be beneficial to have the C2 system integrator begin operating a combined C1/C2 call center, distributing cards, and performing other functions for the C1 system while the C2 system is being implemented. The extent of the activities will be determined based on what is permitted under the existing C1 vendor agreement, and what is helpful to facilitate C1/C2 transition.

In order to streamline the transition, the contract with the existing C1 vendor will be extended into transition, at a minimum to maintain the C1 software a state of acceptable operation and implement necessary changes, as well as to provide ongoing second-line maintenance services for all remaining C1 hardware. The C1 contract would then terminate when transition ends.

### Procurements may be staged for early implementation in preparation for Transition and end of C1 contract (2)

It may be valuable to bring certain aspects of the C2 system into operation as early as possible, to provide sufficient time for testing and full implementation well before the C2 functionality is introduced to customers in transition. Potential functionality for early implementation may include a data warehouse or combined C1/C2 customer service center.

### Any fare collection procurement activities, such as state of good repair upgrades or new equipment purchases, between now and C2 rollout should incorporate aspects of the C2 transition approach whenever possible (2)

The specific requirements can be defined further after the selection of the desired transition approach. By including C2 requirements in near-term procurements, partner agencies place themselves in a favorable position for transition from C1 to C2.

### Where feasible, C1 equipment will be re-used for C2 (1)

Some of the existing C1 equipment is flexible enough that it can be reprogrammed through software or firmware, for use in the C2 system. Examples include ticket vending machines and current-generation bus readers.

### Existing locations selling C1 cards and value loading to customers should sell C2 cards and value loading, when appropriate, during the transition, and new C2-only locations may be added during the transition (2)

Where feasible, the existing set of C1 card sale and value loading locations should offer C2 cards and value loading to customers for continued customer convenience. The timing of ending C1 card sales/value loading and beginning C2 card sales/value loading, as well as any overlap in offering both C1 and C2 at the same retail location, will depend on the selected transition approach. Additionally, new C2-only sales locations may be added.

### Customer support for transition will be prioritized and carefully planned and implemented (1)

A smooth customer transition is critical to the success of C2 from a public perspective, and therefore customer support must be carefully planned and implemented. Customers should be informed when they have been transitioned from C1 to C2.

Customer support should include educational campaigns rendered for both frequent riders, which may be fairly easy to reach, as well as infrequent riders and unregistered cardholders,

which may prove more challenging to reach. The customer service call center, walk-in centers, and front line operational personnel should be trained on policies and procedures and equipped, to the greatest extent possible, to assist with customer issues.

**An automated customer transition approach is desired, where the C2 program will decide when to transition a customer from C1 to C2 operation, and initiate the process (2)**

Customers can be migrated in groups, as determined by the C2 program, beginning at time of Soft Launch. It may be helpful to migrate registered customers before unregistered customers because registered customers can be notified via email and website messages that they have been transitioned to C2. An option should also be provided to allow customers to choose to migrate to C2 operation rather than waiting for the automated migration process. Information from the customer's existing C1 card and web account should be transferred to their new C2 account.

**Any new agencies offering Clipper® functionality during any transition phase should support both C1 and C2 operation (2)**

If a new agency implemented C2-only equipment during transition, any customer still using a Clipper® card in C1 operation would not be able to use his or her card on the C2-only equipment. Therefore, agencies with C2-only equipment should wait until C1 has been fully retired before introducing C2 functionality.

## 5.3 Key Renew, Refresh and Replace Phase Concepts

There comes a point in the lifecycle of any system where it, or elements of it, is renewed, refreshed, replaced, or even removed from service.

For C2 an ongoing program of asset renewals and refurbishments will occur via the maintenance activities performed during the operational phase. However, beyond the ongoing renewal and refurbishment at the individual asset level, consideration must also be given to the preferred approach to renewing, refreshing, or replacing the C2 system as a whole (and/or its principal sub-systems). Conceptually, this could be considered as moving beyond C2 to C3.

There are a number of unknowns that could influence how C2 might be renewed, refreshed, or replaced, which makes detailed planning at this stage of the C2 lifecycle a challenge. However, such analysis is important to minimize the risks associated with this phase of its lifecycle. As the program progresses it will be important to regularly revisit the concepts, plans, and assumptions for its renewal, refresh, and replacement stage considering whether new information or requirements have arisen.

**To support flexibility in C2 sub-system replacement, C2 will seek to adopt a modular design based on defined, open interfaces (1)**

C2 will minimize the use of proprietary, tightly-integrated technologies and use defined, open interfaces and a modular procurement strategy to maximize ongoing, flexible sub-system replacement from a multi-vendor market

**C2 will require eventual replacement and plans should be made accordingly (2)**

Although open interfaces and a modular procurement approach will enable flexible replacement of certain C2 sub-systems, C2 will include a contract for a core system that performs centralized functions such as transaction and financial processing. Fare payment vendors that might supply the core system typically have pre-developed products they would customize and configure for C2.

Eventually these core products will age and become obsolete as vendors develop new versions of their core products that take advantage of new technologies and developments in the market place. It is likely, therefore, the C2 core system will become obsolete at some point—potentially through new technological advancements and/or vendor development of a newer product. The C2 program must plan for such eventually accordingly, and embed in its design, governance, and contracts the right measures to support such an eventuality. Such measures could include

- Consideration of how C2 field devices could be designed to support future integration with a C3 core system
- The ability to access C2 data and enable its use with a future C3 core system

**C2 should account for the varying useful lifespan of each major sub-system and provide a means to allow flexible replacement of each sub-system (1)**

End devices such as TVMs and payment readers will have a different lifespan from websites, mobile applications, payment gateways, and so forth. C2 will be designed to expect and easily accommodate replacements of major system sub-systems throughout the lifespan of C2.