Version Notes: Updated Next Generation Wi-Fi SOW

Updated: Friday, October 19, 2018

Based on one-on-one and subsequent questions and subsequent clarifications we wanted to make, the CCJPA is updating the SOW (Attachment A) to the original RFSOQ. This updated SOW is the official STATEMENT OF WORK to be used for the RFSOQ. Please make note of this in preparing your responses

In general, these updates were done to clarify sections written as to their applicability in a service or capital sale model. Below are the updates noted by section from the Original SOW:

1. Inserted a section 3.5.3.7 to address Multiple Mobile Routers in Train
2. Added to 3.6.6 UL clarification in parentheses
3. 4.7.3 first sentence to clarify about warranty in a capital sale or transfer of ownership and added a second paragraph about service contracts.
4. Section 5 – added an opening paragraph for Operation. Maintenance and Support about how to consider service models vs capital procurement with the example of spare parts and warranty not being applicable to the service model.
5. Section 5.2 Warranty Management – opening paragraph edited to differentiate between service based and capital sales.
6. Section 5.2.1 added “where applicable…”
7. Added a 5.7.5.1 section about Spares Management when Supplying Materials as a Capital Sale and modified the prior paragraph to be put in the case of non-vendor ownership.
8. Added 5.7.5.2 to clarify when considering Spares Management under a service model.

CAPITOL CORRIDOR JOINT POWERS AUTHORITY

REQUEST FOR STATEMENT OF QUALIFICATIONS (RFSOQ)

TO PROVIDE

NEXT GENERATION ON-TRAIN WI-FI SOLUTION

RFSOQ201819-03

The Capitol Corridor Joint Powers Authority ("CCJPA" or the "Capitol Corridor") intends to enter into an agreement ("Agreement") with a SOLUTION PROVIDER ("Provider") to provide next generation Wi-Fi services on-train and in-revenue operations. These services are directly intended for the California Intercity Passenger Rail fleets (existing and future rolling stock) comprised of California owned and Amtrak owned rolling stock as well as potentially other partner rail operators, (e.g., Caltrain), who may come along as later partners to this procurement. This procurement is being led and managed by the Capitol Corridor Joint Powers Authority with inclusion of staff from the San Joaquin Joint Powers Authority (SJJPA) and the Los Angeles – San Diego – San Luis Obispo Rail Corridor (LOSSAN), and the California Department of Transportation Division of Rail and Mass Transit (Caltrans DRMT). CCJPA is acting as the lead procurement agency and accordingly, CCJPA is issuing this Request for Statement of Qualifications ("RFSOQ") to prospective Providers ("Proposers") as specified herein.

A. Service Description

The selected Provider shall provide a complete technology solution that will serve as a communications platform for Wi-Fi and other services aboard California Intercity Passenger Rail (IPR) trains and possibly other partner public train operators. The purpose of this Request For Statement of Qualification (RFSOQ) is to identify a suitably qualified solution provider who can design, install, operate, and maintain a Next Generation Wi-Fi solution (the 'Solution') onto fleets designated by CCJPA or its partners that is optimized based on currently available technologies and has a clear development roadmap to ensure that the Solution can evolve over time to meet the demands of both CCJPA, its partners, and train customers. Under the terms of a Master Agreement, with a CCJPA generated Conformed Statement of Work (CSOW) based on the RFSOQ SOW as matched with the SOQ from the winning Provider, specific Work Directives ("WD") will be issued to tailor the installation and operations to the situation described in the WD. The type of professional services to be provided by the PROVIDER is set forth in Attachment A, SCOPE OF SERVICES.

If a partner rail agency opts to utilize this procurement and Master Agreement as a basis for working with the selected Provider, the CCJPA intends to maintain partnership flexibility with the Provider and prospective partner rail agencies wherein a partner rail agency may establish separate funding and payment pass-through WD based relationships with the selected Provider. Working with a prospective rail agency partner would involve additional negotiation and a payment relationship with the selected Provider, a potential agreement between CCJPA and the rail agency, and refined agreement amendments to the Master Contract with the selected Provider. The primary aspect of a provider working through this RFSOQ and Master Contract is that an open and public procurement has been established.

B. Funding Sources

The funding sources will be provided through the State of California and more directly Caltrans DRMT for each WD. In general, CCJPA will be a conduit using State sourced funds to oversee a service-based or subscription-based model to deliver the services over a period of years. Some deviations for a one-time capital outlay followed by service operations and maintenance funding are also intended to be made possible but the core objective is to primarily use operational funds to support ongoing service/subscription based commercial propositions. Partner rail agencies who may participate in this RFSOQ after the fact will bring their own identified funding sources specific to each WD.

C. California Public Records Act

This RFSOQ and any material submitted by the Proposer are subject to public inspection under the California Public Records Act (California Government Code Section 6250 et seq.), unless exempted by law.

D. Service Duration

CCJPA intends to make one (1) award resulting from this RFSOQ, however the Provider will be expected to acquire and obtain sub-contractors on an as needed basis as identified by the Provider or train service operating partners operating under this RFSOQ.

The term of the Agreement entered into pursuant to this RFSOQ will be for **five (5)** years from the date of execution of the Agreement with five additional option years initially beyond the initial five years. As an intended service/subscription-based model, the Agreement duration is meant to extend across technology, software, and hardware upgrades that modernizes every few years. Additional option years may be pursued at the discretion of CCJPA in consultation with rail service partners and the Provider.

Partner rail agencies that may utilize this procurement are permitted to modify service duration based on negotiation with the selected Provider if the partner rail agency decides to depart from the award duration parameters CCJPA is utilizing.

E. Pre-submittal Meeting

A pre-submittal meeting will be held on Thursday, October 4, 2018. Selected Wi-Fi vendors who had conducted previous exploratory meetings in Summer of 2018 with CCJPA's Wi-Fi Services contractor, Xentrans, Inc., were invited to attend in advance of this RFSOQ release so they could make travel arrangements as well as indicate their interest in convening one-on-one question and answer sessions lasting a half-hour after the initial presentation. As of this release there is one afternoon slot available. The pre-submittal meeting afternoon will operate as follows in three steps:

1. At 300 Lakeside Drive, Oakland, CA, on the 15th floor in Room 1500, we will convene at 1 PM for all attendees for an hour where we will make a presentation and allow questions and responses. This group meeting will be set up to allow a conference call option with a prior email of the slide deck so that persons that are remote can participate.

2. Between 2 PM and through 5:00 PM CCJPA will hold ½ hour one-on-one meetings with individual prospective bidders. Questions and answers in a direct exchange will be taken then but all questions will be collected, sanitized, and later answered in writing for all bidders to see. The group session and individual session questions and official responses will be posted on the CCJPA Opportunities website page as soon as possible following the meeting. Attending the one-on-one meetings IS NOT A REQUIREMENT and does not provide any bonus scoring to future SOQ responses. It is simply a means to get open dialogue going about the RFSOQ and the approach but all salient details from those discussions will be shared in a vendor neutral manner. This discussion will also help CCJPA refine the RFSOQ

requirements, communications, and be a level-setting exercise. These sessions will NOT be covered by a conference call that CCJPA can host however each team can host their own conference call where they can invite their contracts to hear and ask questions in the room. There remains only one available slot for a one-on-one ½ hour meeting. Upon the completion of these meetings we will move to the next step.

3. For the final step, all bidders will be invited to meet at the Oakland Maintenance Facility (OMF) at 1303 3rd St, Oakland, Alameda, California and have up to an hour to examine at least the Northern California passenger rail fleet. We estimate that we could convene at the OMF around 5:30 PM. At OMF, we will try to look in cabinets, take off panels, and give a sense of the installation situation. If attending persons have safety gear (hard hats and protective glasses) please bring them with but if not, we do have safety equipment for temporary use.

F. CCJPA/BART Procedures

The CCJPA is a California joint powers authority with six member agencies. The San Francisco Bay Area Rapid Transit District ("BART", or the "District") is the managing agency of the CCJPA. The CCJPA models its administrative procedures upon those utilized by BART. Accordingly, reference may be made in this RFSOQ to certain BART administrative procedures which have been adopted as CCJPA administrative procedures.

G. CCJPA's Agreement

The selected Provider will be expected to largely accept and comply with the terms and conditions contained in the *Example CCJPA Contract Agreement* included as Attachment B. See Section L for exceptions to the example contract.

H. Compensation

1. Cost Reimbursement

   a. CCJPA is seeking an evolving fixed price services/subscription-based agreement the selected Provider as compensation for the SCOPE OF SERVICES provided for under the Master Contract. Fixed prices shall be based on the prospective Provider's Pro Forma (see Pro Forma Instructions as Attachment C) that initially is established with the SOQ, later refined for the Conformed Statement of Work and Master Agreement, and then further refined based on WDs issued that become the evolved fixed price agreement. The fixed price agreement can be a lump sum amount, but the fixed price agreement must be based on the pro forma annually updated cumulative fixed prices agreed to over the course of the Master Agreement. Such compensation will be allowable only to the extent that costs incurred, or cost estimates included in negotiated, or otherwise established prices, are consistent with the Federal Cost Principles (Title 48, Code of Federal Regulations, Chapter 1, Part 31).

I. Non-Discrimination in Subcontracting

It is the policy of the CCJPA to ensure that Providers that contract with the CCJPA do not discriminate or give a preference in the work of their subcontractors on the basis of race, national origin, color, ethnicity, or gender.

J. Statements of Qualifications Submittal

Firms interested in being considered for award of the Agreement must submit the following as part of their SOQ:

1. Letter of Interest not exceeding two (2) single-sided, letter-sized pages summarizing the firm's understanding of the SCOPE OF SERVICES requirements and why the Proposer is most qualified to perform the requested services.

2. Organization Chart of Project Team. Key Personnel at the time of RFSOQ response shall be shown based on how the Provider will staff critical positions involved in fulfilling the SCOPE OF SERVICES.

   As personnel may change, the selected Provider will be expected to update and maintain the organizational chart.

K. Conflict of Interest

1. Depending upon the nature of the services performed, CCJPA Providers are subject to the same conflict of interest prohibitions which apply to CCJPA and BART employees. These include, but are not limited to, the applicable conflict prohibitions of the Federal government, and the requirements of California law (including Government Code Sections 1090 et seq. and 87100 et seq., and Title 2, Division 6 of the California Code of Regulations.) Notwithstanding subsection 2 below, the CCJPA reserves the right to disqualify any Proposer under this RFSOQ if the CCJPA, in its sole discretion, deems that the potential for conflicts of interest is likely to impair or restrict the Proposer's ability to furnish services contemplated within the SCOPE OF SERVICES.

2. A conflict of interest review will be performed by the CCJPA during evaluation of the SOQs.

L. Exceptions to the Agreement

1. In order to meet the CCJPA's schedule requirements, it is critical that the Agreement be executed immediately following selection of a Provider. Proposer shall be prepared to accept the terms and conditions of the Agreement immediately (a Sample Agreement for Consulting Services is provided as Attachment B).

2. If a Proposer desires to propose any changes in the Agreement, refer to Attachment E, PROTEST PROCEDURES. The Proposer must clearly identify in its SOQ each and every proposed change, the reasons therefor and the specific alternative language proposed. These factors will be considered during the CCJPA's evaluation of SOQs and/or during negotiations of fair and reasonable compensation. The CCJPA may develop price-related factors to be applied to any exceptions taken. **SOQs that take substantial exceptions to the Agreement or proposed compensation terms may be determined by the CCJPA, in its sole discretion, to be unacceptable and no longer considered for award.**

M. SOQ Due Date and Submittal Requirements

SOQs must be received by 3:00 pm local time (PDT), on November 9, 2018.

1. Proposer's SOQ and all required attachments and forms shall be submitted to either of the following address:

   Jim Allison, Manager of Planning
   Capitol Corridor Joint Powers Authority
   300 Lakeside Drive, 14th Floor East
   Oakland, CA 94612

   Envelopes or boxes containing SOQs shall be labeled on the outside packaging as follows:

   "CCJPA RFSOQ201819-03, Next Generation Wi-Fi Services"

2. The number of copies of the SOQs to be furnished shall be as follows:

   a. One (1) (hardcopy) complete copy, marked "ORIGINAL"

   b. One (1) additional copy, excluding Exhibit 2, CONFIDENTIAL STATEMENT OF QUALIFICATIONS AND BUSINESS REFERENCES. This copy shall be clearly marked "PUBLIC RECORDS COPY" in conspicuous letters.

   c. One digital version (USB) of the complete SOQ in Portable Document Format (PDF).

   d. An Email with the digital version of the complete SOQ in PDF as attached or shown in the email as a link (e.g., Dropbox or OneDrive) to download the file(s) sent to jima@capitolcorridor.org

N. Rejection of SOQs

SOQs may be rejected if they show such items as: alterations of form; additions not called for; conditional SOQs; incomplete SOQs; irregularities which make the SOQ incomplete, indefinite, or ambiguous; improper markings and identification; or a signature by other than an authorized person.

O. Evaluation Procedure

SOQs will be first evaluated as to responsiveness to the requirements of the RFSOQ and responsibility of the Proposer.

1. A SOQ will be considered responsive only if it complies in all material respects to the requirements of the RFSOQ.

2. A Proposer's organization will be considered responsible only if it has, or has indicated that it can obtain, the financial resources to fulfill successfully the requirements of the awarded Agreement and possesses the ability to perform successfully under the terms and conditions of an awarded Agreement.

3. If a SOQ is determined to be non-responsive, or a Proposer's organization is determined to be not responsible for the purposes of the RFSOQ, such SOQ and/or Proposer will not be considered for award.

4. Only those SOQs that satisfy the foregoing requirements will be evaluated and scored on the basis of the evaluation criteria. A competitive range will be established and used to determine those Proposers who will be "short-listed" and proceed to the oral presentation stage.

5. Price information based on the prospective Provider's pro forma included with the SOQ that clearly and cleanly demonstrates the cost basis for a service/subscription contract.

6. A SOQ will be considered responsive if at least five (5) references (client contacts under contract with the Provider at this time) that are using the services of the proposed Provider. Contacts provided should include relevant and key rail agency/company clients, role, phone and email contact information of individuals that can be contacted to discuss their experience working with the Provider.

P. Evaluation Criteria and Selection Process

The CCJPA will utilize the Organization Chart, the experience of the team, the technology path of the firm, knowledge of rail car installations, reporting and monitoring tools and data access, demonstrated and referenced checked project management skill sets, communication tools and approaches, clarity of product offerings, price clarity as based on the pro forma, reference checks, and related supporting narratives to evaluate and score the all aspects of the SOQ to determine overall qualifications, experience, and solution approach of the proposed Provider. The basis of selection will be the overall impression of the Provider as parsed by qualifications, experience, and solution approach. Subsequent to these evaluations, the oral presentation phase will be conducted for the short-listed firms.

Project Team qualifications (including subcontractors, if any) are weighted at 5%, experience of the firm(s) is weighted at 20%, and approach in a holistic viewpoint, from technology path to how the Provider will supply the service/subscription model is weighted at 40%. The Oral Presentation will be weighted at 25% and comprise an evaluation of oral communication skills combined with how qualifications, experience, and solution approach to the SCOPE OF SERVICES is communicated. The final 10%, which will only be applied to those who are interviewed, will be pro forma costs, organization and incorporation into the service/subscription model offering. The scoring will be as follows:

a. Project Team Qualifications (including subcontractors). Evaluation based on written submittal with a weight of 5%. The following criteria will be evaluated. Subsections 1. and 2. below are of equal importance. References provided by the prospective Provider that SOQ evaluation team may contact will be considered in the area of Project Team Qualifications.

   1) Qualifications and relevant experience of the Key Personnel relative to the SCOPE OF SERVICES, including how that experience can be applied to delivery through WDs.

   2) Ability to identify and explain how personnel and their skill sets are used to assure WD delivery, on-going operations and maintenance, and communicate with the CCJPA and partner teams involved in WDs.

b. Experience. Evaluation based on written submittal with a weight of 20%. The following criteria will be evaluated:

   1) Demonstrated experience in Wi-Fi deployment, reporting, and operations and maintenance and service delivery as outlined in the SCOPE OF SERVICES. Additionally, experience in managing the installed network for optimal service efficiency, management and shaping of the train customer experience, landing page

delivery and media entertainment provisioning. References provided by the prospective Provider that SOQ evaluation team may contact will be considered in the area of experience

c. Solution Approach (40%). Solution approach will be evaluated blending the Project Team's experience, qualifications, experience and qualification gaps, and skill sets of the Project Team to be innovative, insightful, responsive, flexible, yet strategically focused on delivering to the SCOPE OF SERVICES. This is the most highly rated of all the written criteria because this is where the assembled products, hardware, software, reporting tool and data access, project management, and operations and maintenance package and track record of performance (or lack of performance) come together as the solution. The overall approach should represent a responsive and thoughtful reflection of the SCOPE OF SERVICES presented in a clear and organized manner consistent with the pro forma sheet. The ability to pilot new technologies or layered services is also an acceptable addition to the approach but in doing so, the core SCOPE OF SERVICES must first be addressed before any innovations beyond the SCOPE OF SERVICES are introduced. References provided by the prospective Provider that SOQ evaluation team may contact will be considered in the area of approach. Overall, the solution approach is what will be gained from an overall read of the written submittal, but it will be easier to ascertain the key solution approach if the prospective Provider is organized in presenting their solution approach. There is no page limit as with the project team qualifications, but it will behoove the SOQ to be organized and clear without extraneous information muddying the solution approach understanding for readers.

The above-described scoring for Project Team Qualifications, Experience, and Approach will be used for the purpose of determining those prospective Providers with the highest scores to be short-listed and invited to an oral interview. The short-listed prospective Providers will be provided with the format of the oral interview. Said cost and rate data presented in the pro forma shall be valid for a period of one hundred eighty (180) days from the submittal date but thereafter modified as permitted in the Pro Forma Instructions (Attachment C)

d. Oral Presentation (25%). If selected for interviews, the oral presentation will be weighted at 25% of the total score used by the CCJPA to rank the SOQs. The criteria to be used in scoring the oral interview will again focus on the qualifications and experience of the Project Team as well as the Proposer's solution approach to the SCOPE OF SERVICES and internal agreement with the pro forma sheet.

e. Provisional Cost Reimbursement and Rate Data (10%). For those that are interviewed, the pro forma sheets will be considered on price but also other factors related to how the price and price information is successfully or unsuccessfully meshed in a consistent narrative across qualifications, experience and solution approach. Not only for how the price data is presented, the integration of this information with the other qualities will be used to gain a best value for a prospective Provider's offering. Best value is a subjective impression that will form for the evaluating team members based on their individual assessment of value from all they have seen written and seen and heard when it was presented.

f. Provider Selection. All short-listed firms will be considered qualified. The SOQs will be ranked in relation to the cumulative total of scores from a) the written statement of the Project Team Qualifications, Experience, and Solution Approach, and b) the oral interview and cost rate review. The highest scoring Proposer, on the basis of the cumulative total of scores from the written SOQ and the oral interview and pro forma sheet, will be deemed to be most qualified, and that Proposer will be selected to enter into negotiations regarding Agreement terms and conditions and based on the pro forma sheet. Failure to reach agreement on terms and conditions and fair and reasonable compensation will result in the

formal conclusion of negotiations and the CCJPA will then undertake negotiations with the next most qualified firm.

g. Anticipated Selection Schedule. The tentative selection process schedule is as follows:

1. Release Date	September 28, 2018
2. Pre-Submittal Meeting	October 4, 2018
3. SOQ Submission Date	November 9, 2018
4. Notification - Short-list for Oral Interviews	November 30, 2018
5. Oral Interviews	December 11, 2018
6. Firm Selected for Negotiations	December 11, 2018 or shortly thereafter

The dates above are subject to change so please be mindful of the CCJPA's opportunities website (https://www.capitolcorridor.org/opportunities/) where postings about any changes to this RFSOQ will be conveyed.

Q. Notification of Award and Debriefing

Proposers that submit a SOQ shall be notified in writing regarding the firm to be awarded the Agreement. Said notification shall be made within five (5) days of the date the CCJPA's Managing Director authorizes Award of the Agreement.

Firms that were not awarded the Agreement and desire a debriefing must request the debriefing in writing. Said request must be received by the CCJPA within five (5) days of the above-described notification of award.

R. Protest Procedures

Any protest or objection to this RFSOQ or other procurement procedures must be submitted in accordance with CCJPA's Protest Procedure, included herein as Attachment D.

S. Questions Regarding the RFSOQ

Questions regarding this RFSOQ or requests for additional information shall be directed in writing to the CCJPA's Contract Administrator. Official responses will be posted to the CCJPA Opportunities website and updated as necessary so please do check versions.

Staff from Caltrans DRMT or the various California Joint Powers Authorities managing intercity rail services are not to be contacted about this RFSOQ with the exception mentioned below. If a line of questioning is pursued by any member of a prospective RFSOQ response team with anyone other than the CCJPA Contract Administrator, participating JPA and Caltrans DRMT agencies have been instructed to inform the CCJPA Contract Administrator and the prospective vendor will be excluded from further consideration as a successful RFSOQ respondent.

All inquiries shall be made to the CCJPA at least ten (10) calendar days before the SOQ submission date. Inquiries received less than ten (10) calendar days prior to such date may, at the CCJPA's sole option, not be responded to.

Jim Allison, Manager of Planning
Capitol Corridor Joint Powers Authority
300 Lakeside Drive, 14th Floor East
Oakland, CA 94612
(510) 464-6994
FAX: (510) 464-6501
jima@capitolcorridor.org

This RFSOQ does not commit CCJPA to award an Agreement, to pay any costs incurred in the preparation of a submittal, or to procure or contract for any services. CCJPA reserves the right to reject any and all submittals received from this RFSOQ and reserves the right to negotiate with all qualified firms or to cancel this RFSOQ in whole or in part.

Documents Included in this RFSOQ are as follows:

Attachment A SCOPE OF SERVICES
Attachment B Sample Agreement for Consulting Services
Attachment C Pro-Forma Instructions
Attachment D Protest Procedure

Capitol Corridor Next-Generation Wi-Fi Solution

Statement of Work

Capitol Corridor Joint Powers Authority

300 Lakeside Drive 14th Floor East

Oakland, CA 94612

Version Control: Revision 1 101818

Table of Contents

1 Procurement Approach

1.1 Purpose of the RFSOQ

CCJPA is seeking to identify and procure a complete technology solution that will serve as a communications platform for Wi-Fi and other services aboard California Intercity Passenger Rail (IPR) trains and possibly other partner public train operators. The purpose of this Request For Statement of Qualification (RFSOQ) is to identify a suitably qualified solution provider who can design, install, operate, and maintain a Next Generation Wi-Fi solution (the 'Solution') onto fleets designated by CCJPA or its partners that is optimized based on currently available technologies and has a clear development roadmap to ensure that the Solution can evolve over time to meet the demands of both CCJPA, its partners, and train customers.

The intention of this RFSOQ is not to define precisely a solution which will be implemented within a specific car type but to demonstrate that the technology currently available from respondents meets the requirements defined within this Statement of Work (SOW). The Solution will include robust onboard networking equipment and back office systems that together form the foundation to support the following primary services:

- Open Internet access over Wi-Fi for passengers;
- Secure, managed local area network (LAN) between IP-based systems installed within the rail vehicles;
- Mobile connectivity between the on-board LAN and remote back office systems to support rail business operations now and in the future.

The Solution's back-office will provide real-time monitoring, management, configuration, and status reporting of onboard components; issue logging and remediation and maintenance tracking. The back office will allow secure access to health, usage and performance raw data both in real time and historic data feeds. The Solution shall be sufficiently flexible to provide connectivity for, and query by, other services and business applications in the future as CCJPA or other stakeholders requires. This SOW provides sufficient detail of CCJPA's technical and business requirements for prospective Contractors to submit a complete proposal for the Solution. Solutions proposed are eligible to be used on any train service based on interest and the availability of funds by CCJPA or other rail partners.

1.2 Master Service Agreement and Work Directive Process

The successful respondent shall be awarded a **Master Services Agreement** (MSA) as the Solution Contractor. An MSA is a contract to provide certain services over a predetermined amount of time at predetermined unit prices or prices to be determined based on conditions at the time of the issuance of a Master Services Agreement Release. The MSA will not be a notice to proceed with any specific work. The MSA will contain a Conformed Statement of Work (CSOW) finalizing the baseline technical and business requirements with the Contractor's Solution design applicable to any future deployments. CCJPA will make use of a Work Directive (WD) process under the MSA to inform Contractor of any work to be performed. Each WD issued by CCJPA or its partners shall include a SOW with the specific requirements for that WD. Contractor shall provide a technical and commercial proposal in response to each WD. Upon agreement by both parties that the WD proposal is acceptable, a Notice to Proceed (NTP) shall be issued in the form of a Purchase Order.

Issued Work Directives may include services required to design, procure, install, test, operate, and maintain the Solution. In more detail, those services may include, but are not limited to the following:

- Project management and support;
- Requirements analysis;
- Solution design, development, and integration;
- Procurement of required materials and equipment;
- Installation & commissioning processes;
- Asset tagging and tracking of all installed Solution components;
- Testing and quality assurance in compliance;
- Training for installation, support and maintenance staff;
- User support, documentation, and user guides;
- Operations, maintenance, and tiered help desk support;
- Maintenance and annual update of cost pro forma sheets used in coordination with CCJPA;
- System data performance reporting and raw data sharing for all system usage, health and performance.

For each WD, Contractor shall propose a project schedule and submit to CCJPA for approval before NTP issuance. The approved project schedule will be incorporated into the WD.

1.3 Work Directives

For any rail cars on which CCJPA or its partners decide to install the Solution separate WDs will be issued to Contractor, which in turn will include a SOW. Contractor shall have the capabilities and resources to manage concurrent WDs in different locations, potentially across multiple fleets. Specifications and diagrams for the train cars that shall be equipped with the Solution shall be made available to Contractor for each WD. WDs shall follow the Solution design and specifications listed in the MSA CSOW as far as possible. However, each WD will define specific requirements, specifications, and design more precisely and, where needed, customize them on the basis of the train sets and area of train operation, and on the specific requirements of the route, service, and project. Any reasonable change in the requirements, specifications, and design shall ensure that functional and equipment interoperability is preserved across the entire fleet. All changes and additions to the MSA will be subject to CCJPA's approval.

Where the requirements of a WD differ from the requirements of this document, with the mutual agreement of CCJPA and Contractor, and possible passenger rail partners, the WD requirements shall take precedence and Contractor shall be required to comply with the revised WD requirements (provided these are technically aligned with the Solution defined, rather than the requirements of this document).

2 Roles of Contractor & CCJPA

This section explains the respective roles and responsibilities of Contractor and CCJPA under this SOW or on any issued WD. It also establishes the high-level principles with which Contractor and CCJPA will approach the delivery of the contract and sets out the management structure that will be used by Contractor and CCJPA to report on and monitor WD deployments. For clarification, 'CCJPA' shall include officers and/or employees of CCJPA, Caltrans Division of Rail and Mass Transportation (DRMT), and CCJPA's appointed Wi-Fi Services team responsible for day-to-day management of Wi-Fi services and operations. If CCJPA forms a partnership with other passenger rail agencies that may wish to issue WDs under the MSA, by extension where CCJPA is identified in roles and responsibilities, there would also be a similar role for the partner passenger rail agency.

2.1 Contractor Roles and Responsibilities

Contractor shall provide uninterrupted program and project management services for the successful completion of all phases of the program which shall include, but not be limited to, planning, scheduling, coordination, risk analysis, communication, and complete documentation. Additionally Contractor shall:

- Lead the design, solution development and deployment process activities and team meetings;
- Lead all operation and maintenance tasks with CCJPA's input, to CCJPA's satisfaction;
- Provide sufficient resources to provide for simultaneous deployment on multiple trains, and if required multiple regions, as mutually agreed upon by CCJPA and Contractor;
- Request Contractor identification (badges) as necessary;
- Follow CCJPA safety procedures in order to gain access to the site and support systems;
- Display Contractor identification at all times when on site;
- Abide by all safety standards imposed by CCJPA, the FRA and any local authorities or operating entities having jurisdiction;
- When planning to enter the right of way or working in rail yards, attend all safety seminars and safety training as required by CCJPA;
- Provide suitable notice (recommended at least 21 days written notice) prior to entering or commencing work on railroad property, to a schedule mutually agreed on a case-by-case basis by CCJPA and Contractor;
- Where applicable on a WD basis, remove existing end-of-life Wi-Fi solution components from all rail cars, and deliver such equipment to CCJPA at locations to be agreed;
- Perform all tasks listed in this SOW and submit all deliverables listed under each task;
- Ensure that all equipment complies with FRA regulations and with the specific requirements of CCJPA;
- Provide managed services for delivery and maintenance of a captive portal to which Wi-Fi users are directed upon connection to the onboard Wi-Fi network, and customize to CCJPA's or a State Partner's requirements;
- Adhere to agreed-upon Service Level Agreements (SLAs) for Solution availability, performance and support response;
- Ensure SLA performance is reviewed quarterly through meetings of a Wi-Fi Steering Committee set up by CCJPA and its partners;
- Agree to exclude service-level performance parameters during time when agreed upon parameters are exceeded, or malfunctions are due to user error or negligence;

- Provide second level (Tier 2) support of issues that cannot be resolved by CCJPA Wi-Fi Services personnel and which are escalated to Contractor for investigation and resolution;
- Provide third level (Tier 3) on-site remediation by suitably-qualified staff of Solution issues when such issues cannot be resolved remotely by Contractor, or by CCJPA personnel or train crew;
- Manage all relationships with subcontractors, should there be any proposed;
- Assume full responsibility for all Contractor and subcontractors' quality of work, performance, and timely delivery, and provide oversight of CCJPA-sourced labor as required by WD;
- Provide CCJPA with full access to any and all subcontractors for the purpose of evaluating performance, troubleshooting, and consulting on technical matters with representation from Contractor at discussions and meetings;
- Participate, as required, in meetings with CCJPA; disclose information about the Solution design, development, deployment, operations, and maintenance, and prepare status reports as required;
- Provide automated access to the Solution's operational status and performance metrics via processes and protocols including but not limited to one or more Application Programming Interfaces (APIs);
- Provide qualified resources with skills needed to accomplish tasks throughout the project lifecycle and ensure proper staffing and skills set needed to properly perform tasks;
- Identify Contractor employees who shall be considered key personnel for efforts under this SOW or any subsequent WDs. These key personnel shall have an in-depth understanding of the requirements and their responsibilities as well as the ability, experience, and skills to perform the required tasks. Contractor shall designate key personnel and provide résumés to CCJPA for the following skill sets:
    - Account Manager
    - Project Manager
    - Implementation Manager
    - Technical Manager
    - Solution Architect
    - Network Engineer
    - Systems Analyst
    - Requirements Analyst
    - On-Board Communications Subject Matter Expert
    - Operational Support Systems Subject Matter Expert
    - Quality Assurance / Quality Control Manager
    - Service Account Manager
- Follow predefined processes and provide all appropriate documentation for commissioning work to CCJPA prior to CCJPA-conducted per-car Solution validation, and roll out into production;
- Tag all assets deployed as part of the Solution, maintain an asset database that is updated each time a new or replacement asset is deployed, and provide automated access to the complete asset database via an API, or in the absence of an API via an alternative automated process if acceptable to CCPJA;
- Establish and maintain Configuration Management of software on all Solution components that are upgradeable, and follow an agreed plan for rolling out such updates as they become available;

- Provide full and detailed documentation and training sufficient to enable CCJPA to access and operate software provided by Contractor for the monitoring and management of the Solution on a WD basis.

When working on a WD, Contractor shall be fully responsible to:

- Identify the local and regional project requirements, and regulations to which Contractor is subject;
- Develop a plan that complies with these requirements and regulations that satisfies CCJPA;
- Ensure Contractor employees and subcontractors are in full compliance with such plan.

2.2 CCJPA Responsibilities

CCJPA shall be actively involved in the planning and deployment of the Solution, and of the applications and services it will support. CCJPA shall establish an interactive, participatory, and flexible relationship with Contractor. CCJPA shall:

- Provide information, personnel, and assistance during the planning and installation of the Solution and during its operation;
- Identify a Project Manager to represent CCJPA and be the individual duly authorized in writing by CCJPA to enter into and make changes to the MSA, and to make related determinations and findings on behalf of CCJPA and/or its partners;
- Provide project requirements on a WD basis;
- Provide timely and reliable access to data pertinent to the WD, and administer the flow of such data to ensure efficient communication between CCJPA, Contractor and its subcontractors;
- Provide instructions for safety training and rail yard general policies and procedures for Contractor personnel who shall be working onsite in CCJPA and other partners yards;
- Provide CCJPA credentials/badges for Contractor personnel and that of its subcontractors;
- Determine the need for any type of safety service, as no work shall proceed at the site without proper worker protection;
- Provide Contractor access to rail yards, trains and other facilities as required by WD;
- Provide CCJPA labor where CCJPA deems its work force shall perform work for each WD;
- Provide sets of test requirements and processes sufficient for CCJPA personnel to fully and accurately validate the Solution after installation and commissioning has been completed by Contractor;
- Interact with the Contractor to process initial and annual updates to the cost pro forma sheet;
- Assume full responsibility for all CCJPA labor's quality of work, performance, and timely delivery;
- Assist in establishing and managing relationships with CCJPA departments and contractors as required;
- Provide maintenance facility and engineering assistance to Contractor and its subcontractors during the deployment and after the launch;
- Where applicable on a WD basis, provide facilities for the storage of end-of-life Wi-Fi solution components removed from rail cars;
- Provide a copy of CCJPA's and/or its partners safety procedures necessary to enable Contractor to conduct business at the site;
- Review and approve all project documentation related to this SOW;
- Provide qualified personnel to open and operate train and/or facilities and equipment if required;

- Review and approve all Contractor documentation, designs, integration touch points, test plans and operation environments for all external services;
- Provide cellular data subscriptions and physical Subscriber Identity Modules (SIMs) to Contractor based on the best mix of networks determined on a WD basis;
- Provide project requirements to facilitate Contractor's development of the Service Level Agreement (SLA);
- Provide first level (Tier 1) service/help desk to which train crews may report Wi-Fi service issues as they occur. The service desk will attempt to resolve issues but when unable to do so, will escalate to Contractor's Tier 2 support service for remediation, by phone or email depending on the severity of the issue;
- Provide CCJPA or partner asset tags for Contractor to apply to all physical assets comprising the Solution;
- Work with CCJPA project management personnel to deliver task information or tracking project, material ordering and costs in a timely manner as requested by CCJPA.
- When working on state partner fleets, direct or involve all communications through CCJPA and never solely with the state partner entity unless directed by CCJPA staff on a case-by-case basis.

3 CCJPA Requirements

3.1 Introduction

This section captures CCJPA's specific requirements relating to business needs, functionality, performance, installation, operation and reporting of the system. Contractor shall consider these requirements in the formulation of its concept design, baseline system configuration and product roadmap for new functionality. It is expected that these requirements shall form the basis of WD Statements of Work in the future.

3.1.1 Notes on Language

- Must / shall / will = mandatory requirement of CCJPA
- May / should = desirable requirement of CCJPA

3.2 Assumptions and Constraints

Assumptions	
1	The Solution will be a complete end to end solution in that Contractor will have design responsibility for all system elements, vehicle and shore integration.
2	The Solution will comprise all necessary on-board and back office components to support the successful operation and maintenance of the Solution.
3	The Solution will deliver an Internet experience over Wi-Fi at no cost to passengers with the best possible level of performance achievable with current technology.
4	The primary mechanism for connectivity to trains will be cellular, using 4G LTE or better future standards when available, and the solution will use multiple cellular links to create the greatest capacity possible within the technical limitations of the Solution and/or commercial cellular data networks.
5	Wi-Fi service provided by the Solution to end-user devices will support modern IEEE 802.11 standards; support for IEEE 802.11b for end-user devices is not required.
6	Where they exist, any physical end-of-life Wi-Fi solution components that are deemed not reusable shall be removed by Contractor prior to installation of the Solution.
7	The removal or alteration of any installed equipment on-board shall be determined as part of final design.
8	Sufficient power will be made available aboard trains for the Solution.
9	All systems installed on-board a car will be self-recoverable after the loss and subsequent re-instatement of power.
10	All Solution components installed on trains will be hidden from sight to the extent possible.
11	Contractor understands that trains are a harsh environment for electronics, with extremes of heat, cold, vibration dust, electrical interference and variable power. All Solution components shall meet required environmental, mechanical and electrical standards as detailed in this SOW.
12	Contractor shall provide evidence for all installations that the Solution will meet all relevant smoke, flame and toxicity requirements both as defined within this SOW and as new standards emerge these are also accounted for in future designs.

Constraints

1	The Solution will conform to the space made available aboard trains.
2	Cellular data connectivity may not be available from all carriers in all areas in which target trains operate. Where 4G LTE or better is not available, the Solution will automatically switch to alternative cellular data protocols e.g. 3G HSPA, EV-DO to maintain a data connection albeit with poorer performance.
3	Train speeds may reach speeds of up to 79 miles per hour (MPH).
4	Uptake of Wi-Fi service by passengers is typically very high compared to other modes of transportation, in most cases above 50% of riders on any given train set are expected to connect to the network.
5	Where tunnels exist, clearances are minimal, so the allowance for roof mounted antenna height is very small.
6	The design of any new antennas installations on cars shall be limited to conform to height, wind speed, and other environmental restrictions on rail cars.
7	No alteration or cutting of the car body shell shall be allowed to install Solution components, such as roof antennas, without prior written approval of CCJPA. Contractor will be expected to provide all design details and justifications for such modifications within a detailed design package, with supporting calculations as required, for analysis by CCJPA.
8	Final testing shall be done on a train in service to verify that the Solution is functioning as expected and to the requirements of this SOW.
9	The Solution shall not produce RF interference that will affect other systems aboard trains.
10	Operation of new inter-car links and passenger-facing Wi-Fi access points must work in a variable consist, and be interoperable between all cars within a specific fleet as determined by WD.
11	Antenna placement on car roofs could be restricted by existing antennas using available space or by RF co-interference.
12	Any conflicts among specifications referenced must be brought to CCJPA's attention for resolution.
13	Intra-Car RF pollution is very high due to passengers' personal Wi-Fi hotspot devices and these devices compete for available bandwidth on the cell towers.
14	Equipment designed to run on DC power must have the ability to detect the loss of Head End Power (HEP) and shed their load from the DC bus.

3.3 Business Requirements

The Solution shall meet the following key business requirements of CCJPA:

3.3.1 General

The solution selected by CCJPA shall provide a robust, IP-based connectivity platform to a train fleet. This platform shall be capable of supporting a number of applications that are either passenger or business operations oriented, and provide a secure method for CCJPA to manage all of these applications centrally with full visibility of the system operation.

3.3.2 Scalability

The Solution shall be designed in such a way to deliver connectivity to a train set that is scalable in terms of throughput in downlink and uplink to meet growth in passenger and operational demand over a multi-year period. Similarly all other segments in the network between a passenger and the public Internet, such as links between rail cars and aggregation end-points in the data center, shall be designed to have sufficient capacity for such demand.

Contractor shall clearly illustrate where the practical capacity limitations are within each part of the proposed solution, for example the number of associated devices and maximum per client traffic for each access point. Figures shall be based on empirical testing and not theoretical values from hardware specifications. Contractor shall be able to provide detailed test report data for each value if required as part of evaluation.

3.3.3 Technology Evolution

Contractor's overall design and solution components shall use a modular approach, and be adaptable for future enhancements and development in order to forestall obsolescence, and shall use commercially available off-the-shelf (COTS) hardware and software to the extent practical. To demonstrate this capability Contractor shall detail the lifecycle for each system component and advise how that can be supported over the life of the contract and when that component should be considered life expired and replaced. Contractor shall clearly detail how the proposed solution offers CCJPA upgradability and expandability in terms of function and performance. Contractor shall clearly detail how a wide variety of Contractor or non-Contractor led applications (not covered by this SOW) using the system are supported. Contractor shall adhere to CCJPA's asset management policies for asset identification, tracking and asset depreciation.

3.3.4 Environmental Compliance

Contractor will have a documented plan that will show how the system is optimized in terms of efficient energy usage and what steps are considered in the procurement and disposal of hazardous materials throughout the lifecycle of the contract.

3.3.5 Cost Effectiveness

The Solution shall be cost effective through the use of innovations including but not limited to:

- A method of managing multiple SIM cards effectively to optimize cellular data subscriptions on the train and in the back office;
- Utilization of standards based technology to ensure that there is a wider pool of system parts that can be deployed to upgrade the system at a later date and to simplify future upgrades;

- Cloud-based, back office operational support systems;
- On-board systems monitoring for advance warning and predictive analysis of mechanical and electronic defects, reducing the requirement for on-site visits by support personnel.

3.3.6 Consistency

All hardware, software and firmware comprising the Solution shall be consistent across all trains equipped by Contractor under separate WDs. For the avoidance of doubt Contractor shall not be responsible for managing any Wi-Fi solution not supplied by Contractor.

3.3.7 Open Access to System Data

CCJPA values very highly the ability to extract and analyze data from a Next Generation Wi-Fi solution for a variety of purposes including but not limited to improved business intelligence across CCJPA operations, and the creation of data 'dashboards' within a CCJPA-managed analytics environment that cross-reference and compare metrics generated by disparate yet inter-relational systems for predictive analysis and trend monitoring. The Solution must support and be accessible by such dashboards to the greatest extent possible, using industry standard practices and protocols.

3.3.8 Interoperability with Legacy Systems

WD's executed under the MSA may require a level of interoperability with legacy systems onboard a rail car and/or train set. Contractor may therefore be asked to provide a migration plan to facilitate such a transition while accepting that the intellectual property of both Contractor and the legacy system supplier is not compromised.

3.4 General Technical Requirements

3.4.1 Introduction

CCJPA has defined the minimum technical and operational requirements for the Next-Generation Wi-Fi Solution, while encouraging maximum flexibility, creativity, and innovation by Contractor. This section summarizes each key component of the desired solution, and details the specific requirements for core features and functionality. Contractor shall ensure that these are fully addressed in the written response indicating whether the proposed solution complies with the individual requirements. The key technical requirements of the Solution are to:

- Use multiple cellular carriers to create a train-to-ground (T2G) connection of the best possible quality and capacity;
- Treat additional T2G links – including but not limited to satellite and trackside networks – as alternative methods of connectivity, if and when such links are installed on a train set;
- Create a high-capacity wired and wireless backbone throughout the length of a train with sufficient capacity to deliver an equitable level of service to each passenger rail car. The backbone shall comprise wired or wireless links delivering no less than 1 Gbps in any car from the location of the Internet connection (e.g. café car). The wired connection shall be considered primary and the wireless connection secondary, the latter providing redundancy in the event of wired backbone failure;
- Dynamically self-configure the on-board network when cars are marshaled together in a single train set or consist, while minimizing the risk of radio frequency (RF) interference between cars

either from the inter-car links (if they are wireless) or passenger-facing Wi-Fi access points, and meshing between Wi-Fi-equipped cars in different consists;

- Enable any car from any relevant fleet to connect to each other and be interoperable, regardless of geographical location, route, or car type;
- Deliver Internet access over Wi-Fi using modern 802.11 standards to end-user devices, and ensure that coverage of the Wi-Fi signal is ubiquitous throughout every car in a train set;
- Provide Internet service over Wi-Fi to passengers, allowing common Internet tasks such as email, social media, connected apps, web browsing, VPN connection, and file upload and download (within CCJPA-controlled limits);
- Support the blocking of certain types of traffic based on content type and/or black/white listing;
- Provide on-board media storage for delivery of Wi-Fi landing pages or captive portal content including but not limited to static graphics and HTML, video, and audio in an industry accepted stack (e.g. LAMP[1]) for delivery over Wi-Fi to end-user devices;
- Deliver a portal experience customized to a specific fleet, including but not limited to visual branding, Wi-Fi availability, and real-time trip information;
- Provide remote whole-system and individual component monitoring, analytical reporting, event recording and alerting, troubleshooting, and preventative maintenance capabilities;
- Comprise modular component kits for ease of installation and repair;
- Support migration to or incorporation of emerging technologies as they become available through the use of modular components including but not limited to storage, inter-car link radios (where wireless is used), digital train line (DTL), cellular radios, passenger-facing Wi-Fi radios, antenna and RF design, and IP routing methods;
- Provide back office systems in the cloud to reduce capital and operating costs and enable rapid expansion as the Solution is deployed across multiple fleets;
- Scale to provide a common communications platform using identical primary components for all installed fleets;
- Provide all system derived data to CCJPA as system service reporting and as ingestible raw data into CCJPA's own data management system.

CCJPA is not committed to a specific solution or technology to achieve its business and/or technical objectives, but expects the Solution to use a sufficient combination of cost-effective wired and wireless interfaces and radio spectrum to provide maximum throughput, bandwidth, performance, coverage, redundancy, quality, and reliability. The solution should be capable of creating usable telemetry data to allow system operation, usage and health to be analyzed and monitored in detail through either the vendor or CCJPA's own OSS system.

3.4.2 Notional Solution Design

CCJPA expects the complete Solution to comprise three core operational segments:

1. **On-Board Network (OBN) segment,** i.e. solution components installed and operating in rail cars;

1 LAMP is defined as Linux, Apache, MySQL, PHP.

2. **Operational Support System (OSS) segment,** i.e. solution components installed and operating in one or more cloud-based data centers.

3. **System Data Access segment (API),** data feed(s) and API available to allow access to system operational, health, usage and performance data.

The **OBN** segment comprises radio, antenna and ancillary equipment on the train that provides a cellular backhaul link and delivers Internet access over Wi-Fi throughout a train set. The technical and functional requirements for this segment are detailed in section 3.5 *OBN Segment & Functional Description*.

The **OSS** segment comprises back-office systems for equipment and service monitoring and management. The technical and functional requirements for this segment are detailed in section 3.7 *OSS Segment & Functional Description*.

The **API** segment consists of a mutually agreed data structure and secure method of accessing real-time and historic data related to the system operation, health, performance, and client usage of the system. The technical and functional requirements for this segment are defined in section 3.8 API *Segment & Functional Description.*

Figure 1 illustrates the notional design on which CCJPA has based its assumptions to define technical and operational requirements.

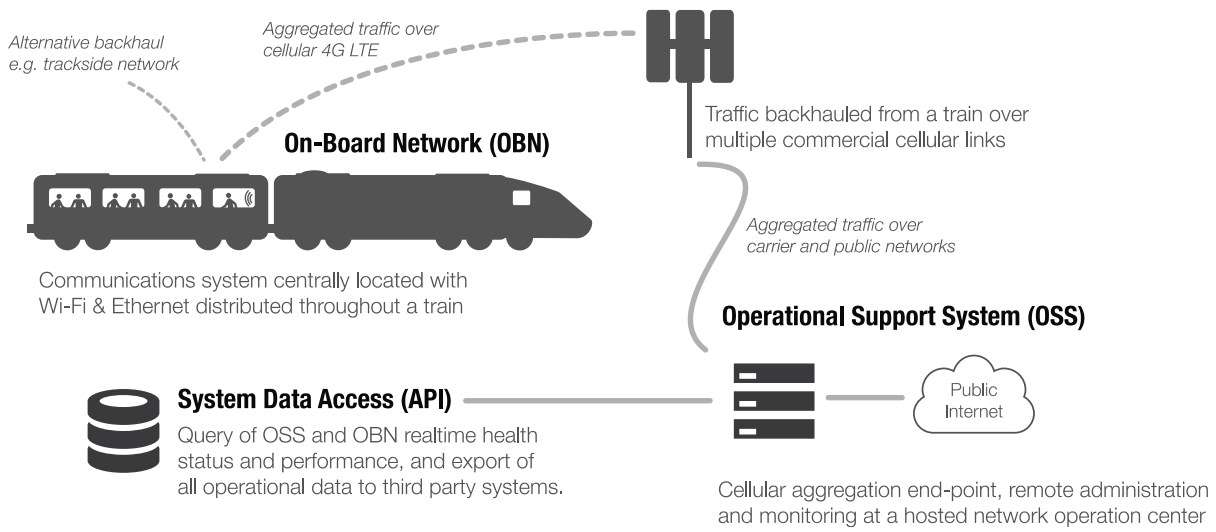

Figure 1 – Notional Solution Design

Referencing the acronyms shown in Figure 1, Contractor is required to propose a solution that encompasses the OBN, OSS and API segments, while providing connectivity via commercial cellular data networks. Due to limitations of capacity and availability on a single carrier, CCJPA expects the Solution to utilize multiple carriers (e.g. Verizon, AT&T, and T-Mobile) to deliver the best possible level of service in any given area of train operation. The Solution shall support alternative backhaul links including but not limited to trackside and satellite networks, utilizing them where available based on CCJPA-defined commercial and technical rules.

3.4.3 Service-Proven Equipment

Contractor shall utilize service-proven hardware. For all parts and components, the Solution shall use designs that have a documented and satisfactory operating history, except where components or technology are so new that they cannot be expected to have a satisfactory operating history and which meet or exceed CCJPA business and technical requirements as described in this document and its appendices. Contractor shall select and utilize high quality and reliable components, materials, and, as far as possible, proven designs that meet or exceed the referenced rail standards. Contractor shall provide product specification sheets for all equipment to be deployed, including replacements, upgrades, date of introduction, and possible dates for EOL support. All hardware will be tested against recognized industry and national standards, and manufacturers' Mean Time Before Failure (MTBF) data provided for CCJPA analysis. Systems and equipment with a limited service record shall be given consideration by CCJPA, but they shall be accompanied by presentations and engineering data containing sufficient information for CCJPA to review the merits of the design. Where Contractor proposes new hardware and/or software features and/or functionality not previously deployed in a live rail environment, then the efficacy of such shall be fully supported by written evidence including but not limited to extensive lab/bench test processes and results to CCJPA's satisfaction. This requirement shall extend to future upgrades and/or Solution improvements during the contract term, whereby such changes shall be fully tested and ready for adoption.

3.4.4 General Rail Standards Compliance

CCJPA requires that all Solution components be fit-for-purpose and suitably rugged for the rail environment, capable of withstanding shock, vibration, impact, humidity, atmospheric pollutants, dust and dirt intrusion, and ambient temperature as well as transient power fluctuations. Equipment located outside, such as train-born external antennas, must also meet requirements for survivability against corrosion, wind loads, object strikes, and other factors.

Contractor shall specify what industry and internationally recognized standards the components have been tested for and found to be in compliance with. In general, Contractor shall meet all requirements stated in the Code of Federal Regulation, Title 49CFR Part 238, and in EN50155:2007 as they pertain to on-board equipment. Contractor shall be and remain responsible for compliance with all applicable federal, state, and local regulations throughout the working relationship with CCJPA .

3.4.5 General System Standards Compliance

The system shall, wherever possible, follow recognized national or industry standards and/or codes of practice that define or guide system operation. This shall include, but not be limited to, the following areas:

1. Train IP network design and topography – IEC 61375 (various parts);
2. On-Board Multimedia and Telematic Systems – IEC 62580-1;
3. System Security – NIST 'Framework for Improving Critical Infrastructure Cybersecurity'.

For all system areas Contractor shall identify where a protocol or process is proprietary, either directly to Contractor or from a sub-system supplier. The purpose of this is to make clear where there is any part of the system that may have to be replaced and/or upgraded in the future to ensure that it is clear how interoperable the system components are with a possible replacement.

3.4.6 Lifecycle & Continuity

While electronic equipment on rolling stock may have an operational lifecycle in excess of 175,000 hours, CCJPA accepts that certain components of the Solution – including but not limited to cellular and Wi-Fi radios – will advance during the Solution's lifecycle and may require upgrade and/or replacement. Contractor shall identify what components are likely to require exchange over a five-year period, and specify the processes for accessing equipment that needs replacing. Contractor shall also specify Mean Time To Repair (MTTR) and Mean Time Before Failure (MTBF) ratings for core components.

System modularity and network agnosticism are key requirements of the successful Solution. Contractor shall accommodate future advances in radio and antenna technology, and keep CCJPA informed regarding the degree of complexity involved with upgrading the Solution, as upgrades are required. CCJPA wishes to minimize equipment service calls that could lead to potential operational downtime. To this end Contractor shall ensure the Solution can be remotely managed for in-field component diagnostics, and remotely updated with new configuration files and firmware in real or near real-time operations.

3.4.7 Network Cyber Security

The Solution shall provide a full range of security features to protect all Solution components from intrusions and unauthorized changes. This shall include, but not be limited to: firewall, encryption, secure SSIDs, and Layer 2 isolation.

Contractor will propose a security design and methodology utilizing the following approach as an example:

- Risk assessment of vulnerability in accordance with recognized industry or national standards, for example: NIST 'Cyber Security Standards', IEC 62443 or equivalent;
- Provide system protection utilizing good practice perimeter protection methods;
- Undertake active anomaly detection on assumption that the perimeter protection can be compromised. This could include unusual network traffic, attempts to laterally move across network segments, and users running privileged levels of access. Anomalies that are to be detected shall be proposed by Contractor and agreed by CCJPA and these shall be reviewed, no later than an annual basis, and updated into the system operation;
- Monitor system operation to detect actual or attempted intrusion that will trigger an alert through the OSS;
- Contractor shall describe if and how the system is capable of automatically providing protection in the event that there is successful intrusion detected within the system;
- Security controls within the OBN shall not be dependent on the available of the T2G communication link;
- Contractor will include Layer 2 isolation within the OBN to ensure that it shall not be possible for any connected passenger device to see or communicate peer-to-peer with any other device on the wired or wireless network with the exception of the gateway/ media server.

3.5 OBN Segment & Functional Requirements

3.5.1 Overview

CCJPA's general system architecture for on-train communications is built around a core IP-based intra-car, intra-train and train-to-ground technology. All of the Solution components that are installed onto the train form the On-Board Network (OBN) segment. The OBN can then support a range of passenger-facing and operational applications which utilize this IP infrastructure.

3.5.2 Location of OBN Components

An existing Wi-Fi solution installed on California IPR rail cars, and other CCJPA partners' fleets, uses a centralized model whereby the core components e.g. the mobile router, cellular modems, RF multiplexers, and roof-mounted antennas are located on a single car. On the California-based fleets this is typically the café / diner car, while on other fleets it can vary between different car types. CCJPA prefers to retain this centralized model to reduce the impact of external work on rail cars, for example when installing roof antennas, and for a Next Generation Solution to utilize the space made available following removal of the existing Wi-Fi system. However CCJPA will consider innovative approaches to improving communications quality and performance including, but not limited to, the use of multiple IP routers in more than one car either configured to function collaboratively or independently. If Contractor recommends a different approach to system design then it should provide a cost benefit analysis of moving to this approach and what car types/ conditions this would be recommended.

It should be noted that many of the vehicles that will be covered by future WDs are bi-level vehicles, Contractor should provide an explanation how system design shall cover such car types and how issues like in-car Wi-Fi coverage are determined in such an implementation.

3.5.3 Mobile Router

CCJPA expects the main purpose of the mobile router will be to act as the gateway between the train and the Internet. The router will be capable of managing multiple cellular connections from different mobile network operators and allow the bandwidth available from each connection to be aggregated to maximize bandwidth between train and shore or use a cost / prioritization scheme to allow different data to utilize different connections based on rules agreed with CCJPA. This task is a critical aspect of Solution functionality so CCJPA encourages responses to include as much detail as possible on how the Solution accomplishes the following requirements:

3.5.3.1 Cellular Link Performance

The router shall deliver the best possible T2G connection at any given moment, and this may be accomplished through a Contractor-specific method of link bonding, aggregation or other technique. CCJPA accepts that Contractor cannot warrant the availability or performance of commercial cellular networks as these are outside its control. Nevertheless as the quality and performance of the T2G link is paramount to the successful delivery of Wi-Fi service, CCJPA requires the Solution to take into account mobile network coverage and quality variations between mobile operators, and employ the combining and optimization of – and seamless switching between – multiple 4G LTE cellular links. Contractor shall detail:

- How the Solution maximizes multiple concurrent WAN connections to deliver the highest possible capacity, lowest latency, and most stable quality; and the method of link aggregation e.g. session- or packet-based;

- How the Solution minimizes the chatter of TCP/IP traffic over the WAN connections;
- How the Solution mitigates network disconnection through seamless and uninterrupted handover between carriers;
- By what criteria and methodology cellular networks will be assessed, prioritized, and selected for use while the train is in motion, and TCP and HTTP traffic will be optimized over cellular networks;
- How the Solution will manage cellular and alternate backhaul links such as trackside or satellite networks; select and prioritize those links for T2G traffic; and how rule settings are monitored and adjusted to optimize for any number of performance objectives (e.g. cost, throughput);
- How the Solution utilizes or considers beneficial metrics including but not limited to packet loss, signal strength, latency and jitter in the process of sending data between the train and ground;
- How the Solution abstracts this data from the specific make and model of cellular modem;
- How the Solution determines how end-user Wi-Fi traffic flows over available data links and then when and how data is moved from one link to another while minimizing any negative effect on the Wi-Fi experience;
- Real-world test cases that can be (a) executed by Contractor and witnessed by CCJPA to demonstrate the operation of the above points and, (b) used if requested by CCJPA when any significant software or component configuration changes are made to show that the core functionality has been maintained.
- The process of managing multiple concurrent cellular links is likely to incur a degree of management overhead; Contractor shall detail what percentage of total throughput is allocated to this overhead.

3.5.3.2 Support for Emerging Mobile Standards

The Solution is expected to use a combination of commercial 4G LTE networks to provide T2G connectivity. CCJPA wishes to ensure that the Solution is capable of supporting emerging mobile standards, protocols and techniques as and when they become available to maximize system quality, performance and reliability. This includes but is not limited to LTE-Advanced, multi-band carrier aggregation, 4x4 MIMO, and techniques and process that comprise the ‘5G’ standard. Contractor shall provide details of how the Solution supports these features today, or intends to support them in the future with an accompanying roadmap and timeframe. Contractor shall also explain how the introduction of new features is managed, the processes for deployment with minimal risk to existing service, and typical corresponding timelines, while identifying how performance or other business objectives can be supported.

Contractor shall describe in detail the process whereby new technology is integrated into the current platform and what provision has been made in the hardware roadmap to accommodate new modem form factors. The level of dependency between a new technology and the current platform operating system and/or software should be clearly defined and the level of abstraction between custom software and development and Contractor’s core technology. The typical timeline to integrate new technology, at the request of CCJPA, should be provided given typical workload and other dependencies.

Contractor should describe the approach that it takes to ensure that the platform maintains compliant with US legislation, for example PTCRB, when new technologies are introduced. The company’s certification and compliance plan specific to the U.S. market should be provided in the response.

3.5.3.3 U.S. Carrier Mobile Network Certification

Devices such as mobile routers, that contain modems using SIMs for U.S. mobile networks, are required to be certified as a 'whole system' by each carrier whose network the device uses. For example, a router containing a modem compatible with Verizon and using a Verizon SIM must meet Verizon conformance requirements, device testing, and certification processes before they are certified for use on the Verizon network. This is the case regardless of whether the individual modem has been certified separately. Contractor shall provide evidence of 'whole system' certification for the Solution for each U.S. carrier on whose network the Solution is intended to operate.

3.5.3.4 Carrier Subscription Management

CCJPA's existing Wi-Fi solution currently utilizes up to eight separate SIMs within the mobile router on each train, with one SIM per modem. Line rentals vary between mobile operators both in terms of monthly price and data plan limits; CCJPA currently sources and pays for these subscriptions directly. Exposure to monthly data overage becomes a real concern for managing ongoing operational costs. CCJPA seeks innovative methods of managing carrier subscriptions and potential risk of overage that includes support for multiple SIMs per modem. These methods may include one or more of the following:

- SIMs physically located in the mobile router;
- SIMs physically located in a separate, easily-accessible unit aboard a train;
- SIMs physically located in a remote data center.

Contractor should explain how the Solution manages SIMs, for example by pooling multiple subscriptions with multiple carriers across a fleet of trains, and intelligently switching between SIMs as data allowances expire. Contractor shall have a means of tracking the location of individual SIM cards and the data that has been passed by that SIM card based on journey, day, or month, or by billing cycle dates as defined by CCJPA.

Contractor shall provide a mechanism to limit the data transferred through a particular carrier or specific modem within the mobile router where it is required to limit usage due to capacity limits on a SIM cards etc. The methods available to support this shall be described for example, de-prioritizing traffic through one carrier type, and limiting day of week or time of day a carrier can be used.

3.5.3.5 Support for Third Party Applications

CCJPA may in the future require that the mobile router be used to support third party software applications either within a virtualized or containerized environment on the router. If this is currently supported then Contractor should describe in detail how this can be implemented in practice, and estimate how much processor and memory capacity can be assumed to be available for third party applications within different mobile router hardware units and any limitations that exist on how this can be assigned. Where Contractor utilizes a hypervisor then this should be described and if and how different applications can be managed or prioritized within the system.

Where container support is provided Contractor should provide details of the system supported (e.g., Docker), the OS kernel, and roadmap showing Contractors development plan for this platform.

If additional memory or processor capability is required for supporting other applications, Contractor will describe if this can be implemented within the same hardware unit or using any external device(s).

Practical limitations and existing deployments should be described to show how industry best practice has been implemented on other similar applications.

3.5.3.6 Mobile Router Hardware

Contractor will describe the mobile router hardware options available and shall tabulate the function and performance of each. Where a device is suited to a particular application or has limitations in either function or performance this should be clearly described to allow choice of hardware to be fully understood. For each device where there are options to upgrade the unit this shall be described and the upgrade options clearly broken out.

Contractor will tabulate typical maintenance operations that can be undertaken on the different models of mobile router to define what actions can be undertaken in the field to remedy issues (e.g., modem or SIM swap) and what would require the complete unit be removed for test and repair off the train.

3.5.3.7 Multiple Mobile Routers in Train

It shall be possible that multiple mobile routers may exist within a single train consist. Contractor shall describe the options available how these routers will successfully and seamlessly interwork to prevent any detriment to the user experience and also share available capacity from the cellular modems in each router.

3.5.4 Interoperability with Alternative Train to Ground Links

While CCJPA expects cellular communications to remain the primary method of T2G connectivity for the majority of fleets, the ability to interoperate with alternative technologies is an important feature of the desired Solution. The Solution shall have the ability to work with such alternative links, and intelligently select the most appropriate connection based on predetermined business rules such as least-cost routing, and technical criteria that will include but not be limited to network availability, order of prioritization, signal strength, modulation scheme, throughput, latency, and other measures of link performance and quality. Contractor shall detail:

- How the proposed Solution manages multiple links that include both cellular and non-cellular connections and performs seamless link prioritization and selection;
- Contractor's business approach to working with CCJPA and its other vendors for implementation of the Solution with alternative technologies;
- Examples of prior projects where non-cellular links have been implemented successfully.

3.5.5 Train Backbone Network & Inter-Car Links

3.5.5.1 Existing Digital Train Line (DTL)

Many WDs may involve installing a Next Generation Wi-Fi solution on cars with an existing Wi-Fi system. In some of these cases, passenger cars may utilize both wired (Ethernet) and wireless (802.11n) links at each end of the cars to create a 'backbone' network the length of the train with a level of redundancy, over which passenger Wi-Fi traffic is passed between adjacent cars and to the central mobile router. In instances where a wired network is installed it is known as a Digital Train Line (DTL), implemented in

accordance with *PRIIA 305-919 Digital Trainline Hardware*[2] and providing a Gigabit connection throughout the train set. If the wired jumper is for whatever reason not connected between adjacent vehicles, or if the wired connection fails, the system will revert to a wireless connection. In summary, the network architecture uses DTL as the primary connection, and the wireless links as a secondary, back-up path.

The current DTL design utilizes two Gigabit Ethernet switches located within each car providing:

1. Car-to-car connectivity;
2. Connectivity within each car to Wi-Fi access points;
3. Connectivity within each car to an On-Board Information System (OBIS) that is being installed on many existing California IPR trains through at least 2021.

In some vehicles the current Ethernet switches support only Fast Ethernet (100Mbps) connectivity to Wi-Fi system components which is considered inadequate for a Next Generation Wi-Fi system. Contractor should propose an upgrade to the system switches that provides a higher bandwidth connection for the Wi-Fi solution at a minimum of 1 Gbps. Where Ethernet switches exist, they should be maintained within each car as these are tightly integrated with the OBIS solution and be integrated with new Ethernet switches provided by Contractor, that will maintain the functions outlined in (1) and (2) above.

Contractor may propose alternative wired jumper equipment to replace the PRIIA 305-919 equipment on applicable cars on a WD basis. It will be Contractor's responsibility to (a) ensure that if the existing equipment is to be re-purposed that it is capable of supporting the required performance, and (b) to remove any equipment not to be used within the Solution, and deliver to CCJPA.

3.5.5.2 New Digital Train Line (DTL)

Contractor may propose the use of wired ICLs – e.g. fiber, copper, or a combination of these – to provide a high-capacity wired backbone of at least 1 Gbps throughout a train set. If a wired solution is proposed then on conventional equipment the DTL should be implemented in accordance with the solution already developed by the PRIIA Next Generation Equipment Committee PRIIA 305-919 unless Contractor can identify a more appropriate and proven standard for the DTL. The installation will be part of Contractor's Solution.

3.5.5.3 Wireless ICLs

Contractor shall propose a solution to provide wireless ICLs between cars as a back-up to a DTL solution. A wireless solution shall use the fastest possible radio technology available in a form factor that meets rail specifications. For example, CCJPA would be interested in understanding how 802.11ac (5 GHz) or 802.11ad (60 GHz) standards with MIMO antennas could be applied to create a high-speed wireless backbone throughout a train. Contractor shall demonstrate how the Solution maintains optimum throughput between the mobile router and the last passenger car in a consist i.e., the car furthest away in terms of ICL hops, and shall specify the predicted decrease in throughput (in Mbps) and increase in latency (in milliseconds) for each hop.

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[2] http://bit.ly/2wjRGIC

3.5.5.4 Dynamic Self-Configuration

It is expected that most vehicles that will be implemented with the Solution under different WDs will comprise cars that are not formed into fixed train consist, but are variable in that individual vehicles can be added or removed on a daily basis with no reliable back office system to notify what a consist is or should be. As a result the Solution must dynamically auto-configure without any manual intervention to establish and maintain car-to-car network communication as cars are coupled and decoupled from a train set. Contractor shall detail the methodology by which dynamic self-configuration and routing is configured, and how accidental train-to-train communication is mitigated, for example when trains with wireless ICLs are adjacent to each other in the same station. Contractor will describe how wireless channels and transmission power levels will be selected automatically to ensure that immediately adjacent radios within the same train set are operating on the same channel and that other links use different channels to reduce the effect of in-band interference on the system performance. A clearly stated analysis of any compromise inherent in wireless ICL design should be provided.

The Solution shall be capable of reporting to the OSS ICL status and configuration including but not limited to power level, throughput obtained over time, modulation scheme, channel assignment on a per car basis within a consist, and alerting the OSS to issues arising from failure to establish or maintain inter-car links. The actual consist arrangement, car order and orientation shall be data that is available both to other systems within the train through an API and also off-train to support reporting and analysis. Contractor shall explain how this is accomplished.

3.5.5.5 On-Board Network Configuration

Contractor may propose an OBN train network design that either functions as a layer 2 or layer 3 network. The advantages of the preferred solution must be described in detail considering cost, performance, security, complexity, and future expansion.

3.5.5.6 Virtual Networks & Future Expansion

When planning the train backbone network, Contractor shall take into account future applications that may increase demand on the network for intra-train use. For example, delivery of video and audio content to passenger devices from an on-board server; video from cameras for operational and security purposes; and media for OBIS. Contractor shall explain how the Solution is expandable to cater to such demand in the future. The Solution shall support 802.1Q Tagged VLANs to securely separate these multiple sources of traffic, and enable prioritization based on traffic type and/or CCJPA-defined rules.

It is anticipated that systems requiring audio and video streaming (e.g., OBIS and on-board entertainment) may utilize multicast channels to transmit data through the train. Contractor will describe how all components that make up the OBN are capable of handling multicast traffic and also any constraints that may need to be considered. Contractor will describe other project examples where multicast traffic has been successfully utilized over the OBN within a train.

3.5.6 Wi-Fi Access Points

3.5.6.1 RF Configuration

Each car shall have a minimum of one Wi-Fi Certified passenger-facing access point (AP) providing sufficient RF signal to cover all parts of the car that a passenger or train crew can be expected to occupy

in normal operation, with a strength not less than -70 dBm and a signal-to-noise ratio in the range of 25-30 dB.

At minimum the AP shall contain discrete Wi-Fi radios supporting end-user devices at 802.11a/g/n at 2.4 GHz and 802.11a/n/ac at 5 GHz, using channels permitted for use in the United States. Please note that APs shall be configured to reject network association by legacy 802.11b passenger devices to avoid the negative impact on network performance. Contractor shall describe if and how emerging Wi-Fi standards are being considered in a development roadmap and how these will be supported when available. The design aspects of different passenger-facing antenna designs should be described in detail with a recommendation made based on currently available technology, and also how these will support emerging wireless standards in the future.

3.5.6.2 Service Set Identifiers

Contractor shall state how many Service Set Identifiers (SSIDs) are supported on a single AP and by individual radios within an AP. CCJPA requires that it shall be possible to identify and prioritize traffic both from different APs and when connected to a different SSID. Contractor shall describe how this can be achieved (e.g., by associating VLANs with different SSIDs).

It shall be possible to have multiple SSIDs concurrently configured per AP that are set with different parameters such as visible or hidden. Contractor will describe how an SSID can be set for a fleet or individual vehicles either utilizing a central controller or similar to carry out the change. The SSID name(s), visibility, and possible Pre-Shared Keys required by CCJPA shall be defined within the specific WD for a fleet deployment.

3.5.6.3 User Connection Seamless Roaming

The AP – either by the configuration of radio power, utilizing a roaming protocol, or a combination of these – shall ensure that when a user device makes an initial connection to an AP in one car and subsequently moves through the train to another car, it shall transfer gracefully so that the connection is moved to another AP that offers a better link based either on proximity or AP loading. Even if the first AP is still visible to the connecting device it shall be automatically re-associated to the new AP without affecting the user experience. In summary, the Wi-Fi experience and delivery of content shall not be interrupted in the event that a passenger moves around the train in the course of a journey.

3.5.6.4 Cyber Security

The AP represents a point where either malicious or accidental access can be made into the train data network. Contractor shall describe, within the response to section 3.4.7 *Network Cyber Security*, if and how cyber threats are managed at each AP.

3.5.6.5 Access Point Management

Contractor shall describe how a fleet of APs will be managed to maintained to ensure firmware and configuration versions are maintained to the latest agreed versions fleet-wide. When it is necessary to upgrade a fleet to a new hardware or configuration version then the method that shall be used to deploy to the fleet shall be described with the aim of ensuring that manual intervention and physical access to cars is limited or unnecessary.

3.5.7 Roof-Mounted Antennas

Optimal performance of T2G links is challenged on many levels by the mobile networks themselves. Operators have not located base station sites with delivery to trains in mind; as a result, sites are often some considerable distance from tracks, and even where masts are close, antennas may not be pointed towards the right-of-way. Coverage issues are compounded by contention for base station capacity by users in residential and business areas, and by passengers on a train who choose to use cellular data devices such as personal hotspots during their journey. Therefore the design and positioning of roof-mounted antennas, and their functionality with individual modems, must take these challenges into account for the best possible RF performance.

Contractor should propose an antenna configuration to demonstrate how performance can be optimized while maintaining an antenna design that can be practically implemented within the gauge envelope of the vehicle. Generally speaking, it is preferred to keep the need to penetrate the outer skin of a train to a minimum. All new antennas must remain with the dynamic gauge envelope of the target vehicle which will be provided with the associated WD. Contractor shall note that static and dynamic gauge envelopes vary between car designs and fleets therefore a single roof antenna design scheme may not be applicable across all car types, and variations may be required on a WD basis.

3.5.7.1 GPS

For the Solution's use of GPS for location awareness or other functionality, the GPS antenna shall be integrated within at least one of the Solution's cellular antennas and not require a separate antenna. Roof-mounted antennas shall:

- Use an CCJPA-approved method of mounting to the car body;
- Be water resistant, and support wind speeds in excess of 300 MPH;
- Withstand impacts of 4G vertical, 4G lateral and 8G longitudinal (direction of travel);
- Withstand corrosion caused by diesel exhaust contaminants;
- Withstand impact of objects, debris and small animals at speed;
- Withstand interference from overhead electrical catenary, where such catenary exists;
- Withstand harsh environmental conditions and comply with European Standards EN 50155:2007 for temperature and humidity category T1.

CCJPA welcomes alternative GPS technologies that may provide additional accuracy or features that may be useful for future applications. As GPS is expected to be used by multiple on-board services and applications in addition to Passenger Wi-Fi, Contractor should provide historic data on the reliability of both the GPS antenna mounted to the roof and to the GPS receiver in the mobile router and, considering the MTTR expected for a roof-mounted component, state a calculated availability for the GPS data for a car. If necessary Contractor may propose more than a single GPS antenna on the roof of the car to provide a level of redundancy to the system to ensure that GPS data can still be made available even if an antenna is damaged.

CCJPA considers effective RF design, and the application of innovative antenna techniques, to be an extremely important part of an effective overall Wi-Fi system design, and encourages responses that reflect this in the proposed Solution.

3.5.8 User Experience

3.5.8.1 Device Connectivity

The primary use case for the Wi-Fi system is to provide a means of allowing a passenger to associate a suitable device wirelessly to the OBN, be authenticated and then be provided with a curated connection to the Internet and the option of walled garden content provided by CCJPA.

Contractor shall describe the connection method used for any device associating with the network to include all of the following steps:

- Associating with one of several wireless APs;
- Device discovery and provision of IP address (train and fleet client IP addressing methodology should be described);
- Access control process including how landing pages are delivered and where the landing page is delivered from;
- How captive portals (for example Apple's Captive Network Assistant) can be managed to allow CCJPA to decide if this is used by the system to deliver the landing page;
- What metrics are gathered from each connected and associated device and reported to the OSS, as CCJPA expects to be able to determine which AP a device has been associated with, and which radio was used to connect (where both 2.4 and 5 GHz radios are available for passenger access);
- How and when a device is dissociated from the network and what the user's experience is if they attempt to re-connect within the same car, train, or fleet within different times on the same day;
- How user sessions are managed when moving from car to car and the AP initially associated with is no longer capable of providing the best connection.

To maintain a satisfactory user experience the Solution shall employ a method of dynamic bandwidth allocation per user, and traffic shaping to prioritize or throttle bandwidth in the downlink and/or uplink for certain types of data-intensive traffic such as large file transfers. The Solution must also be capable of content filtering (e.g. pornography and other explicit content), URL and IP whitelist and blacklist, and of restricting or blocking certain background activities such as streaming video and audio, OS updates, and cloud-based back-up, while also limiting access on a per user or device basis. Contractor shall detail what options are available within the proposed solution to implement a fair use policy for managing bandwidth effectively, and restricting certain types of traffic.

Contractor shall document the expected throughput available on each Wi-Fi AP in each car in the downlink and uplink in an unloaded state (i.e., no end-user devices connected), and state how many concurrent end-user devices are supported for connecting to each AP.

CCJPA may wish to closely manage the volume of data being passed over different cellular networks and as such may want the ability to make changes to policies quickly across a fleet or sub-fleet. Contractor shall describe how these changes can be applied to a fleet and the level of manual intervention necessary to make the changes.

It is also required that some passengers may be provided a different level of service which is based on seating location or a for-pay subscription, loyalty codes or similar. Contractor shall describe how this can be provided within the system.

The Solution shall protect end-users from malicious activity including but not limited to ‘man-in-the-middle’ attacks and rogue APs by using a wireless intrusion prevention system (WIPS) and/or other security measure. Contractor shall provide details of what functionality is currently offered within the Solution, and what will require customized development to meet CCJPA’s security needs.

The Solution shall allow non-passenger devices to connect to the OBN, for example, train conductors’ handheld devices, and other IP-based systems within the train. Contractor will describe the methodology that will be followed when providing such integration and how cyber security will be maintained for the overall system. The Solution will be capable of providing access controls to allow limits to be applied to the type of connectivity available to these devices (e.g., open internet access, or only access to certain devices within train). Contractor will describe in detail, providing examples, of how IP addressing will be managed for the overall system components, user devices within a car, train or fleet, and other systems that may be connected to the OBN at a future date. It should also be noted that CCJPA may already have devices on the network that have an IP addressing range already defined, so Contractor shall describe how such addresses will be integrated and managed within its proposed schema.

3.5.8.2 Captive Portal

The Solution shall use a mechanism to display a captive portal or ‘splash page’ the first time a user connects to the Wi-Fi network during a given journey; this page shall be hosted on the on-board the train (e.g., on the mobile IP router) so that passengers receive content with least delay. The captive portal shall be customizable for specific fleets on a WD basis. CCJPA may wish Contractor to undertake portal design for each WD, or require Contractor to provide sufficient design guidelines to CCJPA to allow this page to be designed by a third party and function seamlessly within Contractor’s Solution.

Wi-Fi end-users shall be required to read and agree to a CCJPA-provided document *Terms and Conditions of Use* prior to accessing the Internet, and be required to click an ‘I agree’ button to verify their acceptance. The action of accepting the Terms and Conditions shall be recorded and stored with other session information. The captive portal shall be capable of scaling to work with a wide range of devices including laptops, tablets and smartphones with appropriate versions for each device type. Using the latest authoring technology for responsive web sites, the portal shall function with a variety of end-user device display mechanisms including the most popular web browsers, and be configured to block captive network assistants (CNAs) such as that found on MacOS which display portals automatically in a non-browser environment. The user shall not be required to re-authenticate unless the Terms and Conditions change, or within an CCJPA-defined timeout period. CCJPA may require that authentication is handled differently for a devise that has already authenticated on a different train within a set period, Contractor will describe how this can be achieved within the system.

After accepting the Terms and Conditions, the user will be presented with a ‘landing page’ branded on a WD basis and customized by fleet, which will notify the user that they are connected to the Internet. The captive portal shall have a mechanism for users to test their Internet connection to (a) verify that the Internet is available, and (b) see the available downlink and uplink speeds. In the event that the T2G link is down for whatever reason and Internet access unavailable, the captive portal shall display a message to this effect, notifying users of a temporary interruption, until normal service is resumed. CCJPA may have additional functional requirements that Contractor shall implement on a WD basis. Contractor shall be responsible for ongoing content update, maintenance and support of the captive portal.

The Solution shall deliver via any passenger-facing Wi-Fi AP a fully-loaded Terms and Conditions page with one second of page request while the train is in motion, with no less than 20 active users on that Wi-Fi AP. Contractor shall document how load testing will be accomplished to measure this performance in a lab environment prior to first train installation. All portal pages shall use Google Analytics for user traffic tracking and reporting, with the relevant Google Analytics account made available to CCJPA.

It shall be possible to scale the portal to provide an enhanced version which includes the provision of rights-managed media content, e.g., digital magazines, movies and TV shows (see section 3.5.9.2 *Entertainment Services*). Contractor should provide detail in their response on how this may be delivered, including technical and commercial arrangements, possibly on a pilot basis. Where there is a requirement for a custom application (app) to be used on a tablet or phone to support digital rights-managed content then this shall be described together with what level of custom development will be required. CCJPA prefers if this can be implemented without passengers requiring a specific app on any device.

3.5.8.3 VPN Support

CCJPA's existing Wi-Fi system supports use of VPN connections by end-users who may wish, for example, to connect remotely to corporate networks that require tunneled, encrypted connections. Unfortunately, use of VPNs also enables passengers to bypass processes imposed by CCJPA to ensure equitable Wi-Fi use, such as content restriction and bandwidth controls. For example an end-user may use a VPN to stream Netflix, a service which is normally blocked by the Wi-Fi system to mitigate network congestion. CCJPA wishes to implement a mechanism whereby corporate VPN connections are permitted while unfair use of those connections is not. Contractor shall outline how the Solution shall enable content controls and fair use of available bandwidth while permitting legitimate use of VPN connections. Contractor shall also identify methods by which VPN connections are maintained when switching between cellular links, and/or where links may be of variable quality.

3.5.8.4 User Session Record Keeping

The Solution shall be required to log end-user device MAC address, session start and end times using RADIUS or some other method, and be capable of reporting to the OSS metrics including but not limited to user device type, operating system, browser version, passenger location based on AP ID and/or GPS, session duration, data volume transferred up and down during the session, URLs visited, and time spent on a page. The system shall also report Wi-Fi network traffic information including protocol, and source and destination IP address and port. Contractor shall outline how this functionality is implemented, and provide visual illustrations/screenshots of how this information is presented. Please see section 3.7.7 *Passenger Wi-Fi Reporting* for further requirements related to record keeping within the Solution OSS.

3.5.9 Connectivity to Other Systems

3.5.9.1 Business and other Operational Systems

CCJPA currently uses and may also seek to integrate other systems on a per car or fleet basis which will require integration with the Solution. It can be assumed that these systems may require functionality including but not limited to:

1. Bi-directional T2G connectivity;
2. IP address allocation or have IP addresses assigned automatically by the Solution;
3. Real-time GPS data as defined in section 3.5.10 below, *GPS Telemetry*.

4. Monitoring to extract data from a device API and making this data available both on-train for other systems or off-train for analysis. This may need to be aligned with other data sources (e.g., GPS data, or real time clock) that already exist within the Solution;
5. Monitoring of hardware to trigger an alert if the device is off-line or functioning out of band;
6. Secure communication through the train line between system components.

Contractor should describe the approach to the integration of such systems with the Solution.

3.5.9.2 On-Board Information System (OBIS) Integration

Contractor may be required to install the Solution on rail cars that are already fitted with, or may be about to be fitted with, an On-Board Information System (OBIS). The OBIS solution will be sourced from one or more suppliers and is designed to provide digital signage and automated announcements to passengers based on real time train location and centrally-generated messaging. OBIS requires integration with three primary functions of a Next Generation Wi-Fi system:

1. **T2G connectivity**. The OBIS system will both pull and push data periodically to an off-train server to obtain updated route and consist details and also any information related to the live train schedule;
2. **GPS data**. OBIS will periodically query the train Wi-Fi system to obtain real-time GPS location data that can be used to trigger appropriate messaging;
3. **Connectivity between cars**. It should be assumed that the OBIS platform will incorporate one or more Ethernet switches to provide connectivity between its own sub-system components. These Ethernet switches will need to share the IP connectivity that is created between adjacent cars (see section 3.5.5.1 *Existing Digital Train Line*).

Where integration with OBIS is required then Contractor will be provided with an Interface Control Document (ICD) that describes how each of the above interfaces will function and how the Solution is required provide the correct integration with OBIS. Contractor should expect to provide the following as a minimum:

1. A specific logical interface on the mobile router that will be used by OBIS to pull or push data to and from the train. Data on that interface will be in a segregated VLAN and the router will ensure that data to and from this interface is transmitted uninhibited to and from the OBIS back office. It may be necessary to provide a specific, dedicated connection (e.g., a VPN) between the Solution's back office and the OBIS back office for all data transfer;
2. Contractor will undertake a security scan and penetration test on the Solution to provide assurance to the OBIS supplier (as responsible party for the overall OBIS security) that the Solution has sufficient InfoSec security protocols in place to assure secure OBIS operation. The InfoSec requirements will be defined within the ICD document referred above;
3. Contractor may be required to provide equipment (under a WD provision) to augment one or more OBIS test benches which are used to validate OBIS firmware and configuration changes. These test benches will be located both in CCJPA's facility and in the OBIS supplier's. The test benches may be fitted with a device acting as simulator of Contractor's solution as long as it can be demonstrated as providing identical performance and function as the on-board solution. The OBIS benches will have to be maintained to an identical release firmware and hardware as the on-board solution. Any changes planned to the train solution will also have to be validated first on the OBIS bench environments in accordance with a mutually agreed change control process;

4. Provision of GPS data to the OBIS solution shall be in accordance with the ICD and can be assumed to be a SNMP query undertaken at one-second intervals;
5. The Solution will be expected to provide car-to-car connectivity for OBIS by supporting multiple VLANS without disruption and being able to transfer several concurrent multicast data streams and other TCP data. CCJPA will advise if and how the OBIS data should be prioritized over other network traffic.

The Solution will not be required to provide any monitoring of the OBIS solution components but should be able to provide (and present for external query by API) metrics related to the data being passed for OBIS, in both directions, between train and back office.

3.5.9.3 Entertainment Services

As CCJPA explores ways to improve passenger amenities aboard trains, the opportunity may arise to provide a range of entertainment services that leverage the presence of the on-board network, and deliver video and audio programming directly to end-user devices. It is not CCJPA's intention to stream live media to the train over cellular networks; instead content would be stored locally on-board and served through the train's backbone network to smartphones, tablets, and laptops over Wi-Fi.

CCJPA may wish to implement entertainment services if Contractor can provide it as an option to the Solution, for future implementation at CCJPA's discretion. Contractor should provide detail of entertainment services offered, if any, including technical requirements and commercial approach. Contractor should address how content is automatically updated on a regular basis but avoiding use of cellular networks, e.g., using Wi-Fi for T2G links when a train is at rest in a station or yard for a period sufficient to download material from a remote server. Contractor should provide examples of how the proposed entertainment services have been successfully implemented by other rail operators.

Contractor shall propose how a pilot of entertainment services could be undertaken on selected rail cars or fleets and the ideal period of time necessary for such a pilot, which may be subject to a separate WD. Contractor shall outline how the Solution's intra-train network shall support entertainment services in the future; how video and audio content would be prioritized over other non-operational traffic and sufficient quality of service ensured; and what intra-train wireless backbone speed (in Mbps) would be required to adequately support service of this kind, and the assumptions made to calculate the capacity.

3.5.10 GPS Telemetry

The Solution shall include at least one GPS receiver and be capable of transmitting telemetry information including latitude, longitude, altitude, azimuth, speed and real-time clock data to the OSS. The system shall be capable of acquiring GPS data with a minimum one-second (1Hz) granularity, and of caching and forwarding GPS data to the OSS in the event of temporary T2G link unavailability. Contractor shall detail how the Solution supports the creation of geofences in the back office, the method by which geofences are sent to and stored on the on-board component of the Solution, and what applications and tasks included in the Solution utilize geofencing. CCJPA currently utilizes and also expects in future applications to be able to leverage real-time or near-real time GPS telemetry for a range of applications and ancillary services located both on and off-board train. This shall include, but not be limited to, OBIS, entertainment, and systems that require a function using geofencing / geo-data.

GPS data on- and off-board shall be available through the API data services as defined within section 3.8, *API Segment & Functional Description*.

Contractor should note any requirement to have more than a single GPS antenna on the roof of the train (see section 3.5.7.1, *GPS*) and shall describe how this can be used most efficiently within the system to ensure high availability of GOS data.

3.5.11 OBN Control and Management

CCJPA requires that any component within the OBN can be queried, and where necessary certain actions undertaken, through an API control mechanism. The API which will be accessible directly on the train and also from a remote location will allow the following actions to be undertaken:

1. Reboot of device (e.g., modem, mobile router, AP, or Ethernet switch);
2. Reboot of function within device (e.g., radio within AP or functional process);
3. Extract fault logs from within device.

The purpose of this API is to allow the Solution to have a level of management that can be easily undertaken by a suitably skilled third party following a basic fault finding guide to resolve simple issues. Contractor should also provide a web interface on the mobile router that can be presented to a mobile device or to a touchscreen panel already integrated on the train. Any actions undertaken using the API will be recorded so it can be audited later to determine what actions were taken and the outcome of the actions. The Solution shall provide watchdog features where an unresponsive system will be automatically rebooted after a configurable time and under conditions agreed with CCJPA. The watchdog shall be capable of functioning independent of the device operating system and shall either exist in all Solution components or control all Solution components within a car. Operation of a watchdog shall be included within any operational data that is transmitted off-train. Contractor shall describe in detail what watchdog features are available and how they work within the proposed Solution architecture.

Contractor shall provide options for a simple indicator panel in each car that train operations staff and crew can use to understand if the Wi-Fi system is powered and operating normally or has one or more faults that could be affecting user experience.

3.5.12 System Audit

The system will routinely self-audit OBN components to determine any anomaly in firmware or configuration of any configurable device. The audit data shall be generated whenever a device is discovered by the Solution, or at a minimum once per day, and compared with the known current platform as agreed through the system design and change control process. The audit data shall be available by API and also reported within the OSS to provide system traceability for all components. The data shall be available for all individual devices, for design locations on a rail car (i.e., where devices are mounted), and for the history of component hardware, firmware and configuration.

3.5.13 Availability

During periods when a train is in revenue service i.e., carrying passengers during normal scheduled hours, the Solution and all components aboard trains shall function with a minimum 99.99% uptime, excluding cellular carrier network availability and performance.

3.6 OBN General Hardware & Mechanical Requirements

3.6.1 Cables & Connectors

All cables and wiring in the Solution shall comply with *Amtrak SPEC 323-C High Performance Wire and Cable* [3]. All connectors shall:

- Have positive lock mechanism;
- Be commonly available;
- Use keying and color-coding to prevent incorrect connections during maintenance;
- Be waterproof if mounted in the ceiling or in the vestibules;
- Have non-threaded connections, where possible;
- Have a cable bonded to connector body to prevent stressing electrical connections if cable is pulled or subject to abuse during vehicle or system maintenance.

All connectors of the same type and size shall be keyed to avoid insertion into the incorrect location. Connectors shall be identified in accordance with the schematic designation. All connector types shall be submitted to CCJPA for approval during design review. All on-board equipment enclosures shall be connected through robust, quick disconnect, multi-pin connectors with removable crimp contacts. The connectors shall be located in the front of the equipment or other easily accessible locations for quick connection and disconnection. No cables shall be run in passenger access areas without being enclosed in conduit. Any cables designed to run underneath the car body or in areas where in normal train maintenance operations may be under foot shall be run inside metal conduit. Contractor shall ensure that, where cables are routed through a conduit, small signal cables are not routed inside the same conduit as cables carrying power feeds to minimize the effects of interference.

Contractor shall propose a method of cable marking and identification that provides detail of cable function and also makes it clear where each cable is intended to be connected so that during normal maintenance operations it is possible to check all cable connections without reference to a circuit diagram.

All cables, cable markers and conduit that are on the interior of the car body shall meet applicable federal smoke, flame and toxicity requirements.

3.6.2 Power

Contractor shall assume that 72 VDC will be available on each rail car, and that it will be possible to run power cabling from the rail car power supply to OBN components as required. The OBN solution shall be able to utilize the available power source; have sufficient power management for protection against fluctuations in voltage and current without damage; and shut down after a predetermined period to avoid train battery drain. Contractor shall provide CCJPA with the continuous and peak power that the on-train components are expected to draw under normal operating conditions. Selected equipment designed to run on DC power must have the ability to detect the loss of Head End Power (HEP) and shed their load from the DC bus. The equipment to be load shed in the event of loss of HEP shall be agreed between Contractor and CCJPA during the design phase.

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[3] http://bit.ly/2N0jJ3n

In event of a loss of train power and subsequent restoration, all OBN components including ICLs, mobile router, and passenger Wi-Fi APs, shall automatically reboot without manual intervention. Components shall have a reboot time of fewer than 120 seconds to recover to normal operation including re-establishment of T2G communication. No re-configuration or manual intervention shall be required on completion of a reboot cycle. It should be noted that some sub-system components which may be using the Wi-Fi infrastructure will not power cycle during temporary loss of power and as such the Solution shall be capable of fully re-configuring without affecting these systems.

CCJPA expects that due to the age of some rail cars the 72V DC power available within the train fleets will not meet typical railway standards (e.g., voltage surges, spikes and dips). Contractor is responsible within the scope of each WD where equipment is being introduced into a car type to properly test the power environment and ensure that new equipment is designed to function reliably within this environment. Contractor will describe the process that will be followed to validate the power environment and how this data could be used within the system design.

Contractor shall provide details of power consumption per OBN component detailing both maximum rated current and steady state, and describe the electrical isolation that is provided between each item of equipment and the rail car electrical power circuits and the rail car chassis.

Contractor shall describe their approach to system earthing (including cable screens) to ensure conformance with mandatory standards, reliable system operation and electrical safety for passengers, train crew, and maintenance staff.

3.6.3 Manual Power Cycling

Should the OBN components require rebooting for whatever reason, it shall be possible via a single ‘hot button’ process whereby, when instructed to do so, CCJPA personnel (e.g., the train conductor) can press a single button to commence a power cycling procedure whereby all Solution components restart in a pre-defined order. At the end of the reboot process the Solution shall resume normal operation. The back office shall log when such manual power cycling occurs and automatically create a trouble ticket for support escalation. If the Solution supports remote manual power cycling (e.g. by use of a GPRS or other low-cost cellular connection independent of the Solution) Contractor shall explain how this process works.

An additional requirement is described in section 3.5.11 *OBN Control & Management* to allow reboot of Solution components through an API interface and automatically with a watchdog.

3.6.4 Cooling

CCJPA prefers that all powered hardware shall be cooled by natural convection, and shall not require a separate fan or other device to provide forced air cooling. All components shall be mounted in a way that facilitates natural airflow and prevents overheating. During the detailed design phase for each WD, Contractor shall specify the maximum ambient temperature that can be tolerated by the Solution’s OBN components, and ensure that the equipment shall meet the temperature tolerances identified when installed in the space provided.

Where forced air cooling is recommended by Contractor then details shall be provided to describe:

- Calculated and actual MTBF for the cooling system;
- Additional maintenance requirements for the cooling system (e.g., replacement of filters);

- Visibility of faults associated with the cooling system (e.g., if a fan fails or airflow affected, how is this indicated on and off train). CCJPA seeks a visible indication of system operation status.

3.6.5 EMI and RF Interference

All equipment provided by Contractor shall meet relevant U.S. national and railway industry requirements related to electromagnetic interference (EMI). Contractor will provide evidence of compliance for all OBN and sub-system components including any certifications and third party test reports.

None of the proposed equipment shall generate harmful interference in the VHF spectrum currently allocated to the U.S. and Canadian railroads for safety applications, including but not limited to Positive Train Control (PTC). All equipment shall conform to all current applicable FCC regulations and be certified to meet current applicable FCC requirements. The equipment shall comply with, and not interfere with, all available FRA mandated emergency or safety systems. Contractor shall make available to CCJPA all relevant test reports for equipment for review by CCJPA and shall submit them as part of the formal approval process for each installation.

3.6.6 OBN Standards Compliance

All new OBN components required to support the Solution shall comply with standards including but not limited to UL (UL 94-V0 for non metallic items, state compliance to UL 50 or equivalent standard), FCC Part 15, EN 50155, IEC 60571, AREMA 11.5.1 C&S Manual for Class I (Vehicle Interior Platform Mounted) equipment (Temperature, Humidity, Mechanical Shock, Abrasive Environment, and EMI), and other relevant rolling stock on-board electronics standards and industry guidelines. Contractor shall meet all requirements stated in *Amtrak Specifications for Components to be Installed on High Speed Train Sets* [4] and *Amtrak SPEC 429-B Environmental and Operating Conditions* [5]. All proposed equipment is required to be approved by CCJPA prior to installation.

CCJPA retains the right to request via specific WDs conformance to additional standards which may be applicable to specific fleets or applications that are not listed within this SOW. Awareness and compliance with emerging industry or national standards that are introduced through the contract period are the responsibility of Contractor. Where these may impact existing or new installations Contractor is responsible to notify CCJPA of these areas and to advise impacts of any new requirements.

Conformance with mandatory and industry standards should be achieved within each OBN component and not through external materials added and incorporated during the installation phase (e.g., external RF chokes, or external voltage suppression).

3.6.7 Ruggedized Equipment

All externally and internally mounted equipment from Contractor and any third party shall be ruggedized and withstand environmental and operating conditions, including extremes of temperature, moisture/humidity, and shock and vibration that can be expected within a railway environment. The ability

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[4] http://bit.ly/2NmsDFa

[5] http://bit.ly/2Nl5R0d and http://bit.ly/2MUMuOz (Bi-Level Cars)

to withstand the railway environment will be a design feature of the individual components and not any secondary protection provided as part of the installation process.

The whole solution and its individual components shall be UL approved. All OBN components shall be immune to any particulates of diesel smoke emissions and any cleaning agents; designed to prevent water intrusion; and shall pass federal smoke, flame, and toxicity requirements.

Contractor shall clearly state the federal, state, and/or industry standards with which the Solution components comply and any specific pass criteria that have been applied. Contractor shall provide a conformance plan that details how new or modified system components are tested to assure compliance.

3.6.8 Modularity

The Solution shall be modular and have the ability to be maintained via a simple swap-and-replace program for both upgrades and repairs. Contractor shall provide diagrams showing how the system is divided into modules clearly showing the Line Replaceable Units and where items can be exchanged in the field versus in Contractor's repair facility. Contractor shall maintain and update all equipment without disturbing other non-Solution equipment.

3.6.9 Remote Updates & Configuration

CCJPA wishes to minimize the requirement for truck rolls (e.g., on-site attendance by Contractor or CCJPA or partner field engineers) to perform software updates and/or device configuration changes. Contractor shall detail how its Solution mitigates to the greatest extent possible the need for truck rolls, and shall list any tasks which due to Solution design require on-site attendance. Remote updates shall be coordinated with CCJPA and follow an agreed configuration control plan prior to rolling out to trains.

3.6.10 Power Outages

All OBN hardware and software components shall survive unexpected power outages or spikes without damage. All components shall have a reboot time of less than 120 seconds to recover to normal operation. No manual re-configuration shall be required on completion of a reboot cycle. All components shall resume normal operation following supply power interruptions after a self-test is completed. As stated previously Contractor must consider that all connected devices on the network may not be subject to power cycling at the same time or under the same voltage conditions.

3.6.11 Workmanship and CCJPA Approval

All processes and workmanship shall comply with *Amtrak SPEC 854-1 Vehicle Design-Build Components*[6] and *Amtrak SPEC 328-1 Materials and Workmanship*[7] respectively. All custom mounting for on-board equipment shall be approved by CCJPA and comply with 49CFR Part 238. Contractor will describe how design information will be presented to demonstrate conformance with these requirements.

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[6] http://bit.ly/2MylftL

[7] http://bit.ly/2NkyF9f

3.6.12 Coordination with CCJPA's or other Stakeholders Mechanical Department

Contractor shall be required to work with the engineering team(s) of CCJPA, other stakeholders' applicable engineering departments, and CCJPA partners or their representatives during installation phases to ensure that the proposed Solution meets all relevant specifications (as agreed at the commencement of a WD rollout) including, but not limited to, those for vibration, heat, electrical, and radio interference; and others as set forth within this SOW. Contractor will describe the typical process that will be followed to ensure conformance with the requirements of these teams.

3.6.13 Equipment not to Impact Maintenance and Other Train Systems

Contractor's Solution shall not require the removal or alteration of any equipment on trains not related to the proposed Solution. All components shall conform to the space provided and will not in any way interfere with or prevent maintenance of other existing train systems. In addition, new roof-mounted antennas shall be positioned and installed in such a way so that they shall not cause RF interference with – and be at sufficient distance from – existing roof-mounted antennas.

Where other CCJPA sub-systems are to be connected to the Solution infrastructure and could be affected by outages or maintenance to the Wi-Fi system, Contractor shall have a robust process in place to allow communication to the parties responsible for downstream systems so that all relevant parties are aware of issues.

3.6.14 Additional OBN & General Requirements

In addition to meeting the requirements stated in this section, Contractor shall be required to state compliance with the additional requirements contained this SOW, and in future WD SOWs.

If the proposed Solution includes parts visible to the passengers (e.g., in-car Wi-Fi antennas), the visible parts should match the surroundings with regards to interior design and shall be agreed in advance with CCJPA, and any other stakeholders, for aesthetics and also safety to passengers. CCJPA prefers a Solution where no parts are visible to the passengers.

3.7 OSS Segment & Functional Description

3.7.1 Overview

The Operational Support System (OSS) provides day-to-day monitoring and management of the OBN and constituent components, while also providing an end-point for all aggregated T2G links from trains, and access to the Internet. The system shall receive data from the train-based OBNs to provide a real-time and historical view of system activity, system component status, health, train-to-ground network performance, and other key indicators. Furthermore, a proactive approach to condition monitoring, with an effective process for alerts and problem escalation, will enable issues to be detected and resolved before they have an detrimental impact on the passenger experience. Condition monitoring shall not require on-train/in-service personnel (e.g., conductors) to play an active role in identifying Solution issues, and those personnel shall only be involved if Contractor or CCJPA identify a simple solution that is most easily and cost effectively addressed by a crew member. In such circumstances the CCJPA Wi-Fi Services team would be contacted to initiate such action.

The OSS and its features shall be accessible by CCJPA personnel 24/7/365 on a tiered access model through a secure web-based, self-service portal for desktop and hand-held devices, with a GUI

appropriately formatted for such devices. All OSS components shall be accessible via a single sign-on (SSO) process, without the need to access different systems for different data. All components of the OSS shall be graphically designed with a common user interface and look-and-feel, regardless of whether data is being derived from different sources. The system shall be fully managed by Contractor on behalf of CCJPA, be hosted as a cloud-based service with a level of redundancy specified in 3.7.2 *Hosting & Redundancy*, and support concurrent use by up to fifty (50) support personnel. Contractor will clearly describe if there are specific license requirements on a per user basis for system access.

3.7.1.1 Real-Time Status

The ability to monitor via the OSS, the health, condition and status of the Solution and its constituent parts wherever deployed is extremely important to CCJPA. This includes all aspects of mobile router operation including but not limited to cellular links (and other T2G links as applicable) and their current and recent status, performance and quality by device ID, by train set and car number, or by route service number; data usage by carrier, modem and SIM ID, and trending to predict cumulative data usage by SIM ID within a pre-determined billing cycle; and events that impact the availability of Wi-Fi service to passengers as they occur. Contractor shall fully explain all aspects of the Solution's real-time status monitoring capabilities, including identification of issues with inter-car links and passenger-facing APs. All such data generated by OBN and OSS segments shall be available for sharing with CCJPA's own database systems using an API and other processes mutually agreed by CCJPA and Contractor.

3.7.2 Hosting & Redundancy

The OSS shall guarantee an extremely high level of system availability and a rapid response time to support issues. All hardware and software components that constitute the OSS shall be required to be fault-tolerant with a minimum 99.99% uptime. CCJPA requires a hosted OSS solution with all components accommodated by Contractor in a suitable cloud-based service provider (such as Amazon AWS or Microsoft Azure) that is compliant with industry standards for security and availability, and provides redundancy through mirroring of essential services i.e., multiple instances. CCJPA must approve the proposed cloud provider(s) and system configuration. Contractor will describe how the requested availability will monitored and achieved for all OSS system components, and how CCJPA will have on-demand access to the uptime statistic in real time via API and other means.

CCJPA expects, via additional WDs, to expand deployment of the Solution on multiple fleets in multiple geographic regions, in some cases in conjunction with rail operating partners in states outside California. Contractor shall provide a plan for scaling the hosted OSS solution to serve a number of train sets in service concurrently in different regions. Virtual data center locations shall be available located strategically around the U.S. to minimize latency between trains and aggregation end-points. The OSS shall allow separate fleets to be segregated so that system and performance data can be viewed for individual fleets only by specific users or all fleets by other users. In all cases, such segregation shall be respected and supported by the OSS API.

3.7.3 OBN Traffic Routing

Contractor shall provide a detailed explanation of the method used, and infrastructure required, to support traffic routing from the train to the public internet. CCJPA appreciates that there exist options for routing OBN traffic from trains to the Internet. For example, non-aggregated traffic could flow from the train to the Internet directly via cellular networks without being routed to a cloud-based end-point. In this instance the cloud-based OSS would perform network monitoring, management and reporting, and traffic controls

such as content filtering and bandwidth control would need to be accomplished on each train. The key advantage of this approach for CCJPA might be to reduce costs associated with passing all Wi-Fi traffic through a cloud provider's Internet gateway. A key disadvantage is that the Solution would not benefit from session- or packet-based aggregation, and the seamless, uninterrupted switching between multiple cellular networks.

Where Contractor's Solution routes aggregated traffic from all trains to one or more cloud-based virtual data center(s) the latter shall provide appropriate aggregation end-point(s) and Internet gateway(s) with sufficient throughput and capacity to serve the needs of the Solution at launch, with smooth scalability as demand for capacity increases over time. Contractor shall explain in detail how the recurring costs of passing this traffic to the Internet via a cloud-based provider's gateway will be mitigated. The OSS shall be capable of reporting live and historical information for backhaul capacity utilization, for individual trains and for the data center(s), and this data shall be made available via the OSS API.

3.7.4 Proactive Condition Monitoring

The OSS shall provide real-time monitoring of the state, condition, and health of all core OBN components including but not limited to train-born T2G links and individual modems, ICL and Wi-Fi radios, and Ethernet routers and/or switches. The OSS shall provide email- or SMS-based alerts if any monitored component experiences an operational issue or fault – identifying the train consist GPS location and train service number, rail car ID, OBN ID, and ID of component as necessary. CCJPA shall be able to configure when and which alerts are to be triggered and to whom they are sent by providing Contractor with a 'whitelist' and groupings of users by role/function for Contractor to manage and implement (see section 3.7.5 *Issue Detection & Real-Time Alerts*).

The performance of the T2G link will have a direct impact on the quality of Wi-Fi service delivered to passengers, and CCJPA's ability to leverage the connectivity for operational applications including but not limited to OBIS. The OSS shall provide detailed live and historical information about the active and non-active cellular links including carrier name, availability, network mode (e.g. LTE, HSPA, CDMA, or GPRS), signal strength, modulation rate, current data throughput, latency, jitter, packet loss, and bandwidth utilized over time in both downlink and uplink. It shall be possible to visualize the cellular network performance information by individual mobile operator (e.g., Verizon, AT&T, or T-Mobile) on a map by train service route, with color-coding for CCJPA-selectable values including network availability, mode, signal strength in dBm, and downlink and uplink throughput in Mbps, with CCJPA-selectable levels of sample rate granularity.

Similarly the performance of the train backbone will impact on the quality of Wi-Fi and operational services. The OSS shall provide detailed live and historical information about the ICLs including radio signal strength, modulation rate, channel, current data throughput, latency, jitter, packet loss, and bandwidth utilized over time in both downlink and uplink.

The OSS shall provide a summary of this information on a web page with drill down capabilities to view the individual details in a graphical representation of each train set and cars within a selected train set. The representation of the train will display:

- Train service number;
- Total number of cars in the consist including power cars, and their respective car numbers;

- ICL unit (wired or wireless) at the end of each car, colored to show status e.g. actively connected, not connected;
- Physical location of all monitored components.

The OSS shall show a single web page graphical representation of each component in the network using red/yellow/green to indicate the working status of each OBN component, and shall have drill-down capabilities for each component to determine why its status is not green. The drill-down shall provide component detail on-screen including but not limited to:

- Component name, electronic serial number (ESN), and other unique identifiers as available;
- IP address of IP-based devices, including all individual interfaces on a component (e.g. Ethernet, Wi-Fi and cellular);
- MAC address of applicable devices;
- IMEI and SIM numbers of all cellular devices;
- Installation date.

In addition, the geographical locations of all trains, derived from OBN GPS, shall be displayed on a moving map with an alphanumeric identifier for each train (e.g. train number) and color-coded to indicate status. The system bandwidth overhead to perform these functions shall be documented by Contractor. All data and metrics related to condition monitoring shall be made available via the OSS API.

3.7.5 Issue Detection & Real-Time Alerts

The OSS shall have the ability to set automated alerts that issue ‘red flag’ notifications in the dashboard and via email and/or SMS when potential issues are detected. Alerts shall be configured to issue notifications based on parameters including but not limited to:

- GPS location;
- Geo-fencing of a specific area;
- Component online/offline status including mobile router, cellular modem, ICL, DTL, or Wi-Fi AP;
- Cellular connection status;
- Number of users.

Contractor shall be able to configure the rules and minimum/maximum thresholds to trigger alerts, and the recipients of alert notifications. Issues detected via this process shall be logged by Contractor’s Operations and Maintenance (O&M) team and automatically forwarded to the CCJPA Wi-Fi Services team, who may choose to escalate to Contractor’s Tier 2 support if unresolved. Contractor shall detail the issue detection and alert functionality of its Solution, highlighting competitive advantages, and process of interaction with the CCJPA and Contractor service desk components.

3.7.6 System Reporting

Generating detailed reports is a key function of the OSS. The OSS shall be capable of creating and exporting thorough reports on all aspects of Solution usage and performance over specified time frames including day, week, month and user-defined period. Reports shall deliver individual and aggregated results, statistics and trends for metrics over time by criteria including but not limited to region, route, service number, individual car number, and OBN component ID. Reports shall include but not be limited to Solution operational hours; component uptime and availability; individual and/or aggregate T2G link and Internet gateway traffic levels by various parameters; prediction of future metrics based on trends;

and all other monitored metrics outlined in section 3.7.4 *Proactive Condition Monitoring*. It should be possible to compare results by current and prior periods to identify performance gains or losses over time.

CCJPA is reliant on the availability and quality of commercial cellular data networks. These networks may change over time as base station sites are added, adjusted or removed, or network contention fluctuates. As a result CCJPA needs to be able to generate reports on a regular basis to assess individual or aggregated network capacity and availability. The OSS shall be able to generate cellular network reports by route which include key metrics such as signal strength and downlink and uplink throughput (in Mbps in half-mile (distance) and/or one-minute (time) increments, and cellular modem network mode and availability. Contractor shall detail what additional intelligence the proposed Solution provides in terms of cellular network discovery and analysis.

The OSS shall be capable of providing report summaries of all generated data graphically on screen in the Solution's dashboard environment, or exported in formats including but not limited to PDF, CSV and Excel. The OSS shall address CCJPA's need for deep analytics of all data gathered by the system, to help CCJPA and Contractor identify areas requiring improvement and otherwise optimize the Solution.

The OSS element shall enable CCJPA to create all reports and automate delivery of these through the self-service web portal; it shall not be necessary for CCJPA to request reports to be manually generated by Contractor. All raw data collected by the OSS shall be provided in the form of a database backup or export, accessible via the self-service portal. Alternatively CCJPA may run its own queries to obtain the all data generated by the OSS pertinent to the entire Solution's operations via the OSS API. The OSS capacity shall allow for the retention and storage of at least eighteen (18) months of data.

3.7.7 Passenger Wi-Fi Reporting

In order that CCJPA may understand the uptake of Wi-Fi service by its ridership, and thus measure return on investment, the OSS shall provide real-time collection and reporting of Wi-Fi usage statistics that will include but not be limited to the ability to view the total number of users (both VPN and non-VPN); total amount of data sent and/or received; and total session duration, all within a selected time frame (e.g. years, months, weeks, days, hours, or live view) and/or geographical range for a service, train, or individual car. The same data shall be available for an individual user identified by MAC address, while also identifying to which AP in which car the user was connected. All reported metrics shall be displayed in the dashboard environment, with same user interface as other components of the OSS, and be available to external query via the OSS API. Contractor shall provide in its response screenshots of the Solution displaying the required information, with accompanying narrative and step-by-step process for displaying each. In addition the OSS shall have the ability to:

- Record and report the number of times a user agrees to the Terms and Conditions of Service displayed in the captive portal by clicking an 'I Agree' button, associating this action with the user's device MAC address;
- Record and report the number of end-user devices connected to each Wi-Fi AP on a train set and/or individual car;
- Record and report the type of end-user devices that utilize the Wi-Fi service, including but not limited to make, model, OS version, and browser type [8];

[8] In some cases only if made available to Contractor by the landing page developer.

- Maintain Google Analytics tracking on all portal pages;
- Maintain records in compliance with CALEA (see section 3.7.11 *Working with CALEA*).

All raw data collected as a result of passenger reporting shall be retained and archived in accordance with the requirements set forth in 5.6.4. *Data Repository*.

3.7.8 OBN Traffic Management

CCJPA requires a robust mechanism for content filtering of passenger Wi-Fi traffic, as specified in section 3.5.8 *User Experience*. If this filtering and other traffic management is provided within the OSS back office (i.e. running on servers within the virtual data center rather than on the mobile router) then Contractor shall provide detail on each relevant component of the Solution. If filtering and traffic management is performed by the mobile router on each train, Contractor shall detail how this is centrally managed from the OSS. In addition the OSS shall have the ability to differentiate between, and report on, traffic sent and received on the Wi-Fi APs, the ICL backbone, and the T2G link(s).

3.7.9 OSS Architecture

Contractor shall explain in detail and by diagram the proposed OSS architecture for review by CCJPA. This shall include communication; network throughput capacity; security; how the required availability will be met; total system capacity; backup and recovery strategy; how the system will be maintained with the latest patches and security updates; and the function and process of API operation.

The proposed virtual hardware (i.e. servers owned and maintained by the cloud service provider) must be identified and selected as among the most reliable and fit-for-purpose for supporting this type of application. The overall OSS solution design shall ensure that no single failure of any component within the system will prevent continuation of processing for all other system components nor prevent successful management of those components. Contractor shall detail how this is accomplished.

3.7.10 System Security & Access

A high level of security is mandatory, and includes firewalls, strong password management, user authentication, and user management. All access to the solution systems, including but not limited to, OSS systems, APIs, databases, reporting tools, monitoring tools, and issues management systems must be done through secure connections over standard ports. Contractor shall describe the practices deployed within systems to ensure robust and secure levels of access controls to the systems.

3.7.11 Working with CALEA

The Solution shall not interfere with an Internet Service Provider's obligations to law enforcement agencies under the Communications Assistance for Law Enforcement Act (CALEA). Contractor shall explain if and how CALEA obligations, if any, have been satisfied with other Contactor Solution deployments in the U.S.

3.8 API Segment & Functional Description

3.8.1 Open Data Principle

CCJPA plans to use other on-board and off-board systems and/or web services in conjunction with the Solution; as a result it shall be capable of working with and being accessed by CCJPA systems and services, and make available both technical data (i.e., data related to system function, performance,

availability and health) and usage data (i.e., data related to passenger or other system use of the data connectivity). All data shall be made available in a raw format that is “as generated” by the system and not subject to post processing or similar actions. When useful post processed data should be made available alongside the raw data but not as a replacement for the raw data. All data of any kind generated by the Solution – including but not limited to OBN, OSS and API performance and availability, and metrics generated by individual Solution components and sub-systems – shall be the exclusive property of CCJPA and/or its partners, as applicable by fleet and/or WD.

It is required that all data generated by the system to be made available both in real time and from a historic data store. Contractor shall describe the methods that can be used by CCJPA to automatically access both real time and historic data either through one or more APIs or similar methodology, and submit samples of API documentation with its response. The API should be an HTTP RESTful JSON API. Responses can use standard HTTP gzip encoding to reduce bandwidth usage. The API should be flexible and when working with large data sets should allow sorting, filtering and paginating the data. Any changes or additions to the API must be backwards compatible. Real-time data can be made available through a streaming API using a long lived HTTP connection or WebSockets and should use a JSON format. Notifications may be provided using webhooks and should include a retry mechanism if they cannot be successfully delivered. Responses that do not show clearly demonstrate that Contractor has a full, open API for data access will be considered non-compliant.

Data APIs shall be provided both within a central location (data center or equivalent) and also as close to the location where data is generated. For example data that is generated on-train shall be available both off train through an API in real time and also from within the OBN through an API. Contractor shall provide documentation showing how this is accomplished.

3.8.2 Data Structure

The data management method used by Contractor shall allow new data sources to be added to the data structure described in section 3.8.1 *Open Data Principle* both on a fleet or train basis. Addition of new data elements shall not affect how systems use the existing data APIs. Contractor will describe how new data can be added to the data structure and what controls are in place to determine the effect of new data feeds on system performance, available T2G bandwidth, storage, and system security.

Contractor shall describe accurately for each data element how it has been sourced, the nature of measurement units, and any other factor that will affect CCJPA or other systems that may acquire and utilize this data for analysis. Contractor shall provide a detailed table of the currently available metrics that are captured by the Solution including the sample rates and measurement units.

3.8.3 Data Security

Where data is made available through APIs or similar, Contractor will describe the methods provided to allow CCJPA to control what data is made available to different data users via the APIs and how access controls will prevent unauthorized users accessing either real-time or historic data. This shall be part of Contractor’s overall Cyber Security plan (see section 3.4.7 *Network Cyber Security*).

3.8.4 Data Availability

CCJPA requires that historic data be maintained in one or more data structure that is available for both querying and extract for a period of no less than 18 months after being generated. After that time

Contractor shall agree options with CCJPA how specific data shall either be discarded or archived. At no time shall data be discarded without the written permission of CCJPA.

3.8.5 Data Accuracy

Contractor shall describe an auditable method to prove that the data generated by the Solution's OBN and OSS segments being and available through the API is accurate and properly reflects the Solution's function, performance, health, and usage. CCJPA requires that this is performed automatically on an agreed period but not less than every thirty days, with the outcome reported automatically to CCJPA by email within 24 hours of generation to provide the necessary level of confidence in recorded and available data.

The Solution shall automatically and continuously validate that all required data is being generated is within expected parameters, is available through the API and storage mechanism/s, and has not been corrupted. The Solution shall provide both a real time alert available to both Contractor and CCJPA where there is a suspected issue with data capture and also shall ensure that the associated APIs and long term data storage mechanisms have a means of reporting that either data is missing or may be inaccurate.

3.9 Product Development Roadmap & Upgrades

Contractor shall provide a software and hardware development roadmap each year following contract award. This roadmap shall include a schedule of enhancements that Contractor shall be implementing in the upcoming 12-18 month period. This roadmap shall also include product logical architecture changes, physical architecture changes, and web service interface modifications. Contractor shall provide descriptions explaining each enhancement and an approximate time frame by quarter of when this enhancement shall be available.

Contractor shall provide CCJPA with maintenance releases of Contractor's base product software. Contractor and CCJPA shall mutually agree on the deployment schedule for updates, prior to any updates going into effect and Contractor shall provide documentation, training, and implementation support for all updates as necessary. The FAT/SAT configurations maintained by Contractor shall be upgraded first and tested. FAT/SAT Testing results and analysis shall be provided to CCJPA for its approval for the rail equipment used in service prior to Contractor performing upgrades on in-service equipment. CCJPA reserves the right to not accepting any modifications, enhancements or upgrades to the solution at CCJPA's discretion.

CCJPA is interested in a service-based commercial approach to Solution delivery that includes OSS and all OBN components installed on the target fleets. Contractor will be responsible for upgrading and replacing Solution components through the entire contract lifecycle, and billing CCJPA a recurring fixed service fee for the Solution as an alternative to upfront capital expenditure. Under this approach all Solution components implemented through a WD shall have a defined Usable Life that will be proposed by Contractor and approved by CCJPA. The Usable Life is the shortest of:

1. The time that a component can be reasonably be considered to be effective following date of installation, and
2. The time by which new technology will be available and a performance upgrade should be undertaken to ensure that the Solution is performing optimally.

For each component that reaches its agreed Usable Life the Contractor will present options to CCJPA for upgrade or replacement including anticipated performance gains or other improvements. Contractor will provide a detailed impact study of how the new component(s) can be integrated within the current system while minimizing any detrimental effects on the Solution operation during the process. Any additional Service Cost fee for the component replacement and implementation will be provided by Contractor together with the new Usable Life of the new component for approval by CCJPA.

Only under particular circumstances will CCJPA consider it acceptable that any component with an agreed Usable Life is not replaced within that time. In most circumstances this will be considered a breach of contract and will be managed through that process.

In addition to Contractor-proposed upgrades, CCJPA may request specific enhancements to the Solution. Contractor shall develop procedures for tracking, prioritizing and scheduling these requests. Contractor shall define and formalize how CCJPA shall request changes to software, and work with CCJPA to determine the best path to implementation. CCJPA will reserve the right to reject or not accept any software that does not fully meet previously agreed-upon requirements.

Contractor shall provide within the proposal a breakdown of technologies that relate directly to this SOW and for each provide a narrative explaining what is currently available in the market, and if it has been approved and deployed in a rail environment. The narrative shall include a critical analysis of the impact the latest product evolutions have within the railway environment, and explain why they are or are not included within Contractors product roadmap. This may include, for example, the migration to 802.11ax Wi-Fi access points, and Category 11 LTE cellular modems. The purpose of this process is to enable CCJPA to understand the rationale of Contractors product roadmap and the importance of particular technology updates that may become relevant to CCJPA fleet operation. This narrative shall be updated and provided with each product roadmap provided above.

3.9.1 Deliverables for Product Roadmap and Upgrades

The deliverable documents required for Product Roadmap and Upgrades are listed and defined as follows:

Document Type	Description
Software Development Roadmap and Upgrade Plan	Software roadmap for 18 months ahead as PowerPoint in PDF format.
Hardware Development Roadmap and Upgrade Plan	Hardware roadmap for 18 months ahead as PowerPoint in PDF format.
Technology narrative	Explanation of current industry trends and how these may or may not be adopted in Contractors roadmap.
Enhancement Request Procedures	Written description and process for requesting software or hardware enhancements.
Training & Documentation	Documentation, training and implementation support for all updates as necessary.

4 Project Delivery Per Work Directive

This section describes the high-level model for full-cycle implementation for WDs, using Contractor's employees and subcontractors. For the purpose of this RFSOQ Contractor shall provide details how each of these stages will comply with the SOW and be controlled within their organizational structure.

4.1 Work Directive Process

WDs will be issued by CCJPA or other rail partner(s) as required for selected rail cars in variable quantities e.g., individually, in sets, or entire fleets. Each WD shall include the work scope and number of cars to be included. Large jobs which require extensive work shall likely be accomplished via a single WD. Contractor shall submit a proposal for each WD and on approval by CCJPA and/or its partners, a Notice to Proceed (NTP) under the Master Service Agreement (MSA) will be issued.

The scope of work per WD is considered to include a full life cycle implementation from initial inception, technical system design, installation and ongoing system operation and maintenance. Each WD will define requirements, specifications and detailed design and, where needed, customize them on the basis route and other factors. Any change in the requirements or specifications will be communicated to Contractor as part of the WD SOW. All changes and additions proposed as part of Contractors WD response will be subject to CCJPA's or its partner(s) approval.

For each WD, Contractor shall propose a complete and detailed project plan as outlined in this section and submit it to CCJPA for approval before commencing the work. If applicable, Contractor shall identify key delivery partners to facilitate each stage of the SOW. As part of the response to each WD issued SOW, Contractor shall indicate the subcontractors (if any) who be involved in executing the WD. Subcontractors that differ from those presented in Contractor's proposal will have a recognized track record within their particular skill set to ensure that implementation is performed to the satisfaction of CCJPA. Any changes in subcontractors must be approved by CCJPA before WD commencement, but shall not be unreasonably withheld.

4.2 Project Team

The project will be supported by a multi-disciplinary team with leadership provided by senior CCJPA personnel at MSA level; other stakeholders and partners as defined and coordinated by CCJPA shall participate as needed, e.g., personnel of Caltrans, other Joint Powers Authorities, rail operators, and other partners relevant to a particular WD. All shall work together to provide monitoring and evaluation of performance, with accountability for the achievement of the targeted project outcome. All required WD deliverables shall be reviewed with CCJPA and the final versions shall be approved by CCJPA. Contractor shall use (where available) CCJPA-provided templates for creating the project deliverables.

Contractor shall serve as the main point of contact for CCJPA program management and Wi-Fi Services personnel, and is expected to manage the work of any and all subcontractors and coordinate with CCJPA personnel when necessary to ensure timely completion of the WD. Contractor shall identify a project team for each individual WD, depending on the specific requirements of a given WD, location, resource availability, expertise, and cost.

It is envisaged that the project team structure will encompass the following key roles and responsibilities, with company affiliation indicated in brackets:

4.2.1 Project Executive/Director (Contractor)

The Contractor Project Director will be responsible for the implementation and delivery of all the WDs that shall arise from the MSA. The Contractor Project Director shall be the main point of contact to CCJPA for all WDs, and shall be responsible for building and supporting the project teams as they are deployed on any specific WD.

The Contractor Project Director will be supported by one or more Contractor Project Managers, who shall manage the detail of the contracts in place with the various subcontractors. The individual WD Project Manager (described below) will take responsibility for the technical delivery of any individual project, and ensure that financial controls are maintained.

4.2.2 Work Directive Project Manager (Contractor)

The Contractor Project Manager will report to the Contractor Project Director and also communicate directly with CCJPA's project team, generating and maintaining a live project plan, and providing regular updates on progress and any issues that shall arise. The Contractor Project Manager will be supported by the Contractor Project Director and his or her team to ensure commercial management of all subcontractors can be coordinated in parallel with the technical delivery of the project.

Contractor will define minimum professional qualification, certification and experience of the Project Manager that shall be used in the execution of any WD.

As CCJPA considers this role to be critical to the success of any WD, CCJPA requires that they be provided with the details of the selected WD Project manager for review and acceptance based on experience, qualification and, if necessary, interview. This will be undertaken during the specific WD negotiation phase.

4.2.3 System Design (Contractor)

Contractor shall nominate a single technical authority for the Solution to be implemented. This person shall take overall responsibility for ensuring that the solution is designed to meet all functional requirements, and to define the specific installation constraints to ensure optimal operation. All system requirements defined for the WD are communicated to the rest of Contractor's team by the technical authority to ensure that all OBN installation and OSS configuration is undertaken as required for the specific WD. This activity will be led by a suitably qualified engineer within Contractor's team, who shall report to the WD Contractor Project Manager and also directly to CCJPA as required.

4.2.4 Materials Staging (Contractor)

Contractor shall be responsible for the configuration and kitting of their respective materials, and for ensuring that these are delivered to the designated installation site when required and in quantities to match the production schedule. The Materials Staging responsibilities include:

1. Choice of main OBN component suppliers;
2. Supplier quotes including deliveries;
3. Supplier management;
4. Placing of purchase orders;
5. Managing supplier schedules;
6. Payment of suppliers;

7. Supply work instructions;
8. Supply configuration settings and train staff;
9. Supply all specialist test equipment;
10. Choice of fixtures supplier, subject to Contractor and CCJPA sign off;
11. Management of the process to Contractor's requirements and to International Standardization Organization (ISO) 9001;
12. Goods receive process;
13. Safe and secure storage of goods at rail yards and other sites as required;
14. Configuration of on-board equipment;
15. Recordation of serial numbers, MAC addresses and other data into Contractor's asset register;
16. Preparation of rail car OBN kits ('kitting');
17. Provision of documentation (e.g. bill of materials, packing list);
18. Shipment to local depot and recordation of delivery;
19. Provision of shipper tracking numbers to CCJPA staff, and maintenance of shipping log online;
20. Identification of materials that failed to arrive, either on time or missing from a shipment;
21. Remediation of the above issues;
22. Management of the return materials authorization (RMA) process for warranty and faulty goods.

4.2.5 Rail Car Installation (CCJPA, Contractor)

Contractor will either:

1. Carry out the installation on a given car, or
2. If CCJPA's train maintainer carries out the installation itself Contractor will provide on-site supervisory support during the installation process. CCJPA's train maintainer will always be given first right of refusal to perform car installation services.

4.2.6 Commissioning (Contractor)

Commissioning refers to the post-installation configuration and testing of a rail car OBN and interaction with the OSS before handing over to CCJPA for validation and acceptance. Contractor may undertake the commissioning itself or utilize a subcontractor to undertake independent commissioning of the operation of each car. Contractor shall develop a commissioning process for CCJPA review and approval prior to commencement of installations. Contractor shall undertake sample audits of installations to ensure that on wide deployments consistent quality is being maintained. Sample audits shall be conducted on a percentage of installed cars that shall be agreed on a WD basis between Contractor and CCJPA.

4.2.7 Validation and Acceptance (CCJPA)

After Contractor has completed commissioning on any given rail car, CCJPA personnel shall conduct a Solution validation process to test and verify that the Solution is operating in the manner expected. Separate validation processes will be developed by CCJPA for each car type, e.g., brain cars containing centralized Solution components including mobile routers and T2G cellular connectivity; intermediate cars containing passenger-facing APs and ICLs; and DTL for multiple car and/or whole train LAN connectivity. Only on successful completion of the validation process shall a car be considered accepted for service by CCJPA.

4.3 Stage 1 – Planning and Project Management

4.3.1 Kick-Off Meeting

Following CCJPA's acceptance of Contractor's proposal and project team for a specific WD, the project will be initiated with a start-up meeting attended by Contractor, all relevant subcontractors, and CCJPA (and its partners where applicable). The prime purpose of this meeting is to review the full project scope, and agree on the role of each individual and organization. The communication structure will be defined and agreed between Contractor and CCJPA. It will include how often project meetings are required, and the attendees required to participate at each review meeting. Agenda items for the kick-off meeting shall include at a minimum:

- Purpose of the meeting;
- Project objectives;
- Assumptions and constraints;
- Project scope including high-level business requirements;
- Project schedule and key milestones;
- Project organization and key personnel;
- Project risks and issues.

Contractor shall ensure that the project team structure will work independently of company boundaries. Contractor shall promote and aim to maintain an open project structure in which CCJPA is encouraged to speak directly across the project delivery team for detailed information on any aspect of the project. While this shall not replace the formal project reporting from the WD Contractor Project Manager and Contractor Project Director, it is often the clearest and most efficient way to communicate details as required.

4.3.2 Project Management & Implementation Plan

For each WD a comprehensive Project Management Plan (PMP) shall be developed by the Contractor Project Manager, supported by the Contractor Project Director, and agreed with CCJPA and all of Contractor's relevant subcontractors, partners and suppliers. The PMP will describe the work to be performed, how the project shall be operated, and procedures that direct activities to ensure that key tasks are performed in a systematic and visible manner. As a minimum, this plan shall address the following key aspects of project control:

1. Definitions and specifications;
2. Scope management;
3. Staffing management and role definitions;
4. Change control and associated pricing;
5. Work breakdown structure;
6. Cost control and tracking against cost pro forma sheet;
7. Document and data control;
8. Design management;
9. Interface management and integration;
10. Configuration management;
11. Supplier management and qualification;
12. Procurement and identification of OBN components with long lead times;
13. Materials management and logistics;

14. Approvals;
15. Safety management;
16. Environmental management;
17. Installation management;
18. API testing and validation;
19. Testing, commissioning and acceptance;
20. Project plan with dependencies, required resources, and review milestones;
21. Progress reporting;
22. Project and stage review processes;
23. Communication management;
24. KPIs and performance measurement;
25. SLA management;
26. Training and Documentation;
27. Documentation QA and approval;
28. Operation, maintenance, and support.

The Project Implementation Plan shall provide particular detail regarding the following key activities:

4.3.2.1 Project Scope Management

The WD project scope is defined with the Project Implementation Plan by the Scope Statement, Work Breakdown Structure (WBS), and WBS Dictionary. The Contractor Project Manager, Director, and stakeholders will establish and approve documentation for measuring project scope which includes deliverable quality checklists and work performance measurements.

Proposed scope changes may be initiated by the Contractor Project Manager, stakeholders, or any member of the project team. All change requests will be submitted to the Contractor Project Manager who will then evaluate the requested scope change. Upon acceptance of the scope change request the Contractor Project Manager will submit the scope change request to the Change Advisory Board (CAB, established at project commencement) and Contractor Project Director for acceptance. The composition of the CAB shall be approved by CCJPA, and include CCJPA team members. Upon approval of scope changes by the CAB and Contractor Project Director, the Contractor Project Manager will update all project documents and communicate the scope change to all stakeholders. Based on feedback and input from the Contractor Project Manager and stakeholders, the Contractor Project Director is responsible for the acceptance of the final project deliverables and project scope.

4.3.2.2 Schedule Management

Project schedules for the WD will be created using Microsoft (MS) Project or equivalent Project-compatible software starting with the deliverables identified in the project's WBS. Activity definition will identify the specific work packages that must be performed to complete each deliverable. Activity sequencing will be used to determine the order of work packages and assign relationships between project activities. Activity duration estimating will be used to calculate the number of work periods required to complete work packages. Resource estimating will be used to assign resources to work packages in order to complete schedule development.

Once a preliminary schedule has been developed, it will be reviewed by the project team and any resources tentatively assigned to project tasks. The project team and resources must agree to the proposed work package assignments, durations, and schedule. Once this is achieved the Contractor

Project Director will review and approve the schedule and it will then be base-lined. The following will be designated as milestones for all project schedules:

1. Completion of scope statement and WBS/WBS Dictionary;
2. Base-lined project schedule;
3. Project kick-off;
4. Approval of roles and responsibilities;
5. Requirements definition approval;
6. Completion of data mapping/inventory;
7. Project implementation;
8. Detailed Design Package;
9. WD First Train Installation;
10. WD Last Installation;
11. Acceptance of final deliverables.

Roles and responsibilities for schedule development are as follows:

- The Contractor Project Manager will be responsible for facilitating work package definition, sequencing, and estimating duration and resources with the project team. The Contractor Project Manager will also create the project schedule using MS Project and validate the schedule with the project team, stakeholders, and the Contractor Project Director. The Contractor Project Manager will obtain schedule approval from the Contractor Project Director and base line the schedule.
- The project team is responsible for participating in work package definition, sequencing, duration, and resource estimating. The project team will also review and validate the proposed schedule and perform assigned activities once the schedule is approved.

The Contractor Project Director and CCJPA Project Manager will participate in reviews of the proposed schedule and approve the final schedule before it is base-lined. The project stakeholders will participate in reviews of the proposed schedule and assist in its validation.

4.3.2.3 Risk Management

The approach for managing risks includes a methodical process by which the project team identifies, scores, and ranks the various risks. Every effort will be made to proactively identify risks in order to implement a mitigation strategy from the project's onset. The most likely and highest impact risks are added to the project schedule to ensure that the assigned risk managers take the necessary steps to implement the mitigation response at the appropriate time during the schedule. Risk managers will provide status updates on their assigned risks in the scheduled project team meetings, but only when the meetings include their risks planned timeframe.

Upon the completion of the project, during the closing process, the Contractor Project Manager will analyze each risk as well as the risk management process. Based on this analysis, the Contractor Project Manager will identify any improvements that can be made to the risk management process for future projects. These improvements will be captured as part of the lessons learned knowledge base.

4.3.2.4 Change Control & Management

Once project definitions have been clearly established and approved by CCJPA, any further potential changes will be identified, assessed, priced (where applicable) and approved by CCJPA before

implementation. Where a specific WD relates to non-CCJPA rail cars, change control shall be facilitated via CCJPA in conjunction with, and with the involvement of, its partners. Contractor shall manage change on all roll-outs in accordance with CCJPA's own management process, referred to as Change Control. This process will allow any stakeholder in the project to propose changes. All changes shall require the approval of Contractor and CCJPA.

Change control submission and execution process shall be established by CCJPA and Contractor in the MSA CSOW, based on the Solution's commercial approach. For example, a Change Control Request Form may be filled out for all future pre-planned enhancements and changes to the Solution components (hardware, software, or support systems). Some examples of changes include, but shall not be limited to:

- Software configuration;
- Software releases (upgrades/patches);
- Firmware upgrades;
- New hardware introduction;
- Existing hardware modification.

A Change Control Log shall be created and managed by the Contractor Project Manager to keep track of all Change Control Requests submitted and their acceptance and execution. No changes shall be made to the production system without using this process. Emergency fixes (unplanned) that resolve a direct and immediate impact on users will be considered on a case-by-case basis. CCJPA's approval shall be required for all emergency fixes where sufficient time and resources are available to request such approval.

The Contractor Project Manager shall manage the Change Control process. All Change Control Requests shall be sent directly to the Project Manager, who shall add them to the Change Control Log and usher them through the approval process. A maintenance window will be established for the preferred window for pre-planned activities. This window may change from task-to-task depending on the availability of cars with any required protection services. Using this timeframe will minimize any potential impact to rolling stock and allow the greatest amount of available support. Any pre-planned changes implemented within the maintenance window must also allow time for those changes to be regression tested, and if need be, backed out.

All Changes will be tracked for submittal, review, approval, and implementation using the CCJPA provided Change Control Log. After implementation, Contractor shall inform the requestor of the implemented change(s) and provide test results and a report, if appropriate and previously agreed. This report shall be provided to the CCJPA Project Manager within 24 hours of the implemented change(s).

4.3.2.5 Quality Management

All members of the project team will play a role in quality management. It is imperative that the team ensures that work is completed at an adequate level of quality from individual work packages to the final project deliverable. The following are the quality roles and responsibilities for WDs:

- The Contractor Project Director is responsible for approving all quality standards for the work within the WD. The Project Director will review all project tasks and deliverables to ensure compliance with established and approved quality standards. Additionally, the Contractor Project Director will sign off on the final acceptance of the project deliverable;

- The Contractor Project Manager is responsible for quality management throughout the duration of the project. The Project Manager is responsible for implementing the Quality Management Plan and ensuring all tasks, processes, and documentation are compliant with the plan. The Project Manager will work with the project's quality specialist to establish acceptable quality standards. The Contractor Project Manager is also responsible for communicating and tracking all quality standards to the project team and stakeholders;
- The Contractor Quality Specialist is responsible for working with the Contractor Project Manager to develop and implement the Quality Management Plan. Quality Specialist will recommend tools and methodologies for tracking quality and standards to establish acceptable quality levels. The Quality Specialist will create and maintain Quality Control and Assurance Logs throughout the project;
- The remaining members of the project team, and additional stakeholders as required, will be responsible for assisting the Contractor Project Manager and Quality Specialist in the establishment of acceptable quality standards. They will also work to ensure that all quality standards are met and communicate any concerns regarding quality to the Contractor Project Manager.

Quality control for the project will utilize tools and methodologies for ensuring that all project deliverables comply with approved quality standards. To meet deliverable requirements and expectations, Contractor shall implement a formal process in which quality standards are measured and accepted. The Contractor Project Manager will ensure all quality standards and quality control activities are met throughout the project. The Quality Specialist will assist the Contractor Project Manager in verifying that all quality standards are met for each deliverable. If any changes are proposed and approved by the Contractor Project Director and CAB, the Contractor Project Manager is responsible for communicating the changes to the CCJPA Project Manager and project team, and updating all project plans and documentation.

4.3.2.6 Document Management

Documents refer to all project records and deliverables. Document management is the process of organizing, storing, protecting, and sharing documents. Contractor's document management will achieve this overall goal through the following objectives:

1. Provide safe storage and backup of all documents in a project library;
2. Provide clarity regarding which version of a deliverable is the latest version;
3. Provide a clear record of approved deliverables over the life of the project;
4. Provide measures to maintain restricted access to confidential documents.

Contractor shall develop a standard naming convention for all project documentation that will be consistently employed for all project documents. Changes to documents shall be tracked to reflect date and type of change and persons responsible. Prior versions shall be archived for reference as needed. Contractor shall employ a change log table in every formal document. All drawings and models of CCJPA cars will be done in an agreed CAD format and provided in that format and PDF to CCJPA.

Contractor shall utilize a secure, online repository for all project documentation accessible via a standard web browser. The repository will contain the official versions of project documentation to include technical design, bill of materials, project plans, risk matrices, installation plans and photographs, test and commissioning reports, change orders, and other project resources. The repository will be backed up regularly so that in the event of system failure the project documentation will be preserved.

Deliverable documents require review and approval of the Contractor Project Manager and Contractor Project Director, where appropriate, prior to submission to the CCJPA Project Manager.

4.3.2.7 Procurement Management

The Contractor Project Manager will provide oversight and management for all procurement activities for each WD. The Project Manager will work with the project team to identify all items to be procured for the successful completion of the project. Contractor shall then review the procurement list prior to submitting it to its purchasing department. Contractor purchasing department will review the procurement items, and begin the vendor selection, purchasing, and contracting process.

The project team will work with Contractor procurement department to define the item types, quantities, services and required delivery dates. Contractor procurement department will then solicit bids from various vendors in order to procure the items within the required time frame and at a fair and reasonable cost under the firm fixed price contract once the vendor is selected. CCJPA reserves the right to review Contractor procurement and to reject the selected source, if deemed unacceptable to CCJPA.

4.3.2.8 Communications Management

The Communications Management Plan sets the communications framework for each WD. It will serve as a guide for communications throughout the life of the work defined within the WD and will be updated as communication requirements change. This plan identifies and defines the roles of project team members as they pertain to communications. It also includes a communications matrix that maps the communication requirements of this project, and communication conduct for meetings and other forms of communication. A project team directory is also included to provide contact information for all stakeholders directly involved in the project.

The Contractor Project Manager will take the lead role in ensuring effective communications on this project. The communications requirements are documented in the Communications matrix below:

Communication Type	Description	Frequency	Format	Participants / Distribution	Deliverable	Owner
Weekly Status Report	Email summary of project status	Weekly	Email	Project Director, Team and Stakeholders	Status Report	Project Manager
Weekly Project Team Meeting	Meeting to review action register and status	Weekly	In Person/ Conference call	Project Team	Minutes, Updated Action Register	Project Manager
Project Monthly Review (PMR)	Present metrics and status to team and Director	Monthly	In Person/ Conference call	Project Director, Team and CCJPA Project Team	Minutes, Status and Metric Presentation	Project Manager
Project Gate Reviews	Present closeout of project phases and kickoff next phase	As Needed	In Person/ Conference call	Project Director, Team and CCJPA Project Team	Phase completion report and phase kickoff	Project Manager
Technical Design Review	Review of any technical designs or work associated with the project	As Needed	In Person/ Conference call	Project Team	Technical Design Package	Project Manager

<u>Meetings</u>

The Contractor Project Manager will distribute a meeting agenda at least two (2) days prior to any scheduled meeting and all participants are expected to review the agenda prior to the meeting. It is

imperative that all participants arrive to each meeting on time. Meeting minutes will be distributed no later than 24 hours after each meeting is completed. All meetings shall have the options of attendance in person and using a phone conference bridge with screen-sharing capability.

Email

All email pertaining to the project should be professional, free of errors, and provide brief communication. Email should be distributed to the correct project participants in accordance with the communication matrix above based on its content. All attachments should be in MS Word, MS Excel, MS Project, or Adobe PDF format and adhere to established formats. For ease of collaboration Contractor shall have the option of using Google's web-based software office suite (i.e., Google Docs, Google Sheets and Google Slides) in addition to email. If the email is to bring an issue forward then it should discuss what the issue is, provide a brief background on the issue, and provide a recommendation to correct the issue. Contractor and CCJPA Project Managers should be included on any email pertaining to the project.

Informal Communications

While informal communication is a part of every project and is necessary for successful project completion, any issues, concerns, or updates that arise from informal discussion between team members must be communicated to the Contractor Project Manager so the appropriate action may be taken.

Training & Documentation

Contractor shall provide a plan for training CCJPA personnel in the use of the Solution. This training shall be sufficient to ensure that all trainees have, at the end of the training period, a level of proficiency with the Solution necessary for smooth and uninterrupted day-to-day operation. CCJPA and Contractor shall agree on a WD basis the quantity of training (in hours), location and number of personnel to be trained.

Project and Procurement Closeout

Closeout begins when CCJPA accepts the project deliverables and the CCJPA and Contractor Project Managers mutually conclude that the project has met the goals established. The major focus of project closeout is administrative closure and logistics and procurement. Project closeout includes the following key elements:

1. Turnover of project deliverables to operations;
2. Closing out financial accounts;
3. Completing, collecting, and archiving project records;
4. Documenting lessons learned;
5. Planning for Post Implementation Review.

Turnover of project deliverables to operations

During the project closeout phase, the project team will provide early-life support of the Solution system. During this time, the project team will provide operations formal documentation to include:

1. Incident management process for supporting the Solution;
2. Technical support manuals;
3. Full API (and SDK, if applicable) documentation;
4. End user support documentation;
5. Support escalation paths.

When the period of early life support has concluded, and all deliverables turned over, operations will assume responsibility for Solution maintenance.

4.3.2.9 Closeout of Financial Accounts

During project closeout, Contractor shall close out project-related financial accounts unless future WDs are expected where these account are expected to be utilized. These will include:

1. Project-related bank accounts;
2. Lines of credit issued by vendors;
3. Removal of procurement authority for project team.

4.3.2.10 Completing, Collecting, and Archiving Project Records

During closeout, the project team will finalize all outstanding documentation. The Contractor's technical writer will be responsible for collecting all final documentation and ensuring all deliverables have been delivered. The technical writer will then ensure that all finalized documents are archived.

4.3.2.11 Documenting Lessons Learned

The lessons learned from the project will be compiled from project journal entries throughout the project lifecycle. Lessons learned will also be gathered from both realized and unrealized risks in the project risk register as well as through interviews with project team members and other stakeholder as necessary. The lessons learned will be used as references for future projects and contain an adequate level of detail so that other project managers may have enough information on which to help base their project plans. The lessons learned will be categorized by project knowledge area. These knowledge areas consist of: procurement management, risk management, integration management, quality management, time management, cost management, scope management, human resource management, and communications management.

The lessons learned from the project will be contained in the organizational lessons learned knowledge base maintained by Contractor in a secure, online system accessible by web browser. This information will be cataloged under the project's year (e.g., 20xx) and the type of project for future reference. This information will be valuable for any project manager assigned to a similar project in the future.

4.3.2.12 Post Implementation Review

The final formal activity of the project team will be to perform a formal Post Implementation Review in which CCJPA, Contractor, and its subcontractors (if applicable) will participate. The following methodologies will be employed during the review:

1. Interviewing stakeholders (e.g., Project Director, senior management, business experts, records management staff and representative users);
2. Using questionnaires or surveys;
3. Observing the Solution in operation;
4. Observing successful transfer of data from the Solution to CCJPA systems using documented APIs and other data exchange processes and methodologies;
5. Examining Solution metrics and reports generated by the OSS;
6. Examining procedures manuals, training materials and other documentation;
7. Carrying out random checks on the quality of records and control information.

The output of the review will become the basis for the final project report to be produced by the Contractor Project Manager and provided to the Contractor Project Director, CCJPA Project Manager, and all stakeholders. A copy will be placed in the project documentation archive.

4.3.3 Stage 1 Deliverables

The deliverable documents required for Stage 1 are as follows:

Deliverable Name	Description
Kick-Off Meeting Materials	Meeting agenda, minutes and project schedule in MS Project format.
Project Management Plan (PMP)	PMP shall include a full project plan for all tasks included in the WD SOW with all sections detailed in 4.3.2.
Project Plan Updates	Updates to the project plan, including changes to tasks and completed tasks, baseline tracking, and updates to the risk assessment.
Documentation & Training Plan	Detailed plan for the training of CCJPA personnel in Solution operation.
Status Reports	A weekly status report containing the following: • A narrative review of work accomplished during the reporting period and other significant events; • Status of all ongoing activities; • Identification of problems encountered (including issues that may impact work performance) and recommended solutions; • Anticipated activity for the next reporting period; • Updated project schedule with a two-week look ahead of activities scheduled.

4.4 Stage 2 – System Design and Approvals

During this phase Contractor shall develop and design the Solution as defined by the WD SOW – comprising OBN components on board cars – while ensuring that all requirements as defined by CCJPA are reflected in the final design. For the purposes of this section, it is assumed that an OSS system will be developed and deployed by Contractor as part of the initial WD, and that additional work on the OSS to support subsequent WDs will be minimal.

The final product of this phase will be a working set of design drawings and selection of hardware and software that shall serve as the basis of the OBN installation on cars. To accomplish this, Contractor shall conduct the following discovery work:

4.4.1 OBN Design Preparation

This work will identify OBN installation options, basing design on architectural and engineering characteristics of the target car type(s) that conform to all referenced standards. Contractor shall identify options for radio and antenna placement, power source, and location of cable runs, and evaluate any other requirements or constraints. Orders for items with long lead times will be placed during this phase. For certain train sets it is possible that the OBN design developed during the initial WD can be maintained for all subsequent car installations with little or no variation required in the design. Deployment on other car types or out-of-state fleets may require a new OBN assessment and design package.

4.4.2 Initial Design Plan

Contractor shall produce an **initial design plan** that will describe in detail the complete Solution arrangement proposed for the all cars included in the WD. The initial design plan shall provide the overall

technology solution and sufficient technical details to undertake detailed logical and physical design, development, testing, and implementation of the project.

The initial design plan shall incorporate detail of the Conceptual and Logical architecture. The Conceptual Architecture shall identify and consider all high-level technology choices necessary to provide adequate confidence that the project deliverables shall conform to project requirements. The Logical Architecture shall define the processes that are required to provide the needed user functionality.

The overall initial design package shall include the following documents at a minimum:

- Overall design and major areas with keyed notes depicting the work required;
- Design consideration including value engineering propositions;
- Verification that Solution equipment and associated components are capable of meeting capacity requirements and providing rated performance in the installed environment and ambient conditions;
- Descriptions of tasks for the following phases of implementation; the tasks must be formulated independently:
    - Installation;
    - Integration;
    - Commissioning;
    - Validation and Acceptance.
- Installation documents and specifications with details of various Solution components including radios, antennas, cabling, connectors, switches, routers, and convertors;
- Interconnection diagrams with currently or soon-to-be installed on-board equipment such as OBIS;
- Detailed cost estimates that provide a breakdown of all material quantities that will be used in the on-train installation, along with estimated labor hours for all installations. The material breakdown will be listed in line with the divisions of the technical specifications.

The design and all supporting documentation shall be presented as the deliverables of the initial design plan review.

4.4.3 System Requirement Specification

Contractor shall provide a System Requirement Specification (SRS) document that shall be formulated at a level of detail that fully describes the features and behavior of the entire Solution comprising OBN and OSS elements, interaction with existing systems (if applicable), and API functionality. Contractor shall submit the updated requirements to CCJPA for review for SRS compliance, which proves the ability to meet functional, non-functional, and technical requirements, along with a Requirements Traceability Matrix (RTM). As the project progresses, any changes to the requirements shall be reflected in the requirements document and the RTM. Any changes to the requirements shall be processed through the CCJPA approved Change Control Process. Such changes shall be approved by all required stakeholders prior to bringing the changes to requirements.

4.4.4 Legacy System Support & Transition Plan

Design and installations shall require careful coordination in situations where existing legacy Wi-Fi and new OBIS systems are already installed on rail cars. Based on the condition of target cars under an individual WD, Contractor shall submit a Legacy System Support & Transition Plan to CCJPA and its partners where applicable that includes:

- Technical approach to Solution installation and system interoperability;
- Risk management and transition process from legacy Wi-Fi to Next Generation Wi-Fi taking into account that whole-train consists may comprise a mix of old and new systems;
- Test plan for mixed consist environments where legacy Wi-Fi and/or OBIS systems are present.

In all cases Contractor's plan shall mitigate the possibility of cars being without Wi-Fi and/or OBIS services in any given train set under a WD. Contractor shall present staggered installation and interoperability options and scenarios for consideration by CCJPA and its partners; such options and scenarios shall minimize the amount of time any rail car must be taken out of service, and require CCJPA approval prior to First Train Installation (FTI) commencement.

4.4.5 Detailed Design & Final Bill of Materials

Following the formal acceptance and sign off of the concept design by CCJPA, Contractor shall produce a **detailed design package** showing the detailed arrangement of interior and exterior equipment, wiring routes, sub-assembly plates, and mounting hardware. An included technical report shall contain enough data for each subsystem or component to confirm the viability of the proposed solution within CCJPA's technical, cost and schedule requirements. This package shall include, but not be limited to the following:

- Compliance matrix to show compliance with all applicable mandatory national and industry standards;
- Supporting calculations as required;
- Gauge drawings;
- Any additional relevant supporting documentation;
- Any additional drawings or data sheets as required.

The design and all supporting documentation shall be presented as the deliverables of the design review. After the internal detailed design review by CCJPA, Contractor shall integrate all agreed changes requested by CCJPA to the system detailed design package and to the final equipment Bill of Materials (BOM). Following approval the design package shall be set to 'final' status after the changes have been made and approved by CCJPA. The design package shall include as a minimum the models and descriptions of the various architectural and technical aspects of the system, including:

- Physical design and deployment of all Solution on-board equipment;
- Logical design of OBN and OSS software functionality, major components, and customizations;
- Informational model describing the handling of data flows, data quality, quantity, and timeliness;
- Detailed API functional description, with full list supported calls, metrics available for query by external systems, and other supporting documentation;
- Product specification sheets for equipment proposed;
- Diagrams for locations of all Solution components per car type;
- System security design;

- OSS software design (including screenshots) of content authoring and management software, and monitoring and reporting software;
- Any one-off components such as brackets that shall be developed for the specific WD;
- Cut sheets and specifications for all products and key components comprising the overall solution.

Contractor shall keep CCJPA as involved as possible through the design process to ensure that there will be no unexpected items when the final package is submitted. CCJPA shall take reasonable measures to ensure timely review and approval.

On formal acceptance and sign-off of this design, Contractor shall order the full BOM for the first brain and intermediate car installation. Materials shall include cables, brackets and all sundry items that may be required. All materials for the fleet shall be organized by Contractor who shall be responsible for:

- Procuring and stockholding all materials;
- Configuring items as required;
- Allocating and recording all serial numbers for all parts where components do not have ESNs;
- Recording MAC address of all interfaces for IP-based components;
- Recording IMEI and SIM numbers;
- Ensuring that the materials can be made available to match the defined production schedule;
- Communicating regularly with the Project Manager to ensure that any change in production rate is matched with the shipment of materials to site.

4.4.6 Stage 2 Deliverables

The deliverable documents required for Stage 2 are listed and defined as follows:

Deliverable Name	Description
Concept Design Plan (incorporating Conceptual, Logical and Solution Architecture, and System Requirement Specification)	This is a detailed and clear description of the proposed design that shall be implemented on a specific fleet or car type. This document captures all of the key functional areas and describes: • Compliance with Federal/ industry and other mandatory standards; • Fulfillment of all functional and non-functional requirements; • The system components that will be installed; • The areas of the vehicle that will be used to accommodate the system components; • Assessment of impact of risks; • This document will allow Contractor to provide an accurate work estimate and to allow CCJPA to review the proposed design before detailed design is initiated. The approval of this document is a *key gating stage* as following approval all long lead-time equipment may be ordered.
Detailed Design Package	Mechanical and electrical drawings will be produced showing where equipment will be located within the vehicles, methods of fixing, cable routes, electrical and Ethernet connections to existing train systems. The level of detail shown on the drawings will clearly show where components are located, and how they are fixed in place, inside and outside the vehicle. All drawings and models of CCJPA equipment will be done in an agreed CAD format and provided in that format, and PDF, to CCJPA .

Deliverable Name	Description
Bill of Materials	This will be an accurate list of all items being used on the installation and will include: • All Contractor Solution components; • Cables; • Fixings; • Sundry items, i.e., sealants. The purpose of this list is to support materials ordering; however it will be used later also, as part of the approvals submission and also as information to support maintenance activities for the life of the system on the train.
Installation Procedure	This will be a detailed written procedure that shall be followed by the installation staff and will describe in detail all aspects of the installation including: • Mounting equipment; • Routing cables; • Electrical connections cable tests and special checks. The document will refer also to specific tests and commissioning activities and will provide a sign-off for each car that must be undertaken when installation work is complete. All sign-off sheets and completion records will be scanned and maintained electronically and will form part of the records maintained for each vehicle installation. These will be fully accessible to CCJPA. These shall be maintained by Contractor and delivered in full to CCJPA upon approval. Following the first installation of each different car type, this document will be revisited for any required updates and photos.
Legacy System Support & Transition Plan	Process for supporting existing systems during WD execution.

4.4.7 Stage 2 Approvals

Documents for this stage that require CCJPA's approval *in addition to those deliverables listed above* are listed and defined as follows:

Document Type	Description
Materials Report	This report will include description of the materials content for all items being installed on a train, with a description of how these meet the fire compliance requirements.
Mechanical Report	Design calculations will demonstrate how train-borne equipment mountings comply with the mechanical strength requirements of equipment mounted to railway vehicles.
Electrical Report	This report will include all calculations relating to electrical loads, earthing, circuit breaker selection, and cable sizes for all OBN components.

4.5 Stage 3 – OBN Installation

4.5.1 Factory Acceptance Test (FAT)

Before the first train installation takes place (where 'train' encompasses a brain car and a series of intermediate cars), Contractor shall undertake a complete Factory Acceptance Test (FAT), typically in a lab environment, where all hardware required for the first train, including cables, is arranged together, and

a full functional test is undertaken to ensure correct operation. This validates all configurations of equipment, and also that cable terminations have been made correctly and minimizes the risk of any issues on the first train installation. The FAT shall also establish base line key metrics for 'whole Solution' performance and functionality against which rail car installations will be validated. These metrics shall include but not be limited to ICL throughput over multiple hops equal to an entire train set; cellular link throughput, latency, packet loss and jitter (whether as individual or aggregated links); traffic prioritization and flow control; and any other OBN configuration or function that CCJPA has specified as a technical requirement. The FAT shall also establish and validate proper functionality between OBN and OSS components, and verify that all components are reporting status, health, and availability for remote monitoring within the OSS and by external systems via API in the manner defined by the System Requirement Specification. CCJPA shall attend and participate in the FAT. Contractor shall provide an example of its typical FAT procedure in its proposal.

Contractor shall maintain all FAT configurations which have passed for all car types and/or equipment configurations to the extent that they differ from each other so that such that all FAT configurations can be utilized for software/firmware upgrades. As hardware configurations may change with particular car types or fleets, the FAT configurations shall be similarly updated on a WD basis.

4.5.2 Lead Time for New Work Directives

For each new WD, Contractor shall, as far as possible, identify the lead times for the equipment required as soon as CCJPA informs Contractor of the upcoming WD (but for the avoidance of doubt Contractor need not place purchase orders for a particular WD until it has received official notification to proceed with the WD and / or purchase order cover from CCJPA). Contractor shall maintain a local supply of all long lead time equipment that shall be sufficient for two (2) complete brain cars and five (5) complete intermediate car installation kits.

4.5.3 Materials Staging

Contractor shall manage equipment configuration, testing, kitting, and shipping. This shall enable Contractor to scale its deployments rapidly over multiple installations and multiple projects. This process delivers consistent, repeatable, and audited quality providing a fixed standard. Contractor's kitting methodology will enable a modular installation approach supporting part installations where rail car availability is an issue. The key elements in Contractor's Materials staging process will include:

- All items from vendor-supplied hardware (e.g. mobile router, APs, and antennas) to manufactured items (e.g. brackets, cable assemblies) shall be shipped from the various suppliers to the staging site(s) agreed by CCJPA and Contractor;
- All configurable items (e.g. mobile routers, cellular modems and SIMs, ICLs, switches and Wi-Fi APs) shall be configured as required;
- Following configuration, the OBN components shall be fully tested;
- All hardware shall be identified with asset identification tags provided by CCJPA. The details of these shall be recorded to identify individually equipment parts, and shall be included as part of the asset database;
- All electronics, brackets, cable assemblies, and other sundry items including fixing hardware, sealants, cable ties etc. shall be packaged into sub-assembly kits as required to suit the installation methodology required for a particular car type and/or train routeM

- Equipment shall be delivered to the designated site following a schedule agreed with the Project Manager. Contractor shall hold sufficient materials to accommodate for fluctuations in production requirements or delays from suppliers (e.g. holidays, disrupted transportation links). Contractor shall establish a fixed three-month moving schedule with its suppliers;
- Issue of shipper (e.g., FedEx, UPS) tracking numbers to CCJPA Project Manager within 24 hours of shipping, and the maintenance of a shipping records on project web site with Bill of Materials, signed packing slips and other documentation in PDF format, ship and receive dates, and comments for noting missing items and path to remediation and correct fulfillment.

4.5.4 Installation Procedure

Working closely with the Contractor Project Director and Contractor Project Manager, CCJPA shall select the most suitable site for undertaking the OBN installation work on a WD basis. The CCJPA staff at that location will have the opportunity to review the design information, and decide whether to undertake the installation work themselves or have this undertaken by labor provided or subcontracted by Contractor. The first OBN installation on a train ('First Train Installation' or FTI) will be undertaken by Contractor during the initial WD to allow the design to be refined and as a means of producing finalized modification instructions to be followed by whomever later undertakes the OBN installation work.

4.5.4.1 First Train Installation

The first train materials shall be delivered to the designated site to be received by Contractor, who shall be responsible for providing a safe and secure storage location within the CCJPA facility, and for checking for completeness before work starts.

The Project Manager and Contractor work supervisor shall agree with the CCJPA facilities' management team on the detailed work schedule for the installation, including any specific requirements for location facilities (e.g., roof access or power). A written plan shall be produced by Contractor showing the exact work breakdown for the first train, and be agreed upon by all parties and submitted for approval by CCJPA before work commences. A hand-over and hand-back procedure shall be agreed to establish the processes that Contractor and CCJPA follow when a set of cars is made available for modification, and then returned following modification. The procedure shall include the inspections that CCJPA shall undertake, as well as test results or paperwork that Contractor's team shall produce to meet the local site requirements.

Contractor recognizes that there will be requirements to work around other depot activities in particular to ensure that train availability is not compromised. As a result, Contractor understands that there will be periods where staff is unable to work while critical activities are undertaken.

All team members shall have local site safety permits allowing them to undertake the required on-site work. All team members shall be introduced to the local CCJPA site supervisor who shall ensure that the safety certification is up to date, or that any additional safety and blue flag training or briefing that is required shall be provided.

The FTI shall establish the efficacy of the Detailed Design & Installation Plan for fitting of OBN components in the desired locations; this includes mobile router, ICLs, DTL, Wi-Fi APs, roof-mounted antennas, and cabling. Modifications shall be made to the design if changes need to be made to accommodate equipment in the manner described in the Detailed Design Plan. The plan shall accommodate any special methods and/or safeguards required by Contractor's Legacy System Support and Transition Plan and include test procedures validating Solution interoperability between all cars covered by the WD.

Contractor shall undertake all tests on cabling, earth bonding and other components to verify installation quality. On completion of each car a 'record pack' shall be produced and shall contain a record of the installation, including all devices serial numbers and test records. The purpose of this pack is to provide clear documentation to CCJPA of the work completed and to Contractor's asset tracking system that forms the live record for all equipment and trains. Contractor shall utilize the web-based project site to archive all records, and CCJPA and its partners shall have access to all of the installation records.

4.5.4.2 First Article Inspection

Prior to release of the first installed train set, CCJPA personnel will perform a First Article Inspection (FAI). The FAI may occur as the installation progresses, or may happen at the end of the install, at CCJPA's sole discretion.

4.5.4.3 System Acceptance Test

On completion of the first train, Contractor shall undertake a System Acceptance Test (SAT) to validate all of the design assumptions, and allow system configurations to be finalized for the production. The results of the test will be presented in a SAT test report. Unless otherwise agreed the report will have the same format as the FAT test report.

4.5.5 As-Built OBN Design Package

Following completion of the FTI during the execution of the initial WD, the design package shall be reviewed to allow a detailed **as-built OBN design package** to be produced. The as-built design package shall incorporate the experience obtained from the FTI to define accurate cable lengths, equipment locations, and clear installation instructions. Contractor shall submit the production design to CCJPA for review and acceptance as before. Where there is significant deviation from the initial design, whether to brain or intermediate cars or both, then the first train shall be brought to the production standard to ensure fleet consistency. At this point the design will be considered to be final (i.e., 'locked down') and any subsequent changes made through a documented change control process. The project plan shall reflect the time it takes for each party to conduct their reviews and acceptance.

4.5.5.1 OBN Design Variations

WDs subsequent to the initial WD may require the OBN to be installed on cars of a different type and design than that on which the FTI was executed. In this event Contractor shall repeat the initial OBN installation process as described in 4.5.4. *Installation Procedure* and conduct new SAT tests and reports accordingly for CCJPA review and approval.

4.5.6 Stage 3 Deliverables

The deliverable documents required for the OBN Installation are listed and defined as follows:

Document Type	Description
OBN Design & Installation Plan	Complete set of drawings and installation process describing the location of all OBN components including mobile router, ICLs, DTL, Wi-Fi APs, roof-mounted antennas, and RF/power cable routing, and custom brackets to be approved by CCJPA prior to installation. Installation plan shall accommodate special needs identified in Contractor's Legacy System Support & Transition Plan.
FAT Specification	When all materials are available for the first train for any fleet type these will be arranged to replicate, as far as possible, the actual on-train installation. All of the device settings will be tested to ensure that these function as expected and a full network can be established through the train system components to the back-office systems. CCJPA shall witness this test and Contractor shall produce a test report including all results and metrics gathered.
FAT Report	This report will document the results of the FAT.
SAT Specification	The first train will be modified in accordance with the design drawings and specifications. The system will be tested in a very similar method employed on the FAT to validate all design assumptions. This test will include a User Acceptance Test (UAT), provided that the first train is kept together in a single consist by CCJPA so as to enable UAT. CCJPA shall witness this test and Contractor shall produce a test report including all results and metrics gathered. Contractor shall define the testing approach and acceptance criteria in the test plan. The document shall include step-by-step procedures used to execute each test.
SAT Report	This report will document the results of the SAT.
Device Configuration Settings	Contractor will finalize all device configuration settings for all configurable devices. Contractor will provide a definition of the configurations describing the settings, and copies of the equipment configuration files.

4.6 Stage 4 – Commissioning

Contractor shall conduct full system testing to ensure that all of the OBN, OSS and API segments and their constituent components work properly both individually and together. During this phase, extensive testing shall be performed under CCJPA supervision to verify that the system is working properly in all potential scenarios, including mixed consists comprising old and new systems as detailed in section 4.4.4 *Legacy System Support & Transition Plan*.

Contractor shall coordinate with CCJPA to facilitate planning and execution of all commissioning tasks. Contractor shall develop and maintain an Issues Log identifying all commissioning activities, test cases, unresolved and closed issues, and service disruptions. Contractor shall update the log as new issues come up or old issues are modified or resolved.

4.6.1 OBN Commissioning

Contractor shall perform commissioning services for the installation of all OBN materials and hardware. Materials are defined as any component of the Solution including but not limited to mobile routers, ICLs, Wi-Fi APs, antennas, switches, power supplies, cables, and connectors. A detailed Commissioning Plan shall be submitted for CCJPA's review and approval prior to commencing any commissioning services and activities. Commissioning services under this task verify that installation procedures meet expectations, that all Solution equipment has been physically installed per the design documents and is

powered correctly, and that the material installed is new and free of damage and defects. The Commissioning process will also verify that RF propagation from ICLs and Wi-Fi APs, and DTL connectivity, throughout a car and/or consist is of acceptable quality and operating according to design. Contractor shall verify component capacities as well as quantities, measurements, and placement of components in comparison to the design documents. OBN commissioning shall be followed by the CCJPA-led Validation and Acceptance procedure on a car-by-car basis.

4.6.2 OSS Commissioning

Contractor shall verify that the OSS software performs to CCJPA requirements, and provide a Functional Matrix showing all software requirements and the test plan used to verify the functionality of the OSS, interaction with the OBN, and data flow via the API. Functional verification shall include both normal and abnormal operating conditions including verifying how an application performs when testing each component of the Solution and verifying its correct operation and expected outcome. OSS commissioning shall be followed by the CCJPA-led Validation and Acceptance procedure specific to OSS functions.

4.6.3 Commissioning of Overall Solution

Contractor shall document final system-wide performance and ensure the overall Solution performs per the design documents, installation, and integration specifications. This includes but is not limited to functional interaction between on-train and off-train components and back-office systems. The final commissioning or turnover package shall include the final punch list and status of issues. All physical assets shall be affixed with a CCJPA asset tag by Contractor, and logged in the asset database.

4.6.4 Typical Commissioning Procedure (Subject to WD)

4.6.4.1 OBN

Contractor shall produce a set of commissioning and test instructions for each car type on which the OBN has been installed. On completion of the installation, Contractor or appointed representative will undertake the Commissioning Test. Where intermediate cars are being installed in the absence of a brain car, Contractor shall provide a portable brain unit to test intermediate car functionality.

The commissioning tests check all OBN materials, and full end-to-end OBN system operation, as well as integration with the existing systems (if applicable). Materials are defined as radios, antennas, switches, cabling, wiring for power, sealants for the prevention of water intrusion, mounting hardware, all fasteners, bolts, screws, strapping, proper clean up, no interference with access to already installed equipment, etc. Contractor shall verify component capacities (for example, that signals to the roof-top antennas are sufficient to ensure stable transmission of data) as well as quantities, measurements, and placement of components in comparison to the design documents. Contractor shall verify OBN operation including but not limited to:

1. Ability of OBN to acquire GPS signal and connect to cellular networks;
2. Ability of OBN to detect and interoperate with alternative backhaul systems, if present;
3. Ability of OBN to detect and interoperate with existing legacy systems, if present;
4. Measurement of key performance metrics to verify Solution meets or exceeds CCJPA requirements including but not limited to:
    - ICL channel assignment and signal strength;
    - Wireless ICL throughput measured at each hop from the mobile router;

- Wired DTL throughput measured at each hop from the mobile router;
- Wi-Fi AP channel assignment and signal strength;
- Wi-Fi throughput measured from a CCJPA-approved end-user device in each car back to the mobile router;
- Ability to load the Wi-Fi portal, authenticate, and access the Internet;
- Page load time and round-trip ping from CCJPA-approved sites on the public Internet.

Contractor shall rectify any issues that arise until the car under test has passed the Commissioning procedure. Contractor shall undertake quality audits on a selection of cars throughout a WD production cycle to ensure that quality and consistency is being maintained throughout.

4.6.4.2 OBN Commissioning Test Deliverables

Document Type	Description
OBN Commissioning Plan	A detailed description of Contractor plan for OBN commissioning processes.
OBN Commissioning Reports	Individual commissioning reports for each car and train set installed.
OBN Test Plan	A full set of tests that that be proposed by Contractor and approved by CCJPA prior to commencement.
OBN Test Results	The results of the OBN Test Plan.
Updated Asset Database	All asset tags are logged in the asset database within 24 hours of each commissioning procedure.

4.6.4.3 OSS

It is expected that the OSS shall be designed and delivered during the initial WD and that subsequent WDs will not require significant modification to core OSS functionality. A typical WD would be adding new network elements (i.e., physical devices such as OBN components) to the OSS database. Contractor shall produce a set of commissioning and test instructions for the OSS components and back-office systems including but not limited to functionality covering:

1. Delivery of OBN component health and status data to the OSS system;
2. Generation of alerts and monitoring reports to CCJPA specifications;
3. Generation of support tickets and proper routing and escalation of support issues;
4. Accessibility of real time and historical data ro external systems via API.

4.6.4.4 OSS Commissioning Test Deliverables

Document Type	Description
OSS Commissioning Plan	A detailed description of Contractor plan for OSS commissioning processes.
OSS Commissioning Reports	Individual commissioning reports for all OSS software components.
OSS Test Plan	A full set of tests that that be proposed by Contractor and approved by CCJPA prior to commencement.
OSS Test Results	The results of the OSS Test Plan.

4.6.5 Validation and Acceptance

On completion of either individual OBN or overall OSS commissioning, the CCJPA-led Validation and Acceptance testing will be carried out. No car may go into service until this process has been successfully completed and approved by CCJPA.

4.6.6 Post-Commissioning Period

On completion of Contractor commissioning and validation by CCJPA, cars will enter a shakedown period of two weeks during which they will be in normal operation and during which Contractor shall diagnose the full Solution to ensure that no issues have arisen as a result of actual operation.

4.6.7 Final Commissioning Report

At the completion of a WD, Contractor shall submit a Final Commissioning Report that includes an Executive Summary, list of participants and roles, brief WD description, overview of commissioning and testing scope, and a general description of testing and verification methods. The report shall contain, at a minimum:

1. Commissioning plan;
2. Completed commissioning, pre-functional, and functional checklists;
3. Copies of all testing logs and documentation;
4. Copies of all commissioning issue reports;
5. Asset verification reports;
6. Final commissioning schedule.

The report shall be a stand-alone document that completely explains the commissioning processes and logic on a WD basis. This document shall contain copies of all design and O&M documentation used in the commissioning process. The report shall be organized and presented in PDF format for approval by CCJPA.

4.6.8 Stage 4 Deliverables

The deliverable documents required for the Solution Commissioning stage are listed and defined as follows:

Acceptance of Solution	
Document Type	**Description**
Commissioning Plan	A full description of the commissioning process, procedures, and reports generated.
Commissioning Procedure	This test document will describe the function tests undertaken for all Solution components. Will include a functional matrix showing all requirements and the tests used to verify the functionality. Contractor shall define the testing approach and acceptance criteria in the test plan. The document shall include step-by-step procedures used to execute each test.
Test Results: Functional	These signed-off test sheets shall show the completed tests done in accordance with the Commissioning Procedure.

Acceptance of Solution	
Document Type	**Description**
Asset Tracking Database	This document shall provide a record of all materials installed with individual fields including but not limited to: • Equipment type and part number; • Serial number (Electronic Serial Numbers (ESN) where available shall be recorded automatically by the OSS); • CCJPA asset tag number; • Revision number, if applicable; • Configuration reference, if applicable; • Other references as required; • Location in car; • Warranty dates; • Expected lifespan of asset; • Raw cost of asset. In addition, the document shall provide a list of software licenses where applicable, which shall include: • Software license denomination and/or module name; • Revision number, if applicable; • Upgrade history; • Configuration reference, if applicable.
Audit Procedure	This document will define the inspection and test procedure that will be followed to undertake sample train and wayside site quality audits.
Validation & Acceptance Reports	A report supplied by CCJPA for each car, confirming the validation procedure and pass criteria have been met successfully.
End of Work Directive	
Full Commissioning Report	Report will include an Executive Summary, list of participants and roles, brief WD description, overview of commissioning and testing scope, and a general description of testing and verification methods.

4.7 Transition from Delivery to Service Support

When the shakedown period has been successfully completed, the installation for the individual cars shall be considered to be complete. The responsibility for the end-to-end system shall at this point be handed over to Contractor's Operation and Maintenance (O&M) team; Contractor's O&M offering is detailed in section 5 *Operation, Maintenance and Support*. The project structure changes from this point where the delivery structure, defined above, was only required to bring cars to where they were successfully installed and ready for service. All design and installation information and records for each car will then pass to Contractor's O&M team who are responsible for the following activities:

1. Monitoring system performance 24/7/365 to identify devices that have failed or that require attention;
2. Managing the asset database and keeping it continually up to date in order to track all materials, warranties, and repair activities;
3. Mobilize second line (Tier 2) support personnel to undertake issue investigation and component change out as required;
4. Report on system operation, system performance, defect analysis, usage, and other reporting as required;
5. Manage any routine updates to the system configurations as required.

The service support team shall report directly to the CCJPA Wi-Fi Services team and other parties as required. Contractor shall create a standard reporting structure so that the Solution performance can be monitored to identify any general issues to be addressed on a network-wide, individual car, consist, or train set basis.

4.7.1 Manuals & Documentation

Contractor shall produce a full set of maintenance and user manuals for each WD to accompany the installed system. As part of the WD rollout Contractor shall provide the maintenance documents as input to, and in support of, Contractor's support activities. Documentation shall include a technical operation and maintenance manual that describes the procedures for system administration, including product specifications and warranty information for all materials installed, configuration of cars and specific equipment settings, configuration and use of API(s), user account setup and maintenance, and all other relevant technical information to ensure technical understanding of the final solution. Manuals shall be available in electronic form and shall become the sole property of CCJPA. Contractor shall demonstrate that all documentation has been through a thorough quality assurance process prior to submission for CCJPA approval. No training shall commence until all documentation has been reviewed and approved by CCJPA.

4.7.2 Training

Contractor shall provide a Training Plan addressing operational, administrative, and technical training for users of the Solution. CCJPA will review and approve the training plan prior to the commencement of training. Contractor shall provide hands-on training using a real-time environment.

Contractor shall work with CCJPA to define the number and length of sessions, the target audience, and the training channels (e.g., classroom versus online), and the number of CCJPA personnel to be accommodated for training. Contractor shall provide training courses including manuals and documentation that cover the use and maintenance of the Solution. Training manuals shall include a complete operator's manual as well as a quick reference guides for daily system operation. Contractor shall deliver the training courses to CCJPA personnel and is responsible for on-site training as required to fully allow train personnel to efficiently perform all necessary Solution functions. All training materials and user manuals will be available both in electronic and paper form.

Contractor shall provide training and documentation to CCJPA departments as deemed necessary during the installation phase that includes but is not limited to specifications for vibration, heat, electrical and radio interference. Contractor shall provide training for CCJPA personnel that will include:

1. Navigation through the materials;
2. Daily system tasks and maintenance;
3. Configuration and administration;
4. Troubleshooting common problems;
5. Documenting and reporting problems;
6. Lab exercises;
7. Frequently Asked Questions (FAQs);
8. Quick Reference Guide.

Contractor shall provide a bi-weekly training report documenting the user training provided to CCJPA personnel. The report shall include total CCJPA personnel trained in that period and year-to-date, and number of classes performed that period and year-to-date.

Should CCJPA choose to have OBN installations carried out by CCJPA (or train maintenance) staff, Contractor shall provide sufficient training to enable CCJPA to conduct OBN installations.

4.7.3 Warranty Transition Plan

In the case of a capital sale or transfer of ownership of hardware to CCJPA, an asset's warranty period commences either at the point of final acceptance of the Solution by CCJPA, or – in the case of a replacement component – when the asset has been installed and verified to be operational. Contractor shall develop a Warranty Transition Plan to enable and facilitate a streamlined transition from deployment to operation. Contractor shall assume O&M responsibilities during the manufacturer's warranty period. At the end of the manufacturer's warranty period Contractor shall transfer the maintenance of the Solution to CCJPA Wi-Fi Services team or chosen service provider. Contractor shall work closely with CCJPA's representatives to assure a smooth transition. After warranty is expired CCJPA shall determine further support requirements, if needed. Contractor shall continue to maintain OBN software running on trains, and OSS systems on virtual data center servers. Contractor shall enter and maintain warranty information as Configuration Items in the Asset Database; see section 5.7.7 *Asset Database & Configuration Management* for more detail.

In the case of a service contract where there is no transfer of asset ownership to CCJPA, Contractor will be responsible for all defect repairs for the period of that contract while ensuring that CCJPA are advised of any equipment failures and exchanges through an agreed service management process.

4.7.4 Deployment Acceptance and Closeout

Upon CCJPA's acceptance of the deployment, Contractor shall request in writing a review by the CCJPA project manager for final signoff. After the satisfactory final completion inspection and CCJPA's concurrence, Contractor shall secure the required signatures and transmit proper notice to CCJPA along with the required guarantees, affidavits, releases, bonds, escrow, and waivers. Contractor shall certify in writing that all work has reached final completion in accordance with the WD documents and that the final estimates of payment to Contractor are correct. Contractor shall transmit to CCJPA all closeout documents as defined in the contract, and participate in an overall lessons learned session to identify opportunities for improvement.

4.7.5 Stage Deliverables

The deliverable documents required for the transition to O&M stage are listed and defined as follows:

Document Type	Description
Service Support Plan	Contractor shall design a Service Support Plan as detailed in Section 5.
Technical Support & User Manuals	In these documents, Contractor shall describe the procedures for system administration, including configuration for specific deployment, network, and environmental settings, user account setup and maintenance, and all other relevant technical tasks.

Document Type	Description
Equipment Installation and Maintenance Manuals	Contractor shall provide installation and maintenance manuals in Adobe Portable Document Format (PDF) to be used by CCJPA and other system users to maintain and support the OBN, OSS, and API segments in the event CCJPA elects to maintain its own system post-implementation. CCJPA shall be permitted to make additional copies of the installation and maintenance manuals for CCJPA needs. Manuals shall include: • Detailed specifications and drawings; • Detailed installation diagrams; • Maintenance procedures including, but not limited to, removal, installation, cleaning, and safety precautions; • Complete electrical schematics with narratives describing logical operation, drawings of components, and wiring diagrams.
Maintenance Documentation	Maintenance documentation shall describe how to identify and change-out faulty equipment. It shall include but shall not be limited to: • Component change specification; • Fault finding guide; • Test record sheets; • RMA procedure; • Routine maintenance.
Personnel Training Plan	Training Plan shall include but not be limited to: • Classroom and/ or online training sessions – number of sessions and personnel accommodated to be agreed; • Supporting training materials in PDF format; • Bi-weekly training report.
Warranty Transition Plan	Warranty Transition Plan shall include but not be limited to: • Detailed migration path from Contractor to CCJPA at end of manufacturer's warranties, where applicable; • Contractor's continuation of OBN, OSS and API software and service support.
Deployment Acceptance Documents	Documentation shall include: • CCJPA Project Manager sign-off sheets; • Delivery of all outstanding project records to CCJPA; • 'Lessons Learned' report.

5 Operation, Maintenance and Support

Two different options are available for Contractor to deliver equipment and services to CCJPA based on either a capital procurement or as a service model. Depending on the option exercised, the support plan may need to be defined to reflect the responsibilities of each. Some aspects of the requirements defined below may not be applicable under the service model approach (for example spare parts and warranty) however Contractor is still required to provide the appropriate details so that CCJPA can assess readiness and also any risks that could affect system availability.

Upon CCJPA's acceptance of a working solution for a given WD, Contractor shall transition to the role of maintaining the Solution. Contractor shall formulate a Service Plan that takes into consideration component and system operating procedures, and is structured in a logical, sequential and efficient manner to include protocols, forms, checklists, and procedures to maintain centralized documentation. The Service Plan shall include a methodology for tracking deployed and spare materials, warranties for all materials, schedule of service activities and bi-weekly reporting procedures. The plan also shall define the resources, processes, and procedures used to support the Solution's functional operation, including interactions with CCJPA personnel to log, track and resolve issues. CCJPA shall have full visibility into the status of warranties, spare parts and service tickets through direct access to the management system and regular reporting on these activities at system, rail car and back-office levels.

5.1 System Support – Scope of Services

Contractor shall be responsible for:

- Maintaining hardware components installed by Contractor to enable Solution functionality comprising OBN, OSS and API segments;
- Managed virtual data center components;
- The software and firmware running on Solution components, and on-going updates;
- The end-to-end logical service from the on-board equipment to back-office servers;
- Maintaining, in partnership with CCJPA, the cost pro forma for the variety of cost categories;
- Management and overall control of spare Solution components and parts.

Contractor shall deploy a performance-based maintenance approach against an SLA defined in 5.4. *Service Level Agreement (SLA)* of this document. The managed support service shall comprise the following service elements:

- Service desk for Solution support ('Tier 2') – Remote investigation and attempted resolution of incidents escalated to Contractor by CCJPA Wi-Fi Services personnel;
- Field Engineering Support ('Tier 3') – On-site support to investigate and resolve issues on trains;
- Specialized support service teams for software and hardware ('Tier 4').

Maintenance spares, trained personnel (certified and experienced), software support and other resources necessary to fully maintain and support the entire Solution shall be made available for the full warranty period, starting from the date of initial service. Contractor's performance of this managed service will be measured by the Service Level Agreement (SLA) and Key Performance Indicators set out in this document.

5.2 Warranty Management

In the case of a capital sale or transfer of ownership of hardware to CCJPA, Contractor shall warrant all Solution components comprising hardware and software for a minimum one-year period. Under the terms of a service based contract then CCJPA assumes that all failed and defective parts that are replaced on the vehicle will be replaced by Contractor. Warranty will cover all parts, labor, shipping and other costs related to preparing and installing replacement parts. Any and all additional manufacturer's warranties should be provided. Due to cost implications associated with equipment replacement, it is critical that Contractor keep accurate and timely updated records in the asset management system as the warranty management process relies heavily on that system.

Two critical attributes associated with the Configuration Item ('CI') records are 'Warranty Start Date' and 'Warranty End Date.' These dates are based on final acceptance of the equipment and will be accurately captured and logged. This information will then influence the manner in which Contractor responds to a CI failure that requires replacement. A CI under warranty will enter into the Returned Materials Authorization (RMA) process. Components that cannot be repaired are handled differently based on warranty status; warranted CIs will be replaced at Contractor's cost, while CCJPA will determine whether to replace individual non-warranted CIs at CCJPA's cost. Contractor shall report monthly on all Warranty Management activities. The reports will show (at a minimum):

- Number of RMA events for prior month;
- Type of CIs affected;
- RMA ticket quantity;
- Comparison to other months (trending);
- Incidents associated with RMA events.

5.2.1 Deliverables for Warranty Management

Where applicable the deliverable documents required for the Warranty Management, in addition to those required by 4.7.3. *Warranty Transition Plan,* are listed and defined as follows:

Document Type	Description
Warranty Transition Plan	Written End-of-WD plan to enable and facilitate a streamlined transition from deployment to operation.
RMA Process	Detailed explanation and steps for RMA process.
Monthly RMA Report	This report will document all RMAs in the prior month.

5.3 Service Plan

Contractor shall formulate a service plan that takes into consideration component and system operating procedures. The service plan shall be structured in a logical, sequential and efficient manner and shall include protocols, forms, checklists, and procedures to maintain centralized documentation. The service plan shall include a methodology for tracking deployed and spare materials, warranties for all materials, schedule of service activities, and bi-weekly reporting procedures. The plan also shall define the resources, processes, and procedures used to support the Solution components on trains and in the virtual data center. The service plan shall include input from CCJPA personnel. At minimum the Plan shall include:

- 24/7/365 SLA;
- Response time < 1 minute from automatic or human fault identification, and initial call response < 3 minutes;
- Fault prioritization as defined in section 5.4;
- Trouble ticket management with customer portal access;
- Real-time network monitoring;
- Remote fault diagnostics and resolution;
- Service management with escalation;
- System performance monitoring and reporting tools;
- Asset, Warranty, and RMA management;
- Automatic Customer notification emails.

The service terms referred to above are defined as follows:

Term	Definition
SLA	Service Level Agreement denotes the minimum service level defined in section 5.4.
Response Time	Time to begin investigating a potential fault, based on SLA's defined in section 5.4.
Fault prioritization	Fault prioritization is defined in section 5.4.
MTTR	Mean Time To Repair.
Trouble ticket management	To ensure all faults (including faults found through monitoring/alerts and service calls) are logged and are maintained during fault resolution, the following information will be captured at minimum: • Trouble Ticket Number; • Vehicle/Site location; • Date & Time of fault raised; • Fault prioritization; • Fault resolution; • Date & time of resolution; • Name of reporting person (if applicable) • Fault aging (reporting).
Remote fault diagnostics and resolution	Fault diagnostics and resolution via fault troubleshooting will be processed by Contractor Service Desk.
Service management with escalation	A service manager assigned to the portfolio will act as a point of contact to provide detailed feedback and any escalations.
Service reporting	A range of reports will be available and will be tailored to CCJPA's requirements, including but not limited to Incident Aging, Fault Priority, and RMA History.
Asset warranties and RMA management	Return Materials Authorization is the ability to manage faulty equipment through a returns process, and to have spares stock available to be dispatched at the earliest opportunity to ensure the service is operational for the maximum available time. Warranty status will be managed by Contractor.
Access to ticket system	CCJPA will have direct access to Contractor trouble ticketing system and will be able to view tickets and run reports. CCJPA will need access to open trouble tickets and read only access to run reports via a web-based self-service portal component of the OSS.

Asset management	All Contractor's equipment provided for the Solution, including but not limited to mobile router, ICLs, DTL and Wi-Fi APs, and all software licenses, will be tracked to their location in the Asset Tracking System. If exchanged due to faults they will be tracked through the replacement process, and will be reported upon deployment. CCJPA will also need access to the Asset Management system for reporting process and to ensure that the information is available for audit, accounting, and tax depreciation purposes. All solution assets are required to be logged in the CCJPA Wi-Fi Services system and Contractor shall be required to conduct a quarterly and annual audit at CCJPA's request.

5.3.1 Deliverables for Service Plan

The deliverable documents required for the Service Plan, are listed and defined as follows:

Document Type	Description
Service Plan	Written Service Plan for component and operating service procedures.

5.4 Service Level Agreement (SLA)

Contractor shall provide the standard offered services levels aimed at incident and problem management. This SLA will be used to ensure that the system is available when required by CCJPA, and it will be delivered to the agreed standards. CCJPA and Contractor shall review the Service Desk classification of faults by priority on an ongoing basis. The resolution times stated below are used for wayside sites that can be accessed as needed, and when train sets are available for incident resolution at predetermined maintenance facilities, and the cars containing Solution components are made available to Contractor for access. All on-site resolution times are strictly dependent on availability of the vehicle or access to the wayside, as well as – in the case of rail cars – receiving accurate information from CCJPA regarding the intended location of vehicles at (and for) the times where a Contractor field service engineer is required on-site.

NEXT-GENERATION WI-FI O&M SERVICE LEVELS			
Hardware and Infrastructure Failures			
Priority Level	**Response Time**	**Resolution Time**	**Example Faults**
Priority 1 "Critical": Wi-Fi Service Failure	< 1 minute to begin remote investigation after identification of a potential fault from any source.	**Remote Resolution:** < 2 hours after response time ends.	Data center outage, T2G link complete outage, complete DTL outage, brain car only Wi-Fi outage, all cars except brain car Wi-Fi outage, whole train set Wi-Fi outage, GPS failure.
Priority 2 "High": Vehicle Failure	< 1 minute to begin remote investigation after identification of a potential fault from any source.	**Remote Resolution:** < 2 hours after response time ends. **On-Site Resolution:** Begins < 2 hours after response time ends, subject to rail car availability and access.	Single car OBN failure, DTL failure, or Wi-Fi outage.

		95% of faults resolved on first visit; remaining faults resolved on second visit.	
Priority 3 “Medium”: Component Failure	< 1 minute to begin remote investigation after identification of a potential fault from any source.	**Remote Resolution:** < 4 hours after response time ends. **On-Site Resolution:** Begins < 4 hours after response time ends, subject to vehicle availability and access. 95% of faults resolved on first visit; remaining faults resolved on second visit.	Failure of single or multiple mobile router, cellular modem, ICL, switch, Wi-Fi Access Point, , antenna, cable or any other OBN segment component.
Priority 4 “Planning”: Informational	< 1 hour to begin remote investigation.	Resolution time is not applicable as Priority 4 tickets are not fault-related. If a fault is identified, the priority will be adjusted on a per-ticket basis.	Non-service affecting threshold alerts such as a storage device nearing capacity or equipment. temperature outside nominal bounds.
System Failures			
Priority Level	**Response Time**	**Resolution Time**	**Example Failures**
Priority 1: System Failure	< 1 minute to begin remote investigation after identification of a potential fault from any source.	**Remote Resolution:** < 2 hours after response time ends.	More than one OSS software component non-functional.
Priority 2: Software Failure	< 1 minute to begin remote investigation after identification of a potential fault from any source.	**Remote Resolution:** <1 hour for programming errors to be referred to CCJPA service desk. < 2 hours after response time ends for all other content failures.	One OSS software component non-functional, including monitoring or reporting, API or other data export method error or failure.
Priority 3: Informational	< 1 hour to begin remote investigation.	Resolution time is not applicable as Priority 4 tickets are not fault-related. If a fault is identified, the priority will be adjusted on a per-ticket basis.	Non-service affecting requests. OSS account creation request, OBN system assistance, service desk ticketing issue

5.4.1 Deliverables for SLA

The deliverable documents required for the SLA, are listed and defined as follows:

Document Type	Description
Final Service Level Agreement	Written and detailed SLA with priority levels, response times, and resolution times.

5.5 Support Plan

Contractor shall provide centralized warranty, spare part, and service ticket management. CCJPA shall have full visibility into the status of warranties, spare parts, and service tickets through self-service web portal access to the management system(s) and regular reporting on these activities at both the system and train level.

Maintenance spares, trained personnel (certified and experienced), software support, and other resources necessary to fully maintain and support the entire system shall be made available for the full warranty period, starting from the date of Production Readiness Acceptance. Contractor shall provide such service twenty-four (24) hours per day, seven days per week.

Back up and spare parts shall be specified and stored in specific CCJPA or Contractor locations, as approved by CCJPA. Contractor shall have a centralized system for tracking the location and warranty of all deployed and spare parts.

Contractor shall perform all its own on-site maintenance and bear all additional costs associated with expediting manpower or materials to effect repairs. Contractor may use subcontractors approved by CCJPA in the execution of maintenance activities. Contractor shall provide a Defect Failure & Root Cause Analysis for the failed equipment and replenish the spare to CCJPA within one week.

In addition to the O&M central management function Contractor shall provide on-site resources to conduct the following activities:

- Dispatch qualified Field Technicians within the contracted SLA response times;
- Confirm fault diagnosis and troubleshoot to determine the root cause of the failure;
- Request and receive spare units or parts not stored on-site;
- Affix CCJPA asset tag on replacement and/or spare parts whether in stock or deployed;
- Replace defective units or parts;
- Dispose of defective units or send for repair as appropriate;
- Communicate with CCJPA personnel to confirm repaired unit is on line;
- Update asset tag information in OSS reflecting in- or out-of-service status;
- Provide monthly reports of on-site activities.

In addition, Contractor shall indicate how it shall provide additional support, including Original Equipment Manufacturer (OEM) support, for issues beyond the Field Technicians' ability to solve.

Contractor shall submit a support and maintenance plan that defines how each of these services shall be provided. Such support services shall be available in all locales and regions served by CCJPA.

5.5.1 Field Support & Maintenance

Contractor shall have technicians within a reasonable distance of Solution service areas to enable response times stated in the service level agreement are met. Technicians will be equipped with a vehicle appropriate for their assignments. Each vehicle will be equipped with tools, test equipment, and safety equipment appropriate for the assignments anticipated for that vehicle. The vehicles will be equipped with sufficient spares to allow the team to proceed directly to a work site and be ready and able to perform required maintenance or replacement.

The vehicles will have a secure lock box sufficient to assure the security of all spares, tools, and test equipment. The technicians will have a laptop computer with the proper cabling and software to interface with the field equipment. This will allow them to engage with Contractor's network operations center via the OBN and in the event of OBN failure via a commercial cellular data network. The laptop computer should contain all reports and forms required to complete any work effort.

Contractor shall employ an approach that involves swapping parts of all defective or suspect equipment with new and/or certified parts, so that parts removed from service are ticketed in the field and returned to the NOC for test, RMA, and/or disposal. The return of a piece of equipment shall result in a replacement being supplied to the vehicle's inventory. The vehicle's inventory will suffice to completely re-equip a single rail car (including mobile router, ICLs, switches, Wi-Fi APs, cables, connectors and other consumables) and all team members shall have been trained to do the same.

Contractor shall comply with all CCJPA rules and procedures for accessing Solution components and in providing field support within the CCJPA and partner maintenance facilities.

5.5.2 Deliverables for Support Plan

The deliverable documents required for the Support Plan, are listed and defined as follows:

Document Type	Description
Support & Maintenance Plan	Written and detailed plan for all Solution components provided by Contractor.
Defect Failure & Root Cause Analysis	Report for failed component.
Service Repair Reports	Monthly report on service repairs, and back-up and spares usage and inventory levels.

5.6 System Performance & Reliability Monitoring

Contractor shall undertake system performance and reliability monitoring, and will:

- Remotely respond to Solution issues and alerts 24/7/365;
- Provide field-based maintenance for all OBN equipment and OSS systems;
- Provide remote troubleshooting to assist with problem diagnosis and correction;
- Respond to CCJPA personnel with regards to system functionality and operating procedures;
- Proactively monitor systems and automatically recover from problems;
- Provide system software updates to improve performance and reliability;
- Use Contractor or CCJPA diagnostic systems to monitor communications system;
- Provide hourly updates via written report of reported high priority issues;
- Provide monthly reports that show conformance with/deviation from the SLA.

5.6.1 Network Operations Center (NOC)

Contractor shall provide a NOC, the purpose of which is to provide CCJPA with a high availability, mission-specific Preventative Maintenance Programs (PMS) facility. This facility is designed to execute customized PMS with integrated Monitoring, Planned and Predictive Maintenance, supported by a Tier 2 and Tier 4 Demand Maintenance Team, ready to be deployed as required, to minimize the occurrence and impact of down time for the industry's mission critical IT components.

Contractor shall operate the NOC 24/7 and together with the cloud-based OSS offer trained Tier 2 (Service Desk and System Administrators) and Tier 4 (Application and System Engineers) personnel. Contractor shall provide a system with monitoring parameters, thresholds and hurdles, reports (both ticket and status reporting), trend analysis and Tier 2 and Tier 4 Demand Maintenance.

5.6.2 Preventative Maintenance & Monitoring

Contractor shall implement a proactive approach to support for the Solution. Metrics, existing under ticket condition green, will be monitored as part of the routine maintenance procedures with trend analysis and review of daily performance determining if preventive maintenance is indicated. This will provide the ability to start support prior to Severity Level 1 and 2 conditions and prevent issues before they start.

Contractor shall monitor software and hardware on all Solution segments, whether constantly moving and/or geographically distributed, or static. Contractor shall notify CCJPA of both the content and the timing of Planned Maintenance effort and that appropriate approvals are obtained from CCJPA before execution.

Contractor shall provide monitoring of all OBN, OSS, and API segments and of constituent components and applications using a variety of tools and techniques. Each item under this effort will be monitored based on actual versus target for system performance factors. Automated notifications will be produced when the actual departs from specification.

The OSS shall also monitor and report on Wi-Fi and DTL element status, health, availability and RF conditions within an individual car, to mitigate RF signal interference and channel conflicts on APs and wireless ICLs. The Solution shall create an alert when RF issues are detected and generate a report for action. Contractor shall detail the RF health capabilities of the Solution, providing screen shots of system functionality where appropriate.

Contractor shall supply a preventative maintenance plan with its proposal, providing a detailed description of the services offered, samples of various use case scenarios, and resolutions processes.

5.6.3 Reporting

CCJPA and its Wi-Fi Services personnel shall be able to create reports at any time on demand both (a) from within the Solution's OSS segment via the self-service web portal using Contractor's proprietary tools, and (b) using real time and historical data received via API calls. It shall not be necessary for CCJPA to require Contractor to generate reports on its behalf, unless there is a temporary failure in either of the two report-generating methods described above. These requirements cover all functions of the OSS including but not limited to system, segment and component status, health, performance, and availability. The ability to create reports shall extend to service desk ticketing, warranty, and asset and configuration management functions.

Contractor shall provide CCJPA with training for system access and the creation and export of all report types.

5.6.4 Data Repository

Contractor shall store all system reports in an online document history repository with an appropriate search engine, and data feed via API. CCJPA will have full access to this repository for searching and retrieving all information developed under this effort, or via raw data feed for import to CCJPA systems via one or more API. This shall include but is not limited to:

- Completed Work Orders performed on site;
- O&M documentation related to incident reports;

- Report Logs of damaged components and correspondence with manufacturer regarding replacement of damaged components;
- Report Logs of warranty issues and correspondence for defective components;
- Report Logs with certification of component model numbers and verification of component installations for asset management purposes.

Contractor shall retain all data generated by the Solution for a minimum period of eighteen months, provided an archive to CCJPA on a quarterly basis in a format to be mutually agreed by Contractor and CCJPA prior to contract commencement.

5.6.5 Deliverables for System Performance & Reliability Monitoring

The deliverable documents required for System Performance and Reliability Monitoring are listed and defined as follows:

Document Type	Description
System Performance Reports	Regular written reports on Solution performance and reliability containing the elements defined in the approved SLA and indicators reported in UAT testing results.
O&M Database	Database of O&M documentation and verification of completeness and conformance to project specifications.
Training	Training of CCJPA personnel on performance monitoring system.

5.6.6 Key Performance Indicators

Contractor shall use Key Performance Indicators (KPIs) to baseline and report the Service Model operations; these KPIs will include but not be limited to:

- Availability of all on-train OBN components;
- Availability of all OSS systems and applications, and API segment;
- Service Management statistics such as Mean Time To Resolve (MTTR) and Mean Time Between Failures (MTBF).

5.6.6.1 Key Performance Indicators for OBN Elements

The primary KPI for the OBN elements will be reported using tiered levels of granularity. Availability of primary components will be presented as an average across the network and will allow drill-down to individual OBN components, e.g. mobile routers, ICLs, switches, DTL, Wi-Fi APs, and other IP-based components. These reports will be available for CCJPA to run at any time.

The availability KPI will be measured according to a formula based on the following metrics:

- *t*: Hours of operational time;
- *c*: Number of components of a given type;
- *d*: Hours of operational time in which the component was reported non-functional by the OSS.

The formula for calculating this availability will be:

$$\frac{(t * c) - d}{(t * c)}$$

Note: Failures of the Solution due to an outage of train power or third party systems should be measured against those systems' KPIs and not against the Solution KPIs.

The following table illustrates how KPIs are expressed for individual components of OBN elements. All availability KPIs for all OBN equipment will be calculated as a relationship to the time in scheduled service.

Component	KPI	Expressed As
Mobile Router	Measured continuously (a measure taken at least every minute)	Percentage uptime as a ratio of time in service and time operational.
Cellular Modem	Measured continuously (a measure taken at least every minute)	Percentage uptime as a ratio of time in service and time operational.
Wireless ICL	Measured continuously (a measure taken at least every minute)	Percentage uptime as a ratio of time in service and time operational.
Wired ICL (DTL)	Measured continuously (a measure taken at least every minute)	Percentage uptime as a ratio of time in service and time operational.
Wi-Fi Access Point	Measured continuously (a measure taken at least every minute)	Percentage uptime as a ratio of time in service and time operational.
Ethernet Switch	Measured continuously (a measure taken at least every minute)	Percentage uptime as a ratio of time in service and time operational.

5.6.6.2 Key Performance Indicators for OSS Element

The OSS elements will contain a number of components as proposed within Contractor's Solution. Contractor will measure the KPIs for OSS element as follows:

Based on the performance relevant to the equipment and services provided in the OSS location(s), the following KPIs will be measured according to the following criteria:

- Uptime is derived as a function of availability of OSS application servers, network appliances, and data center ingress / egress portal peering, notwithstanding pre-approved maintenance windows.
- Availability of the OSS element will be subject to the following KPIs:
  - OSS application services (at virtual data center defined by WD) - 99.99%
  - OSS data center hardware (at virtual data center defined by WD) - 99.99%

The availability of data center hardware and application services will be calculated according to the following formula:

$$\frac{\mathrm{t} - d}{\mathrm{t}} \geq required\ availability$$

where:

- *t:* Hours of operational time in hours
- *d*: Non-functional hours

5.7 Service Desk and Other Support Services

CCJPA's Wi-Fi Services help desk will provide Tier 1 phone and email support to train crews, conductors and other personnel who need to report issues regarding the Wi-Fi experience on trains, including those reported to train staff by passengers. An 800 number will connect callers to CCJPA help desk personnel 24/7/365 who will attempt to resolve issues with callers. In the event that an issue cannot be resolved, CCJPA Wi-Fi Services will escalate the issue to Contractor's Tier 2 Service Desk which will:

- Provide Tier 2 phone and email based technical support 24/7/365 to CCJPA's Wi-Fi Services help desk personnel who require escalation of issues for resolution by Contractor;
- Provide a ticket management system for issue submittal, tracking, resolution, and historical reference;
- Provide remote troubleshooting to assist with problem diagnosis and correction;
- Provide access to monthly service desk reports which shall include:
    - All known software and hardware defects that affect functionality and security of applications and supporting software;
    - Timelines for issue resolution and system patches.
- Provide service desk call statistics on a monthly basis.

Contractor shall perform and manage the following tasks:

- Answer all incoming calls and emails from CCJPA personnel within SLA limits;
- Obtain sufficient detail of issues to create an incident ticket and commence remediation;
- Provide solutions and take ownership of problems until resolution;
- Escalate issues to Contractor's Tier 3 or Tier 4 personnel as required;
- Keep track of all open issues until resolution and ticket closure.

All phone calls to Contractor's Tier 2 Service Desk shall be recorded. It shall be possible at minimum for CCJPA Wi-Fi Services personnel to submit an email to Contractor's Tier 2 Service Desk containing information about an issue. Contractor's ticket management system shall be capable of automatically receiving issue emails and creating an incident ticket containing the detail from the CCJPA email. In addition to phone and email submission of issues, CCJPA seeks the ability to submit via an API.

Contractor shall extract data from the automated tracking system once per calendar month and make available to CCJPA via the self-service portal an incident report presenting and summarizing that data.

5.7.1 Incident Progression

After an issue is reported to Contractor by CCJPA Wi-Fi Services help desk, Contractor Tier 2 staff shall work directly with the CCJPA personnel to resolve the issue within SLA boundaries. If the issue cannot be resolved, Contractor shall escalate it to Tier 3 or Tier 4 staff as appropriate. Contractor shall provide a call and email flow diagram in its RFSOQ response that illustrates how incidents are handled and progressed through to resolution and closure.

5.7.2 Ticket Management System

Contractor shall provide a ticket management system that shall offer a central view of all outstanding tickets and their status to Contractor and CCJPA Wi-Fi Services personnel. The ticket management system will allow for a paper trail into both current and historical issues allowing for analysis of Contractor's processes and the identification of re-occurring issues for consideration by CCJPA and Contractor personnel. Information contained within the ticket management system shall be automatically extracted and reformatted by Contractor into a formal report sent to CCJPA on or before the 15th of each month, for the period of the prior full calendar month.

5.7.3 NOC Support

The NOC described in 5.6.1. *Network Operations Center (NOC)* will provide Tier 2 support and a central location for all help desk items.

5.7.3.1 Demand-Based Support

Tier 2 Personnel shall be trained to perform routine and preventive maintenance and to resolve warnings and alerts. They will receive clear instruction to escalate to Tier 3/4 support when proposed or demanded maintenance involves performing an activity which exceeds their training or which may impact service levels or violate protocol. Additionally, the Service Desk will receive the ticket and reach out and confirm (by voice) that the alert has been received and that the appropriate personnel have been dispatched.

Contractor shall use the severity levels below to properly respond to each item. The thresholds used to issue these tickets are based upon the SLA requirements of this SOW:

Tier 2 Specialist Support			
Priority Level	**Help Desk Response**	**Resolution**	**Description**
Severity 1 – Emergency	Call Response time < 1 Minute (Trouble Ticket automatically generated)	Tier 2 support where possible, or escalate to Tier 3 or Tier 4.	Defects that cause the system to suspend, crash, or otherwise become completely inoperable; including errors that cause valid data to become corrupt in the database.
Severity 2 – Serious	Call Response time < 1 Minute (Trouble Ticket automatically generated)	Tier 2 support where possible, or escalate to Tier 3 or Tier 4.	Defects that materially affect normal processing of work for which no reasonable work-around as determined by CCJPA is available.
Severity 3 – Inconvenient	Call Response time < 1 Minute (Trouble Ticket automatically generated)	Tier 2 support with escalation as required.	Defects for which users have an acceptable, defined work-around that allows the system to continue work and where the error does not compromise data integrity or security.
Severity 4 – Minor	Call Response time < 1 Minute (Trouble Ticket automatically generated)	Tier 2 support with escalation as required.	Defects where the system behavior does not exactly match the system specifications but does not significantly impact the processing of work or compromise data integrity or security.

5.7.4 Deliverables for Service Desk

The deliverable documents required for System Performance and Reliability Monitoring are listed and defined as follows:

Document Type	Description
Service Desk Plan	Written set of Service Desk procedures and processes with escalation paths.
O&M Database	Regular written reports on Solution performance and reliability containing the elements defined in the approved SLA and indicators reported in UAT testing results.
Monthly Service Desk report	Report with all service desk activity recorded including ticket lifecycle.

5.7.5 Spares Management

5.7.5.1 Spares Management when Supplying Materials as a Capital Sale

In the case of capital sale or transfer of ownership of the system hardware to CCJPA Contractor shall supply a Spares Management Plan that provides a mechanism to remove and replace defective hardware on-board trains and any physical data centers. Contractor shall store and have available sufficient quantities of components to support CCJPA's deployed equipment. Contractor shall maintain the spares list and shall make it available to CCJPA on an as-needed basis. Contractor shall train CCJPA resources on the removal and installation of component spares. Contractor shall indicate if any spares or parts are reconditioned as well as the extent of the manufacturer's warranty. Contractor shall provide insurance coverage of spares and verification of coverage for storage facilities. The quantity, distribution, and condition (new or refurbished) of spares are subject to CCJPA's final acceptance.

Contractor shall be responsible for affixing CCJPA asset tags to all Solution equipment prior to assets going into a live production environment. Contractor shall be responsible for logging asset changes in the asset management system for tracking, audit, and depreciation purposes.

Contractor shall have sufficient inventory levels to support CCJPA's contractual SLAs based on the following factors:

- CCJPA's projected deployment schedule;
- Established and documented OEM mean time between failure (MTBF) rates;
- Actual failure rates for similar equipment;
- Expected hours of usage;
- Repair intervals;
- Shipping time to CCJPA;
- Other factors such as age of product, environmental conditions, and equipment anomalies;
- Staging plan for equipment refresh by region;
- Procedures for coordination between help desk and personnel responsible for component replacement;
- Procedures for determining the need for part replacement and how to replace the part.

Contractor shall be responsible for Spares Management and utilize its current process for management of inventory assets. Contractor shall provide for at least 5% of sparing of all equipment to support the O&M

of the Solution. All spares will be stored and managed by Contractor personnel. Contractor shall maintain a secure online system showing the spares inventory which will be available 24/7/365 for CCJPA and Contractor to access. Each spare will document at a minimum the following:

- Manufacturer;
- Model;
- MFR Part Number;
- ESN;
- IMEI (for cellular modems only);
- ICCID (for SIM cards)
- CCJPA asset tag number;
- Firmware Version (where applicable);
- Date Purchased;
- Warranty Date;
- Date Delivered;
- Received by.

5.7.5.2 Spares Management when Providing the Solution as a Service

Where Contractor is providing hardware on a service basis then CCJPA would still require that Contractor provides visibility into the spares management process used for each installed fleet in order to assess preparedness and understand any risks that may affect system availability.

5.7.6 Deliverables for Spares Management

The deliverable documents required for Spare Management are listed and defined as follows:

Document Type	Description
Spares Management Plan	Written set of Spares Management procedures and processes.

5.7.7 Asset Database & Configuration Management

Configuration Management will be a critical component of the Solution's Asset Database. With potentially hundreds of assets in the field, process areas such as Warranty, RMA, Preventative Maintenance, Incident Management, and others rely on this system. Contractor shall be responsible for maintaining the Asset Database and use a Configuration Management Data Base (CMDB) to track Configuration Item (CIs) types and the assets associated with them. The CMDB will contain a record for every hard and soft CI associated with OBN physical components. Contractor shall capture and track attributes associated with each CI. These include but are not limited to:

1. CCJPA Asset Tag Number	24. Name
2. CI ID	25. Contractor Part Number
3. CI Name	26. Number

4. CI Number	27. OEM Part Number
5. CI Type	28. Original Install Date
6. Component	29. Landing Page Content Version
7. Model	30. Installed Location
8. Component Type	31. Project Engineer
9. Configuration Release Date	32. Project Manager
10. Configuration Version	33. Purchase Date
11. Current Install Date	34. Serial Number
12. Customer	35. Source/Supplier
13. EOL	36. Status
14. Equipment Model	37. Sub-component Model
15. Equipment Type	38. Sub-component Type
16. Firmware Release Date	39. Submit Date/Time
17. Firmware Version	40. Submitter
18. Last Edit Date/Time	41. Type
19. Last Edit User	42. Additional Notes
20. MAC Address	43. Warranty End Date
21. Manufacturer	44. Warranty Start Date
22. MBTF Source	45. Expected End-of-Life Date
23. MTBF	46. Raw Cost excluding overheads

Additionally, Contractor shall track the upstream/downstream relationships associated with each CI. This is a critical component of assessing impacts of changes or incidents to other systems or users. Each CI will be assigned a status based on where it resides in the CI lifecycle. The following statii shall be available in the CMDB:

- Ordered;
- Installed;
- Spare;
- Quarantined;
- RMA – Return Materials Authorization;
- BER – Beyond Economical Repair;
- DOA – Dead on Arrival;
- Active;
- Inactive.

Contractor shall provide a detailed description of proposed CI lifecycle management. CCJPA reserves the right to request that Contractor uses a Configuration Management system already in use by CCJPA. CCJPA also reserves the right to migrate Asset Database and Configuration Management services from Contractor responsibility to the CCJPA Wi-Fi Services responsibility with at least 60 days written notice.

6 Appendix A – Acronyms

ATTACHMENT B

SAMPLE AGREEMENT FOR CONSULTING SERVICES

AGREEMENT

Between

CAPITOL CORRIDOR JOINT POWERS AUTHORITY

And

_____

TO PROVIDE

NEXT GENERATION WI-FI SERVICES

CCJPA AGREEMENT NO. _____

2018

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Example Attachments

This is an example contract – as such the attachment references below are for illustrative purposes only. References within this Example Contract Agreement will be modified pursuant to the final form of the contract entered into with the selected Provider.

ATTACHMENT A: SCOPE OF SERVICES

(CCJPA intends to utilize the SCOPE OF SERVICES included as Attachment A to this RFSOQ)

ATTACHEMENT B: KEY PERSONNEL LIST

(No example provided but this would list the Key Personnel for the environmental, initial design, and project management work)

ATTACHMENT C: COMPENSATION LIMITS, FIXED FEE AND ALLOCATION OF FUNDS

(No example provided but this will be based off of the Provisional Cost Reimbursement and Rate Data included as Attachment D and Cost Disclosure Statement D-1 of the RFSOQ)

ATTACHMENT D: PROJECT PROVIDER TEAM

(No example provided but this would mirror the information required in Exhibit 1)

TO PROVIDE

NEXT GENERATION WI-FI SERVICES

CCJPA AGREEMENT NO. _____

Between

CAPITOL CORRIDOR JOINT POWERS AUTHORITY

And

_____

THIS AGREEMENT ("Agreement") is made and entered into this ____ day of _____, 20__, by and between CAPITOL CORRIDOR JOINT POWERS AUTHORITY, a California authority for the joint exercise of power ("CCJPA") and _____("PROVIDER"), with offices at _____.

R E C I T A L S

This Agreement is made with reference to the following facts:

1. CCJPA proposes to obtain a Next Generation Wi-Fi solution on board the California intercity passenger rail service;

2. The Wi-Fi solution and accompanying services provided in this Agreement cannot be performed satisfactorily by the officers and employees of CCJPA;

3. The parties hereto now wish to enter into this Agreement pursuant to which PROVIDER will furnish on-call railroad service planning professional services as hereinafter provided.

* * *

A G R E E M E N T

In consideration of the mutual promises set forth herein and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereto agree as follows:

1.0 WORK TO BE PERFORMED

The parties agree that the work to be performed by the PROVIDER under this Agreement shall be as hereinafter set forth in this Article 1.0;

1.1 SCOPE OF SERVICES

PROVIDER's services are described in Attachment A, SCOPE OF SERVICES, incorporated herein and by this reference made a part hereof. PROVIDER shall be responsible to perform or secure the performance of all requested services in their entirety subject to the prior written approval of work plan(s) ("Work Directive(s)" or "WD(s)") by a designated representative ("Project Director"). The Project Director may designate a different representative for each WD.

1.2 WORK DIRECTIVES

PROVIDER shall provide services to CCJPA for the tasks as described in each WD subject to prior approval in accordance with the following procedures.

A. Work Directive Proposal Request

CCJPA will initiate a WD by transmitting to the PROVIDER a Work Directive Proposal Request ("WDPR") that describes an initial task description and implementation schedule.

B. Work Directive Proposal

PROVIDER will then prepare a detailed Work Directive Proposal ("WDP") and transmit it to CCJPA within the time specified in the WDPR. The WDP shall specify the following:

1. Services to be performed by the PROVIDER (see Article 1.1 above and Attachment A);
2. Management Plan that includes a list of Key Personnel (see Article 1.5 below);
3. Budget Plan including a detailed cost estimate and a cost-loaded schedule;
4. Work Breakdown Structure;
5. Schedule;
6. List of subProviders, their scope of work and estimated value of work;
7. Work products (see Article 1.1 above and Attachment A); and
8. WD project specific procedures (see Article 1.4, below).

C. WDP Evaluation

CCJPA will evaluate the WDP. In its discretion, CCJPA may request PROVIDER to revise and resubmit the WDP.

D. Acceptance of WDP

CCJPA will notify PROVIDER in writing whether a WDP has been accepted. A WDP not accepted in writing shall be deemed rejected.

E. Rejection of WDP

If a WDP or its revision is rejected, neither party shall have any rights or obligations arising out of the WDP or WDPR.

F. Acceptance of WD

Each WD shall be placed into effect by the Project Director and by the acceptance of the PROVIDER. In addition, at any time during the course of the WD performance, the Project Director may revise the WD by project direction, subject to acceptance by PROVIDER.

G. Conflict of Interest

Each WD shall incorporate the provisions of this Agreement by reference. A conflict of interest review will be performed by CCJPA prior to issuing project direction under a WD.

1.3 MANAGEMENT PLAN AND PROCEDURES

A. Management Plan

In response to a WDPR from CCJPA, at a minimum, PROVIDER shall submit with each WDP a list of Key Personnel assigned as defined by Article 1.5 below.

PROVIDER agrees not to make any substitution of subProviders without prior approval of the Project Director after a WDP has been accepted in writing by the Project Director.

B. Management Procedures

Apart from any specific WDs, PROVIDER and those subProviders at any tier that CCJPA at its discretion may identify, shall develop, implement and maintain procedures, all subject to approval by CCJPA's Project Director, who gives direction as to the performance of the work by PROVIDER or subProvider personnel, including, but not limited to, performance of WDs.

The intention of the parties is for PROVIDER or its subProviders, to develop, implement and maintain clear, concise, and project specific procedures to give CCJPA reasonable assurances that all charges for direct labor and other direct costs are relevant and necessary to accomplish the WD scope.

1.4 PROJECT AND ORGANIZATIONAL PROCEDURES

A. Modification of Procedures

At the direction of the Project Director, pursuant to a WD, PROVIDER shall develop or modify previously proposed WD project specific procedures in accordance with a schedule and in a form approved by the Project Director. Such procedures as developed or modified shall be specifically related to activities performed for the WD project and basic PROVIDER functions including, but not limited to, the process of budgeting, invoicing, and submitting reports to CCJPA hereunder. The intention of the parties is for PROVIDER to develop, implement and maintain clear and concise WD project specific procedures.

B. Additional Modifications

In addition to any specific WD project procedures as described immediately above, and apart from any specific WDs, CCJPA may require PROVIDER to revise its WD project procedures other than those set forth immediately above in Article 1.3 that are used throughout its organization if they conflict with the requirements of this Agreement.

1.5 PERSONNEL

A. Key Personnel

PROVIDER and CCJPA agree that the personnel listed in Attachment B, KEY PERSONNEL LIST, incorporated herein and by this reference made a part hereof, shall be designated as Key Personnel. PROVIDER shall also make every effort to insure that the key personnel maintain, at a minimum, _____ percent (__%) of their proportionate share of the estimated number of hours for a WD.

PROVIDER shall not remove any such Key Personnel prior to the completion of his/her assignment under the Project without the prior written approval of the Project Director, which approval will not be unreasonably withheld. PROVIDER shall nominate a replacement individual to CCJPA and shall not remove any individual from the Project until his/her replacement has been approved by the Project Director.

B. Notice of Temporary Assignment

PROVIDER shall provide the Project Director with written notice of the temporary assignment of any personnel to an individual WD Project.

C. Removal of Personnel

CCJPA's Project Director reserves the right to direct removal of any PROVIDER or subProvider personnel assigned to the Project when in CCJPA's opinion the individual's performance is unsatisfactory.

1.6 FINANCIAL ADMINISTRATION

Apart from any specific WDs, PROVIDER and its subProviders at any tier shall establish and maintain records pertaining to the fiscal activities of the Project. PROVIDER's and subProviders' accounting systems shall conform to generally accepted accounting principles and the following requirements:

A. Cost Breakdown

All such records shall provide, at a minimum, a breakdown of total costs charged to the Project, including properly executed payrolls, time records, invoices and vouchers.

B. Labor Charging Procedures

For work performed on a basis other than fixed price, PROVIDER and those subProviders at any tier that CCJPA at its discretion may require, shall develop, implement and maintain labor charging (i.e. time card, or payroll) procedures that meet the following criteria:

1. All time records shall be in writing, recorded by the employee and verified by the immediate supervisor. Such records shall (i) be complete, (ii) record all employee's activities, Project and non-Project related, within a given accounting period and (iii) identify by means of cost codes what activities were being performed.

2. All charges for labor (direct/indirect or hourly as appropriate) by personnel for the Project shall be identifiable to the nearest half-hour.

C. "California Public Employees" Retirement System (CalPERS) Compliance

To ensure compliance with state laws and regulations related to membership in CalPERS, PROVIDER shall comply with the following requirements:

1. Written verifications regarding prior service at a CalPERS agency:

   a. Prior to assigning an additional Provider to this Agreement, PROVIDER shall request that the individual verify in writing:

      1. Whether or not the individual has previously worked for a CalPERS employer; and
      2. Whether or not the individual is a CalPERS retired annuitant.

2. CalPERS members - Employee contribution to CalPERS:

   a. If the individual to be assigned to the position verifies that he or she has previously worked for a CalPERS employer and is not a retired annuitant, PROVIDER shall require the individual to acknowledge in writing that if he or she is a CalPERS member, the employee contribution to CalPERS shall be deducted from each paycheck while performing work under this Agreement.

3. Limitations on Hours:

   a. Retired annuitant: If the individual to be assigned to this Agreement verifies that he or she has previously worked for a CalPERS employer and is a CalPERS retired annuitant, PROVIDER shall monitor the individual's work hours to ensure that the individual does not exceed 960 hours per fiscal year. PROVIDER shall inform the Project Director in writing as soon as the individual accrues 900 hours, in order to allow for timely replacement.

   b. No previous service at a CalPERS employer: If the individual to be assigned to perform work under this Agreement verifies that he or she

has not previously worked for a CalPERS employer, PROVIDER shall monitor the individual's work hours to ensure that the individual does not exceed 1000 hours per fiscal year. PROVIDER shall inform the Project Director in writing as soon as an individual accrues 900 hours, in order to allow for timely replacement.

4. PROVIDER Certification

a. PROVIDER shall certify in writing that the hours of the individual performing work under this Agreement does not exceed the limitations set forth above (i.e., 960 hours per fiscal year if the individual is a CalPERS retired annuitant, or 1000 hours per fiscal year if the individual has not previously worked for a CalPERS employer). Such certification shall be submitted monthly with each invoice.

D. Cost Reimbursement Services

For those services performed on a cost reimbursable basis by PROVIDER and those subProviders at any tier that CCJPA at its discretion may require, the following shall apply:

1. For all indirect cost groupings, budgets shall be developed on an annual basis which coincide with the entity's fiscal year.

2. The system of accounting shall at a minimum, (i) report on a quarterly basis, a comparison between the actual indirect costs incurred to that budgeted, and (ii) reconcile all compensation for direct costs including, but not limited to, payroll, inventory and accounts payable against incurred cost, as set forth in Article 3.1, COMPENSATION.

E. Approval of Procedures

CCJPA's Project Director (i) may approve existing procedures that meet these criteria as well as waive certain specific requirements of this Article (provided that such approvals or waivers are made in writing); or (ii) may require copies of any of this accounting material, records, reports or procedures.

2.0 TIME OF PERFORMANCE AND DELAYS

2.1 TIME OF PERFORMANCE

A. Performance of Scope of Service

PROVIDER's performance of SCOPE OF SERVICES as described in Attachment A shall commence upon receipt of a Notice to Proceed issued by CCJPA for each respective WD and shall be completed within the number of calendar days specified in such WD, unless terminated earlier in accordance with Article 5.0, TERMINATION, or if the limit on maximum compensation established in Article 3.1, COMPENSATION, is reached.

B. Term of Agreement

The term of this Agreement will be two (2) years from the date of execution of this Agreement, subject to termination as provided for in the Agreement.

2.2 DELAYS

Neither party hereto shall be considered in default in the performance of its obligations hereunder to the extent that the performance of any such obligation is prevented or delayed by unforeseen causes including acts of God, acts of the public enemy and governmental acts beyond the control and without fault or negligence of the affected party.

Each party hereto shall give notice promptly to the other of the nature and extent of any such circumstances claimed to delay, hinder or prevent performance of any obligations under this Agreement.

3.0 COMPENSATION AND PAYMENT

3.1 COMPENSATION

A. Basis

The compensation for each WD performed under this Agreement will be on a fixed price basis, an incurred cost reimbursement basis plus a fixed fee, or some combination thereof. Such compensation will be allowable only to the extent that costs incurred or cost estimates included in negotiated, or otherwise established prices, are consistent with the Federal Cost Principles (Title 48, Code of Federal Regulations, Chapter 1, Part 31).

B. Requirements

Such compensation shall be further subject to the following requirements:

1. Conform with:

   a. the work to be performed pursuant to an accepted WD;

   b. any compensation limits or sub-limits set forth in such WD(s), and this Agreement; and

   c. all other terms of this Agreement.

2. Be necessary in order to accomplish the work.

3. Be reasonable for the services to be performed or goods to be purchased in connection with the performance of services hereunder.

4. Be actual net costs or prices to the PROVIDER or its subProviders at any tier, (e.g. the cost or price less any refunds, rebates, or other items of value received by PROVIDER or its subProviders at any tier, that have the effect of reducing the cost or price actually incurred).

   As used herein, the term “costs” shall include the following:

a. Those costs recorded by PROVIDER that result, at the time of the request for reimbursement, from payment by cash, check, or other form of actual payment for items or services purchased directly for the work.

b. When PROVIDER is not delinquent in payment of costs of agreement performance in the ordinary course of business, costs incurred, but not necessarily paid, for:

(1) Direct labor;
(2) Other direct costs that are not subcontracted;
(3) Indirect costs.

c. The amount of reimbursement that has been paid by PROVIDER for subcontracted services under similar cost standards.

5. Be for direct costs or prices incurred for work performed after the effective date of this Agreement, and presented for payment within one hundred eighty days (180) days of the incurrence.

C. Rate Agreement

In addition to these requirements, the parties will negotiate in good faith and enter into a Provisional Cost Reimbursement and Rate Agreement ("Rate Agreement") on an annual or multi-year basis for the work to be performed for each PROVIDER fiscal year(s). At the end of the annual or multi-year period, either party may request a rate adjustment subject to negotiation between the parties and modification to the Rate Agreement. Should the parties fail to negotiate a new Rate Agreement, PROVIDER agrees to accept the provisions of the previous Rate Agreement until such time as a new Rate Agreement is executed. If neither party requests a rate adjustment, the rates contained therein shall remain in effect until completion of Agreement No. ____-___.

D. Notification

The PROVIDER shall inform the Project Director when total expenditures for all approved WDs exceed ____ percent (__%) of the maximum compensation for this Agreement.

E. PROVIDER Costs

All PROVIDER costs associated with providing services that are identified in this Agreement as being apart and separate from any individual WD, are considered to be either indirect costs or a portion of the PROVIDER fee, as the case may be.

F. Compensation Limits

Subject only to changes made in conformance with Article 4.0, CHANGES AND MODIFICATIONS, below, it is expressly understood and agreed that:

1. In no event shall PROVIDER be compensated in an amount greater than the amount in an individual WD, for services performed under such WD; and

2. In no event will the total compensation and reimbursement for expenses to be paid PROVIDER for services described in Article 1.1, SCOPE OF

SERVICES, above and services described in Attachment A hereto, exceed One Million Dollars ($1,000,000).

3.2 DISALLOWED OR OTHERWISE UNRECOGNIZED COSTS

PROVIDER understands and agrees to the following:

A. Waiver

Any compensation or reimbursement received under this Agreement does not constitute a final decision by the CCJPA as to the allowability of such compensation or reimbursement and does not constitute a waiver of any violation by PROVIDER of the terms of this Agreement (including, but not limited to, requirements of the Agreement to be included in PROVIDER's subcontracts).

B. Final Determination

Unless approved otherwise by the Project Director, the CCJPA will not make final determination about the allowability of compensation or reimbursement of cost received under this Agreement until an audit of this work performed under this Agreement has been completed.

C. Notification

If the CCJPA determines that PROVIDER or its subProvider(s) is not entitled to either the compensation or reimbursement requested or received, the CCJPA will notify PROVIDER stating the reasons therefor.

D. Return of Funds

Completion of the work under this Agreement will not alter PROVIDER's or its subProvider(s)' obligation to return any funds due the CCJPA as a result of later refunds, corrections, or other transactions, nor alter the CCJPA's right to disallow or otherwise not recognize costs on the basis of a later audit or other review.

3.3 METHOD OF PAYMENT

A. Monthly Invoices/SubProvider Payment

Unless approved otherwise by the Project Director, PROVIDER's services shall be invoiced on a monthly basis and payment will be made within thirty (30) calendar days of receipt of an acceptable invoice with satisfactory backup documentation, approved by the Project Director, provided a completed form W-9 is on file with CCJPA. As used herein, the term "invoice" shall include the PROVIDER's bill or written request for payment under this Agreement for services performed. All invoices shall be made in writing and submitted with two duplicates at a minimum.

PROVIDER shall promptly pay any and all subProviders by an instrument that guarantees availability of funds immediately upon deposit of said instrument. The PROVIDER shall include in its monthly invoice submission to CCJPA, amounts to pay for all subProviders' acceptable invoices, no later than thirty (30) days after receipt of such invoices. Unless otherwise approved in writing by the Project Director, PROVIDER shall, within ten (10) calendar days after receipt of the payment made by CCJPA, pay to each of its immediate subProviders (or their respective assignees), for satisfactory performance of its contract, the amounts to which each is entitled, after

deducting any prior payments and any amounts due and payable to PROVIDER by those subProviders. Any delay or postponement of payment among the parties may take place only for good cause and with the CCJPA's prior written approval. If the PROVIDER determines the work of the subProvider to be unsatisfactory, the PROVIDER must immediately notify in writing the Project Director and state the reasons therefor. Failure by PROVIDER to comply with this requirement will be construed to be a breach of contract and may result in sanctions as specified in this Agreement.

In addition, the PROVIDER must promptly return any retentions withheld to a subProvider within thirty (30) days after the subProvider's work is satisfactorily completed.

B. Invoice Procedures

PROVIDER shall invoice for the then current WD in conformance with procedures approved by the Project Director and the then current Rate Agreement.

1. Such invoices shall segregate current costs from other costs. Current costs are those costs which have been paid within the last sixty (60) calendar days and not previously submitted to CCJPA for reimbursement. Other costs shall include, but not be limited to, the following:

    a. Costs for which the CCJPA has requested additional justification for allowance;

    b. Costs which have been recorded by PROVIDER in the current accounting period and not incurred as an obligation within the last ninety (90) calendar days.

2. Costs for individual labor shall be identified by activity and product in a manner consistent with that of the detailed cost estimate submitted with PROVIDER's WDP.

3. Notwithstanding the above, in no case shall PROVIDER invoice for costs which CCJPA has disallowed or otherwise indicated that it will not recognize.

C. Invoice Requirements

Such invoices shall be, at a minimum, (i) mechanically accurate, (ii) substantially vouchered and properly supported and (iii) in compliance with the specific requirements of Article 1.6, FINANCIAL ADMINISTRATION above.

D. Certification

PROVIDER shall also certify, for each invoice, that (i) the hourly rates for direct labor, whether for PROVIDER or its subProvider(s), to be reimbursed under this Agreement are not in excess of the actual hourly rates in effect for PROVIDER or subProvider employees engaged in the performance of services under this Agreement at that time, and (ii) that such hourly rates are in conformance with the then current Rate Agreement.

E. Fixed Fee

The fixed fee for PROVIDER or any of its subProviders shall be billed monthly on a percent complete basis as approved by the Project Director.

CCJPA in its sole discretion may make any of the remaining fixed fee payments due PROVIDER, or any of its subProviders, in full; or may withhold any amount up to one hundred percent (100%) thereof as CCJPA may find appropriate, based on the progress of PROVIDER and/or any of its subProviders.

F. Invoice Submittal Address

All invoices, indicating this Agreement name and number, shall be made in writing and delivered or mailed to CCJPA as follows:

By email (preferred): ap_supplier@bart.gov

By US mail: Capitol Corridor Joint Powers Authority
300 Lakeside Drive
14th Floor East
Oakland, CA 94612

G. Taxpayer Identification Number

PROVIDER represents that PROVIDER's taxpayer identification number (TIN) is evidenced by a completed Federal Form W-9 on file with CCJPA on the date of execution of this Agreement. PROVIDER agrees to file such tax forms as may be reasonably requested by CCJPA to implement Internal Revenue Code Section 3406 and to accept as a part of any compensation due, any payments made by CCJPA to the Internal Revenue Service pursuant to that Section.

3.4 WITHHOLDING OF PAYMENT

CCJPA reserves the right to withhold payment(s) otherwise due PROVIDER in the event of PROVIDER's material non-compliance with any of the provisions of this Agreement, including, but not limited to, the requirements imposed upon PROVIDER in Article 6.0, INSURANCE; Article 8.0, INDEMNIFICATION; and Article 9.1, WARRANTY OF SERVICES, below. CCJPA shall provide notice of withholding, and may continue the withholding until PROVIDER has provided evidence of compliance which is acceptable to CCJPA.

4.0 CHANGES AND MODIFICATIONS

CCJPA reserves the right to order changes to this Agreement, and modifications to WDs, to be performed pursuant to this Agreement, as set forth below.

4.1 CHANGES

A. Services

CCJPA reserves the right to order changes to this Agreement including but not limited to, the services to be performed by PROVIDER. All such changes shall be incorporated in written change orders duly executed by CCJPA and PROVIDER, which shall specify the changes ordered and the adjustment of compensation and completion time required therefor.

B. Execution

Any such services added to the scope of this Agreement by a change order shall be executed under all applicable conditions of this Agreement. No claim for additional

compensation or extension of time shall be recognized unless contained in a duly executed change order.

4.2 MODIFICATIONS

A. Work Directive Modifications

CCJPA reserves the right to order modifications to WDs, including but not limited to, the services to be performed by PROVIDER pursuant to an accepted WD. All such modifications to a WD shall be incorporated in written WDMs, executed by the Project Director and the PROVIDER, which shall specify the modifications ordered and the adjustment of compensation and completion time required therefor.

B. Additional Compensation

Any such services added to the scope of this Agreement by a Work Directive Modification ("WDM") shall be executed under all applicable conditions of this Agreement. No claim for additional compensation or extension of time with respect to a WD shall be recognized unless contained in a duly executed WDM. The parties also understand and agree that PROVIDER will not be reimbursed for costs incurred prior to the effective date of a duly executed WDM.

5.0 TERMINATION

5.1 TERMINATION FOR CONVENIENCE

CCJPA may, at any time prior to completion of the work under any WD or the work under this Agreement, terminate any such WD, or this Agreement whenever CCJPA determines that such termination is in its best interest, by written notice to PROVIDER. CCJPA's written notice to PROVIDER shall state in detail the extent of such termination with respect to WD, or this Agreement. Effective on receipt of such notice of termination from CCJPA, no new work or obligation with respect to such WDs, or this Agreement will be undertaken by PROVIDER unless so directed by CCJPA in writing. Upon such termination, PROVIDER shall submit an invoice or invoices to CCJPA in amounts which represent the compensation specified herein for services actually performed to the date of such termination and for which PROVIDER has not been previously compensated. Upon payment of the amount due, CCJPA shall be under no further obligation to PROVIDER, financial or otherwise, with respect to terminated WDs, or this Agreement if it is terminated.

5.2 TERMINATION FOR CAUSE

If PROVIDER should be in default and fails to remedy this default within five (5) calendar days after receipt from CCJPA of notice of such default, CCJPA may in its discretion terminate this Agreement or such portion thereof as CCJPA determines is most directly affected by the default.

The term "default" for purposes of this provision includes, but is not limited to, the performance of work in violation of the terms of this Agreement; abandonment, assignment or subletting of the Agreement without approval of CCJPA; bankruptcy or appointment of a receiver for PROVIDER's property; failure of PROVIDER to perform the services or other required acts within the time specified for this Agreement or any extension thereof; refusal or failure to provide proper workmanship; failure to take effective steps to end a prolonged labor dispute; and the performance of this Agreement in bad faith.

Upon CCJPA's termination of this Agreement or any portion thereof for default by PROVIDER, CCJPA reserves the right to complete the work by whatever means it deems expedient and the expense of completing such work as well as any and all damages proximately caused by the default shall be charged to PROVIDER.

5.3 FORCE MAJEURE

The performance of work under this Agreement may be terminated by CCJPA, in its discretion, upon application therefor by PROVIDER for unforeseen causes beyond the control and without the fault or negligence of PROVIDER, including acts of God, acts of the public enemy, governmental acts, fires and epidemics if such causes irrevocably disrupt or render impossible PROVIDER's performance hereunder. An "act of God" shall mean an earthquake, flood, cyclone, or other cataclysmic phenomenon of nature beyond the power of PROVIDER to foresee or make preparation in defense against.

6.0 INSURANCE

At all times during the life of this Agreement to acceptance of the work covered by the Agreement, or as may be further required by the Agreement, PROVIDER, at its own cost and expense, shall provide the insurance specified in this Article 6.0, unless otherwise approved in advance and in writing by the Project Director.

A. Evidence Required

At or before execution of this Agreement and at such other times as the CCJPA may request, PROVIDER shall provide the CCJPA with Certificate(s) of Insurance executed by an authorized representative of the insurer(s) evidencing the PROVIDER's compliance with the insurance requirements in this Article 6.0. The Certificate(s) shall reference the CCJPA's Agreement Number and Title to which the Certificate relates. In addition, a copy of all required endorsements shall be included with and attached to the Certificate(s) of Insurance.

B. Notice of Cancellation, Reduction or Material Change in Coverage

All policies shall be endorsed to provide the CCJPA with thirty (30) calendar days prior written notice of any cancellation, reduction, or material change in coverage. The San Francisco Bay Area Rapid Transit District ("BART") is the managing agency of the CCJPA. Accordingly, all notices shall be sent to BART's Department Manager, Insurance, San Francisco Bay Area Rapid Transit District, P.O. Box 12688, Oakland, California, 94604-2688. The PROVIDER shall annually submit to the BART's Department Manager, Insurance, certifications confirming that the insurance required has been renewed and continues in place.

C. Qualifying Insurers

Policies shall be issued by California admitted companies which hold a current policyholders alphabetic and financial size category rating of not less than A:VIII according to Best's Insurance Reports.

D. Insurance Provided by PROVIDER

1. Commercial General Liability Insurance for bodily injury (including death) and property damage which provides limits of Five Million Dollars ($5,000,000) per occurrence and Five Million Dollars ($5,000,000) annual general aggregate.

a. Coverage shall include:

(1) Premises and Operations;

(2) Broad Form Property Damage;

(3) Products and Completed Operations;

(4) Broad Form Contractual liability, expressly including liability assumed under the Agreement;

(5) Personal Injury Liability;

(6) Independent Contractors Liability;

(7) Cross Liability and Severability of Interest.

b. Such insurance shall include the following endorsements, copies of which shall be provided to the BART's Department Manager, Insurance:

(1) Inclusion of the CCJPA and BART as managing agency and their directors, officers, representatives, agents and employees as additional insured as respects to PROVIDER's operations under this Agreement; and

(2) Stipulation that the insurance is primary insurance and that no insurance or self-insurance of the CCJPA will be called upon to contribute to a loss.

2. Automobile Liability Insurance for bodily injury (including death) and property damage which provides limits of liability of not less than One Million Dollars ($1,000,000) combined single limit per occurrence applicable for all owned, non-owned and hired vehicles.

3. Workers' Compensation/Employers' Liability Insurance for Statutory Workers' Compensation and Employers' Liability Insurance for not less than One Million Dollars ($1,000,000) per accident applicable to Employers' Liability coverage for all employees engaged in services or operations under this Agreement. The policy shall include Broad Form All States/Other States coverage. Coverage shall be specifically endorsed to include the insurer's waiver of subrogation in favor of the CCJPA and BART as managing agency and their directors, officers, representatives, agents and employees; a copy of which shall be provided to the BART's Department Manager, Insurance. Should any such work be subcontracted, PROVIDER shall require each subProvider of any tier to similarly comply with this Article 6.0, all in strict compliance with Federal and State law.

4. Professional Liability Insurance for damages arising out of PROVIDER's acts, errors or omissions. The policy shall provide a coverage limit of not less than Five Million Dollars ($5,000,000) per claim/aggregate as respects PROVIDER's services provided under this Agreement. Such insurance shall be maintained for a period of not less than two (2) years following completion of services.

E. Special Provisions

1. The foregoing requirements as to the types and limits of insurance coverage to be maintained by PROVIDER, and any approval of said insurance by the CCJPA is not intended to and shall not in any manner limit or qualify the liabilities and obligations otherwise assumed by PROVIDER pursuant to this Agreement including but not limited to the provisions concerning indemnification.

2. The CCJPA acknowledges that some insurance requirements contained in this article may be fulfilled by a funded self-insurance program of PROVIDER. However, this shall not in any way limit liabilities assumed by PROVIDER under this Agreement. Any self-insurance program must be approved in writing by the BART's Department Manager, Insurance.

3. Should any of the work under this Agreement be subcontracted, PROVIDER shall require each of its subProvider(s) of any tier to provide the aforementioned coverage's, or PROVIDER may insure subProviders(s) under its own policies.

4. CCJPA reserves the right to withhold payments to PROVIDER in the event of material noncompliance with the insurance requirements of this Article 6.0.

5. CCJPA reserves the right to terminate this Agreement in the event of material noncompliance with the insurance requirements of this Article 6.0.

7.0 INDEPENDENT CONTRACTOR

PROVIDER is an independent contractor and not an employee or agent of CCJPA and has no authority to contract or enter into any other agreement in the name of CCJPA. PROVIDER has, and hereby retains, full control over the employment, direction, compensation and discharge of all persons employed by PROVIDER who are assisting in the performance of services under this Agreement. PROVIDER shall be fully responsible for all matters relating to the payment of its employees, including compliance with social security, withholding tax and all other laws and regulations governing such matters. PROVIDER shall be responsible for its own acts and those of its agents and employees during the term of this Agreement.

In its capacity as an independent contractor, PROVIDER shall comply with any and all CCJPA operations rules and procedures which relate to the performance of its services on CCJPA property.

7.1 CONFLICT OF INTEREST

PROVIDER, its subProviders and suppliers shall perform all work under this Agreement in conformance with all applicable statutes and regulations pertaining to conflicts of interest, including but not limited to, the financial reporting requirements and the conflict prohibitions of federal law (see, e.g., Federal Transit Administration Circular 4220.1F, Third Party Contracting Requirements) and California law (see, e.g., Government Code Section 1090 et seq., Government Code Section 87100 et seq. and Title 2, Division 6 of the California Code of Regulations).

When, in the judgment of CCJPA, it is necessary in order to avoid any potential conflicts of interest, PROVIDER, its subProviders and suppliers may be precluded from subsequently participating as a vendor or contractor on projects for which they are providing services under this Agreement.

7.2 PROVIDER PERSONNEL

PROVIDER shall ensure that any person employed by PROVIDER, whose duties include work on matters involving CCJPA, is made aware that he or she is required to disclose immediately to PROVIDER any offer of employment from any person or entity currently doing business with CCJPA or proposing to do business with CCJPA. PROVIDER shall immediately so notify the Project Director, and ensure that unless, and until the offer of employment is unequivocally rejected by PROVIDER's employee in writing and a copy of this rejection is transmitted to the Project Director, PROVIDER shall remove such employee from any projects or services relating to CCJPA. Failure of PROVIDER to comply with the provisions of this section may result in termination of this Agreement by CCJPA for default upon written notice to PROVIDER.

8.0 INDEMNIFICATION

PROVIDER to the extent permitted by law, shall defend, indemnify and hold harmless CCJPA and BART as managing agency and their directors, officers, agents and employees from all claims, demands, suits, loss, damages, injury and liability, direct or indirect (including reasonable attorney's fees, and any and all costs and expenses in connection therewith), incurred by reason of any act, or failure to act, of PROVIDER, its officers, agents, employees and subProviders or any of them, under or in connection with this Agreement; and PROVIDER agrees at its own cost, expense and risk to defend any and all claims, actions, suits, or other legal proceedings brought or instituted against CCJPA and BART as managing agency and their directors, officers, agents and employees, or any of them, arising out of PROVIDER's services, and to pay and satisfy any resulting judgments.

Such indemnification includes without limitation any violation of proprietary rights, copyrights and rights of privacy, arising out of the publication, translation, reproduction, delivery, use or disposition of any data furnished under this Agreement.

9.0 WARRANTY OF SERVICES AND MATERIAL NONCOMPLIANCE BY PROVIDER

9.1 WARRANTY OF SERVICES

A. Warranty

PROVIDER warrants that its consulting services will be performed in accordance with the standards imposed by law upon professional engineering service firms performing engineering services of a similar nature at the time such services are rendered. In addition PROVIDER shall provide such specific warranties as may be set forth in individual WDs as agreed upon by the parties.

B. Re-performance

In the event that any services provided by PROVIDER hereunder are deficient because of PROVIDER's or a subProvider's failure to perform said services in accordance with the warranty standards set forth above, CCJPA shall report such deficiencies in writing to PROVIDER within a reasonable time. CCJPA thereafter shall have:

1. The right to have PROVIDER re-perform such services at PROVIDER's own expense, or

2. The right to have such services done by others and the costs thereof charged to and collected from PROVIDER if, within thirty (30) calendar days

after written notice to PROVIDER requiring such reperformance, PROVIDER fails to give evidence satisfactory to CCJPA that it has undertaken such reperformance.

C. Re-performed Services

If PROVIDER is required to correct or re-perform any services as provided in Article 9.1 B.1. (immediately above), any services corrected or re-performed by PROVIDER shall be subject to this Article 9.1 to the same extent as work initially performed.

9.2 MATERIAL NONCOMPLIANCE BY PROVIDER

CCJPA reserves the right to withhold payments to PROVIDER in the event of PROVIDER's material noncompliance with Articles 8.0, INDEMNIFICATION and 9.0, WARRANTY OF SERVICES AND MATERIAL NONCOMPLIANCE BY PROVIDER, above.

10.0 DATA TO BE FURNISHED BY CCJPA

All data, reports, surveys, studies, drawings, and any other documents and materials made available to PROVIDER by CCJPA for use by PROVIDER in the performance of its services under this Agreement shall be made available for information only and shall be returned to CCJPA at the completion or termination of this Agreement.

11.0 OWNERSHIP OF WORK PRODUCTS

11.1 DOCUMENTS

All drawings, designs, specifications, manuals, reports, studies, surveys, models, software (including source code), and any other documents, materials, data and products ("Work Products") prepared or assembled by PROVIDER or obtained from others ("Subcontractors") by PROVIDER in connection with the services under this Agreement shall be the property of CCJPA; and copies shall be delivered to CCJPA promptly upon the completion of the work or upon an earlier termination of this Agreement. PROVIDER shall be responsible for the preservation of any and all Work Products prior to transmittal to CCJPA; and PROVIDER shall replace any such Work Products as are lost, destroyed or damaged while in its possession without additional cost to CCJPA.

11.2 ASSIGNMENT OF RIGHTS

PROVIDER hereby assigns to CCJPA all right, title and interest including, but not limited to, copyright, patent, trademark and trade dress rights, in and to the Work Products. PROVIDER acknowledges CCJPA's exclusive rights to reproduce, publish, display, create derivative works from, sell, transfer or otherwise exploit ("Use"), and permit others to Use all or any part of the Work Products, and to obtain and hold in its own name patents, copyright and/or trademark registrations for the Work Products. PROVIDER shall provide all documentation, information and assistance reasonably required by CCJPA to obtain such registrations or patents, or with respect to claims that third parties have infringed the Work Products.

11.3 WARRANTY OF WORK PRODUCT

PROVIDER warrants and represents that the Work Products are original to PROVIDER or its Subcontractors and shall not infringe the copyright, trademark, trade secret, privacy, publicity, patent or other intellectual property or proprietary rights of any third party; PROVIDER will not attempt to license or transfer to any person or entity any interest in the Work Products; and PROVIDER shall obtain from all Subcontractors written assignment of all rights, title and

interest, including copyright and other intellectual property rights, in their contributions to the Work Products.

12.0 PATENTS

PROVIDER agrees to communicate promptly to CCJPA full particulars with respect to any and all improvements and inventions (whether or not patentable) conceived by it in connection with work performed by it hereunder. Subject to rights due to the United States Government under a grant of the FTA, if any, assisting the financing under this Agreement, such improvements and inventions shall become the property of CCJPA and PROVIDER agrees to assign to CCJPA, upon CCJPA's request, all of its right, title and interest in and to ideas and inventions and in and to any and all patents and applications for patents based thereon, including both United States and foreign patents and applications for patents. PROVIDER further agrees, upon CCJPA's request and at CCJPA's expense, to execute such proper instruments and to perform such proper acts as may be deemed by CCJPA necessary to evidence CCJPA's title to said improvements and inventions, and to enable CCJPA to obtain such patents and any continuations, reissues or extensions thereof.

13.0 MATTERS CONFIDENTIAL AND PRIVILEGED

All of the drawings, designs, specifications, manuals, reports, studies, surveys, models, or other data and products prepared or assembled by PROVIDER, obtained from others by PROVIDER or made available to PROVIDER by CCJPA in connection with the services under this Agreement , shall be treated as confidential by PROVIDER. At no time shall PROVIDER use or disclose or make available, other than in the performance of PROVIDER's services for CCJPA, confidential information gained in the course of or by reason of PROVIDER's retention by CCJPA and/or performance of services for CCJPA, nor shall PROVIDER permit such use or disclosure, without prior written approval by CCJPA. It is the intention of CCJPA to preserve and make use of all applicable legal privileges, and PROVIDER shall make all reasonable efforts to cooperate with CCJPA in this regard.

14.0 SUBCONTRACTS

A. Approved Subcontracts

PROVIDER shall use approved subProviders as shown in Attachment PCT (Project Provider Team) hereto and as listed in each WD. PROVIDER shall not further subcontract all or any portion of its services under this Agreement or a WD without the prior written approval of the Project Director and any attempt to do so shall be void and unenforceable. Written approval by the Project Director of use of a subProvider for specified services in connection with one WD or project shall not constitute approval for any other purpose. In the event that PROVIDER enters into one or more subcontracts pursuant to this Article, it is understood and agreed that the participating subProviders shall be solely and directly responsible to PROVIDER, and CCJPA shall have no obligation to them.

B. Subcontract Provisions

PROVIDER agrees that the requirements in: Articles 1.3 B, 1.4, 1.5, 1.6, 3.1A, 3.1B, 3.2 and 4.0 through 31.0, inclusive, of this Agreement, will be included in every subcontract entered into relating to services under this Agreement. Upon request, the PROVIDER shall provide CCJPA with copies of all such subcontracts, with changes and amendments thereto.

15.0 ASSIGNMENT OF AGREEMENT

PROVIDER shall not assign this Agreement, or any part thereof, without the prior express written consent of the Project Director, and any attempt to do so shall be void and unenforceable.

16.0 RECORDS

PROVIDER shall maintain full and adequate records to show the actual time devoted and the cost incurred by PROVIDER with respect to the performance of services under this Agreement.

PROVIDER and its subProviders shall establish and maintain records pertaining to the fiscal activities of the Project. PROVIDER's and subProviders' accounting systems shall conform to generally accepted accounting principles and all records shall provide a breakdown of total costs charged to the Project, including properly executed payrolls, time records, invoices and vouchers.

17.0 AUDIT

PROVIDER and its subProviders shall permit CCJPA and its authorized representatives to inspect, examine, make excerpts from, transcribe, and copy PROVIDER's and subProvider's books, work, documents, papers, materials, payrolls, records, accounts, and any and all data relevant to this Agreement at any reasonable time for the purpose of auditing and verifying statements, invoices or bills submitted by PROVIDER pursuant to this Agreement, and shall provide such assistance as may be reasonably required in the course of such inspection including, but not limited to, the following:

A. Audit Interviews

PROVIDER shall arrange audit entrance and exit interviews in which PROVIDER and/or its subProviders and CCJPA and/or its authorized representatives will participate.

B. Accessing Documents

PROVIDER's and its subProviders' accounting divisions shall provide instruction to CCJPA on accessing documents.

C. Letter of Representation

PROVIDER's management, or the management of a subProvider, as well as the management of their appropriate units, will provide at CCJPA's request a letter of representation concerning such matters as CCJPA determines appropriate.

CCJPA further reserves the right, for itself and its authorized representatives, to examine and re-examine said books, work, documents, papers, materials, payrolls, records, accounts and data during the three-year period following the final payment under this Agreement and until all pending matters are closed; and PROVIDER and its subProviders shall in no event dispose of, destroy, alter or mutilate said books, work, documents, papers, materials, payrolls, records, accounts and any and all data

in any manner whatsoever for three (3) years after the final payment under this Agreement, or until all pending matters are closed, whichever is later.

Pursuant to California Government Code Section 8546.7, the parties to this Agreement shall be subject to the examination and audit of the State Auditor, at the request of CCJPA or as part of any audit of CCJPA by the State Auditor, for a period of three (3) years after final payment under this Agreement. The examination and audit shall be confined to those matters connected with the performance of this Agreement, including, but not limited to, the cost of administering this Agreement.

18.0 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA

If any price, including profit or fee, negotiated in connection with, or any reimbursement of cost including profit or fee, under this Agreement, any WD, modifications thereto, Rate Agreement or change order to this Agreement was increased because PROVIDER furnished cost or pricing data that were not complete, accurate, and current at such time as the price was determined, the price or cost shall be reduced accordingly and the Agreement, WD(s), Rate Agreement(s), or change order(s) and any applicable invoice(s) shall be modified to reflect the reduction.

If CCJPA determines that a price or cost reduction should be made, PROVIDER agrees not to raise the following matters as a defense:

A. Bargaining Position

PROVIDER was the sole source supplier or otherwise was in a superior bargaining position and thus the price would not have been modified even if accurate, complete and current costs or pricing data had been submitted;

B. Cost and Pricing Data

CCJPA should have known that the cost or pricing data in issue were defective even though PROVIDER took no affirmative action to bring the character of the data to the attention of CCJPA;

C. Item Cost

The price was based on an agreement about the total cost of the work and there was no agreement about the cost of each item procured under the Agreement.

19.0 NOTICES

Except for invoices submitted by PROVIDER pursuant to Article 3.0, COMPENSATION AND PAYMENT, above, and insurance notices submitted pursuant to Article 6.0 B., Notice of Cancellation, Reduction or Material Change in Coverage, above, all notices required hereunder or other communications to either party by the other may be given by personal delivery, U.S. Mail, courier service (such as Federal Express) or facsimile transmission. Notices shall be effective upon receipt at the following addresses:

To CCJPA by US Mail:	District Secretary San Francisco Bay Area Rapid Transit District P.O. Box 12688 Oakland, California 94604-2688 Attention: CCJPA Contract Administrator
To CCJPA by Personal Delivery or Courier	District Secretary San Francisco Bay Area Rapid Transit District 300 Lakeside Drive, 21st Floor Oakland, CA 94612 Attention: CCJPA Contract Administrator
To PROVIDER:	To be determined Attention: To be determined Project Manager
Facsimile Transmission:	
To CCJPA:	(510) 464-6501
To PROVIDER:	To be determined

Either party may change its address for notices by giving written notice of the new address as provided above.

20.0 NONDISCRIMINATION

The PROVIDER or subProvider shall not discriminate on the basis of race, color, national origin or sex in the performance of this Agreement. The PROVIDER shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of U.S. Department of Transportation-assisted contracts. Failure by the PROVIDER to carry out these requirements is a material breach of this Agreement, which may result in the termination of this Agreement or such other remedy as the CCJPA deems appropriate.

In connection with the performance of services under this Agreement, PROVIDER shall not, on the grounds of race, religious creed, color, national origin, ancestry, handicap, medical condition, marital status, sex, sexual orientation or age, discriminate or permit discrimination against any person or group of persons in any manner prohibited by Federal, State or local laws.

For purposes of this Article “sexual orientation” shall mean a preference for heterosexuality, homosexuality or bisexuality; or having a history of, or being identified with, any such preference.

21.0 LAWS AND REGULATIONS

PROVIDER shall comply with any and all laws, statutes, ordinances, rules, regulations, and procedural requirements of any national, state or local government, and of any agency of such government, including CCJPA, which relate to or in any manner affect the performance of this Agreement. This Agreement and any documents supplied hereunder are subject to public inspection of the California Public Records Act, California Government Code Section 6250 et seq., unless exempted by law.

22.0 ADDITIONAL FUNDING AGREEMENT REQUIREMENTS

This Agreement is subject to any additional restrictions, limitations or conditions that may be required by any local, State or Federal funding agreements applicable to this Agreement.

23.0 CHOICE OF LAW

All questions pertaining to the validity and interpretation of this Agreement shall be determined in accordance with the laws of the State of California applicable to agreements made and to be performed within the State, without reference to conflicts of law principles.

24.0 SEVERABILITY

If any provision of this Agreement is held by a court of competent jurisdiction to be invalid, void, or unenforceable, the remaining provisions shall nevertheless continue in full force without being impaired or invalidated in any way.

25.0 COVENANT AGAINST CONTINGENT FEES

PROVIDER warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by PROVIDER for the purpose of securing business. For breach or violation of this warranty, CCJPA will have the right to annul this Agreement without liability, or at its discretion, to deduct from the Agreement price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage or contingent fee.

26.0 COVENANT AGAINST GRATUITIES

PROVIDER warrants that it will not and has not offered or given gratuities in the form of entertainment, gifts or otherwise, to any director, officer or employee of CCJPA to secure favorable treatment in the awarding, amending or evaluating performance of the Agreement.

27.0 CAPTIONS

The captions of the Articles and paragraphs in this Agreement are for purposes of reference only, and shall not be construed to affect the meaning of any provision hereof.

28.0 BENEFIT OF AGREEMENT

This Agreement shall bind and benefit the parties hereto and their successors and permitted assigns.

29.0 ENTIRE AGREEMENT

This Agreement is the entire agreement of the parties, and supersedes and replaces all prior communications, written and oral, regarding the subject matter hereof. PROVIDER represents that in entering into this Agreement, it has not relied on any previous representations, inducements, or understandings, written or oral, of any kind or nature.

IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto as of the day and year first written above.

CAPITOL CORRIDOR JOINT POWERS AUTHORITY	(NAME OF PROVIDER)
_____	_____
By Executive Director (or designee)	By (Signature)
Name and Title _____ Print or Type	Name and Title_____ Print or Type

ATTACHMENT C

PRO FORMA INSTRUCTIONS

For RFSOQ procurements where a Work Directive is used to implement technology solutions over a discrete set of parameters, the contract with the selected Vendor will serve as a Master Contract, wherein a Conformed Statement of Work (CSOW) will be an attachment to the Master Contract. Whether responding with a capital outlay or a services approach, pricing across a number of categories needs to be consistently applied to individual Work Directives according to the disclosures and methodologies established in the CSOW at the time of Master Contract award. Pricing shall be maintained as an attachment to the Master Contract as a *pro forma* pricing sheet except the *pro forma* pricing sheet shall be a dynamic document meant to be updated with each Work Directive is completed and upon the anniversary of the Master Contract so that it is maintained as a current record of pricing and service delivery at cost.

Vendors who respond to RFSOQ procurements are required to disclose their per unit costs in various categories (hardware, staging, shipping/delivery, markups, financing and amortization [in the case of service contracts] and labor) in a clear an open manner using categorized cost tables that clearly show (per unit) costs that can be applied to comparative examples required in the RFSOQ response. For instance, when a Vendor discloses their hardware costs across a variety of hardware categories in their RFSOQ proposal (in cost sheets and any example pricing sheets, if those are required in the RFSOQ), it would follow that the final Master Contract will carry those costs forward through the Conformed Statement of Work as well as in a related and consistently developed cost *pro forma* for any subsequent Work Directive. From RFSOQ response through implementation via a Work Directive, CCJPA expects that the Vendor-supplied pricing tables are being consistently used (and using permitted rates escalations) for the life of the Master Contract. Pricing structure will be subject to audits at request by CCJPA consistent with use of public funds in the State of California.

The format for presenting these cost details in a Statement of Qualifications (SOQ) submittal is at the discretion of the Vendor. Modifications to the submitted format may be requested if the Vendor is selected, and refinements for clarity will be requested in future iterations of the pricing details during the terms of the Master Contract. A format that is lacking adequate detail and clarity will negatively affect the SOQ evaluations for the Vendor.

HARDWARE (GENERAL HARDWARE COSTS)

CCJPA anticipates that most Vendors have negotiated volume pricing with their original equipment manufacturers (OEM) for all commercial off the shelf (COTS) parts based on worldwide volumes. The CCJPA understand that Vendors should be insulated from market fluctuations in their hardware costs but believes that this consideration should be built into the Vendor-OEM negotiated fixed price, and as such avoid building risk into their pricing to

account for things like exchange rate fluctuations. For COTS pricing, the Vendor should also demonstrate, and justify, their selected markup for all such hardware. If there are custom parts and there are volume discounts that can be applied (if ordering volumes are sensible), grouped unit scaled cost figures should be provided. If the Vendor believes that there is a specific project element that requires developing hardware or other system component that go beyond regular cost of doing business, an amortization rate over a select or suggested number of first-time units should be shown and then removed for any subsequent units.

Under a Master Contract, costs can be reviewed annually to reflect new unit cost per item provided under the contract terms. Since hardware installs may last multiple years, hardware pricing can fluctuate over time and it is understood that unit pricing may go up or down year to year.

In summary, the selected Vendor needs to provide a master hardware bulk unit pricing sheet that can be updated at most once per year based on the date of the Master Contract award. On an annual basis, the range of unit pricing may rise at most 3% or the US Consumer Price Index, whichever is less, and may decrease at any rate offered by the selected Vendor. Increases over 3% in any given year for any category of hardware may be allowed but only based on a written justification and subject to approval by CCJPA based on the terms of the Master Contract.

HARDWARE PRICING (AMORTIZATION/FINANCING) IN SERVICE BASED CONTRACTS

With service-based procurements that include a hardware component, the expectation is that hardware, which is leased, will be upgraded as necessary to stay on a current technology path. The annual pricing sheet should reflect the technology road-map and be a point of engagement with the CCJPA for strategic upgrades on an assigned schedule. Thus, the pricing sheet for service-based contracts is a vital tool used by all parties to extend the technological relevance of hardware and software components. The Vendor should present a technology roadmap and CCJPA expects to see a commitment to investigate hardware and software evolutions for each pertinent item. While CCJPA understands that a solution roadmap will be a vision of how future developments may be undertaken and that actual development may not exactly follow this course, the Vendor will be expected to discuss and plan strategic upgrades according to adherence of the technology roadmap during the terms of the Master Contract. Any significant deviation from the technology roadmap that is not documented, explained, and approved by CCJPA, can be grounds for significant payment penalties including contract termination. It is an expectation of CCJPA that the technology roadmap and the life-cycle support plan put forward by the Vendor shall converge such that, as a hardware or software approaches end of life, the technology roadmap will have been faithfully followed and the appropriate replacement hardware or software already identified and documented, and thus be available for purchase and use under the terms of the Master Contract.

The costs of leased hardware should be presented in a clear manner to demonstrate how hardware technology upgrades will be considered and priced in a service model response. As an example – if WiFi Access Points (APs) are expected to be exchanged every 36 months and if a new AP unit price has a $100 higher capital cost than the previous model, then the pricing sheet should amortize that price over the next 36 months so the cost to CCJPA is $135 / 36 so about $4 per month extra onto the current lease cost (per AP).

The CCJPA intends to work with the selected Vendor within a service model to allow for reasonable adjustments in pricing between years of the contract based on documented changes that would affect the pricing sheet. It is the intention of CCJPA that the Vendor's annual cost categories and profit structure established during contract establishment are shared, discussed, reviewed and submitted to CCJPA for approval, on an annual basis, so that the service level agreement is satisfactorily maintained for both parties over the life of the Master Contract.

Except as otherwise provided in a specific Work Directive, CCJPA will make no ownership claim, no right, title and interest in all deliverables provided or generated by the Vendor under any Work Directive associated with the Master Contract to be executed as a result of this RFSOQ procurement. Upon completion of the contract terms, it is assumed that all hardware title will be fully owned by the Vendor unless CCJPA expressly purchased hardware items under a capital acquisition-based Work Directive.

SHIPPING AND DELIVERY

The Vendor should show separate shipping/delivery costs for applicable hardware installation and maintenance sites (delivery costs may vary over time and become more specific when Work Directives are developed). As with hardware pricing, whether via a capital or service (lease) delivery model, the dynamics of shipping and delivery should be shown and documented as part of the pricing sheet. As an example, if delivery of items can be stored on site and in bulk, then bulk shipping should be shown. If shipping is unique for particular items, those direct shipping costs should be provided. Recognizing the specifics of Work Directives, shipping/delivery costs may vary from the Master Contract pricing sheet to reflect specific Work Directive conditions such as timing, quantities, and other factors.

SOFTWARE LICENSES

Vendors shall provide the details of their baseline software licenses and any additional software options that may be available. CCJPA believes that it is unlikely that any specific code will be created for CCJPA for this project. However, if this is not the case, and the code is not part of the Vendors roadmap, then the Vendor should provide details of any additional development effort in terms of number of full-time work equivalent-days, to be charged an agreed-upon development fee rate.

SOFTWARE LICENSES IN THE SERVICE BASED CONTRACTS

Software in a service-based contract should resemble the amortization considerations built into software as a service models (e.g. Office 365 “cost per month”) rather than upfront funding with annual recurring costs to support the renewal of license.

CCJPA views Vendors who respond to technology RFSOQs fundamentally as software providers and system integrators. Prospective Vendors should develop their software pricing sheet details on a pay-to-use fee structure. CCJPA believes this model creates the advantage of being much easier to add and remove software features later as opposed to making additional new software license agreements and changes to annual recurring software license/ maintenance fees. Documentation of the software as pay-to-use should be presented in the SOQ, subject to the formatting under the discretion of the Vendor.

LABOR COSTS

As with hardware unit costs, labor costs of the Vendor are expected to vary over time. Labor costs to acquire, inventory, conduct quality assurance, test and configure, repackage for shipping, etc., each hardware unit should be considered, calculated and shown under either a capital or service delivery model. Tangible labor costs to customize, program, ship, etc., should also be considered and shown under either a capital or service delivery model.

For the RFSOQ submittal, prospective Vendors shall submit a labor rate table for different job classifications. Subject to annual evaluation and negotiation, this labor rate table will be included in the Master Contract and apply to subsequent Work Directives. As Work Directives are issued, the scale of maintenance and operations is expected to expand, and thus labor should reflect the scale in the collective ongoing service delivery under each Work Directive.

The labor rate table under the Master Contract can increase up to 3% at most once per year based on the date of the Master Contract award or according the change in the US Consumer Price Index, whichever is sooner. Increases higher than 3% may be allowed at the discretion of the CCJPA but written justification will need to be provided by the selected Vendor for evaluation by CCJPA.

ATTACHMENT D

PROTEST PROCEDURE

PROTEST PROCEDURE

A. Submittal of Protests

All protests must be in writing, stating the name and address of the protestor, a contact person, the RFSOQ Number and Title and shall specify in detail the grounds of the protest and the facts supporting the protest.

All protests must be addressed as follows, to the District Secretary of the San Francisco Bay Area Rapid Transit District ("BART") who also serves as the CCJPA Board Secretary:

For Special Delivery or Hand Delivery:	or	**By U.S. Mail**:
CCJPA c/o District Secretary		CCJPA c/o District Secretary
San Francisco Bay Area Rapid Transit District		San Francisco Bay Area Rapid Transit District
300 Lakeside Drive, 23rd Floor		P.O. Box 12688
Oakland, CA 94612		Oakland, CA 94604-2688

Protests not properly addressed to the District Secretary may not be considered by the CCJPA.

Copies of the District's Protest Procedures which are equally applicable to the CCJPA may be obtained from the District's Division of Contract Administration, P. O. Box 12688, Oakland, California 94604-2688, Telephone (510) 464-6543. SOQs will be opened and a Notice of Award will be issued by the CCJPA only in accordance with the Protest Procedures.

B. Pre-submittal Protests

Pre-submittal protests are protests based upon the content of the solicitation documents. Five (5) copies of pre-submittal protests must be received by the District Secretary no later than ten (10) calendar days prior to SOQ opening. A written decision specifying the grounds for sustaining all or part of, or denying, the protest will be transmitted to the protestor in a manner that will provide verification of receipt, prior to the submission of SOQs. If the protest is sustained, the SOQ submission date may be postponed and an addendum issued to the RFSOQ document or, at the sole discretion of the CCJPA, the advertisement may be canceled. If the protest is denied, SOQs will be received on the scheduled date.

C. Protests on the Recommended Award

All Proposers will be notified of the recommended award, if any. This notice will be transmitted to the Proposer at the address contained in its SOQ in a manner that provides verification of receipt. Any Proposer whose SOQ has not lapsed may protest the recommended award on any ground not specified in subsection B. above. Ten (10) copies of a full and complete written statement specifying in detail the grounds of the protest and the facts supporting the protest must be received by the District Secretary at the appropriate address set forth in subsection A. above no later than seven (7) calendar days following receipt of such notification. A written decision stating the grounds for allowing or denying the protest will be transmitted to the protestor and the Proposer recommended for award in a manner that provides verification of receipt, prior to execution of the Agreement. Such decision shall be final.