ATTACHMENT A.
2006-0208

King County Metro
Transit Division

Radio & AVL Replacement Project

Response to 2006 Budget Proviso

April 2006

Transit Radio/AVL Replacement Project

Report to Project Review Board

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Information in this report responds to the items requested in the proviso to the 2006 Adopted Budget

King County

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April 5, 2006

To: Harold Taniguchi, DOT Director

From: David Martinez, Chief Information Officer

Subject: DOT: Radio and AVL Replacement Project – Project Review Board Review and Recommendation

Thank you for the March 1, 2006, package containing documents needed to respond to the Council's proviso regarding the Radio and AVL Replacement project, and the final document versions submitted for the Project Review Board [PRB] meeting on March 21, 2006.

The Project Review Board reviewed the following documents:

1. Draft Scope of Work for Quality Assurance, February 28, 2006
2. Project Charter, March 21, 2006
3. Implementation Plan
   - Integrated Master Schedule, February 28, 2006
   - Macro Report: Transit Radio System Project Assessment – March 2006
   - Motorola Contract – 03/17/06
4. Macro Technical Evaluation Reports
   - Conclusion of TRS Proposal Review Motorola, Inc, August 31, 2005
   - Conclusion of TRS Proposal Review M/A-Com, Inc, August 31, 2005
5. Business Case
6. Cost Benefit Spreadsheet
7. Project Plan
8. Possible Contractor List

Based on the review of the consultant report entitled "Transit Radio System Project Assessment" from Macro Corporation and their earlier reports, it appears that the consultant's assessment of

the project documentation is complete and should provide assurance that the project is well structured and planned out.

I appreciate the consultant's Clarifications Responses and Resolution Status of TRS Evaluation Issues provided in the Appendix A and Appendix B of the consultant's report documenting the consultant's assessment that relevant issues are adequately addressed and reflected in the contract.

The Project Review Board concurs and approves the proposed scope of work for the consultant quality assurance, the project charter, the current implementation plan and the consultant's evaluation of the selected vendor's technology and its ability to meet the transit division's needs.

Regarding the on-going consultant's quality assurance, the Project Review Board requests that Quality Assurance reports be presented to PRB by the consultant at major milestones:

- Complete Detailed Project Schedule - August 9, 2006
- Factory Acceptance Testing and Microwave Installation - March 5, 2008
- Installation of Radio System Infrastructure - July 29, 2008
- Fleet Installation and Testing - July 4, 2009
- Final Acceptance - November 25, 2009

Additionally, PRB supports and recommends inclusion of ACCESS solution in the contract with Motorola as 1) the contract provides for an option, at no cost, to exclude the ACCESS scope within 12 months of contract signing, if the planned evaluation of the ACCESS component and/or budgetary constraints would demand so; and, 2) inclusion of ACCESS in the contract at this time is at a discounted price.

In conclusion, the PRB review resulted in this letter of endorsement of the final report that you will be including in your transmittal package to the County Council per the proviso requirements.

The Project Review Board would appreciate receiving a final electronic version of all materials in the transmittal package to bring closure to the PRB review.

Thank you for your support of the technology governance and this review process.

cc: Kevin Desmond, General Manager, DOT Transit
Project Review Board Members:
Sheryl Whitney, Assistant County Executive
Paul Tanaka, County Administrative Officer
Bob Cowan, Director, Office of Management and Budget
David Martinez, Chief Information Officer

Office of Information Resource Management

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Project Review Board - March 21, 2006

Agenda

- March 21, 2006 Agenda

Handouts

- 0b_PRB_March_Summary

- **1_DOT_RAVL**
- Meeting Minutes – Agenda Item 1: Radio/AVL project only
  - TRS_Contract
    - Main Contract and Exhibits
    - Motorola Excerpts
  - a1_PRBBrief_TRSProject_PRBReview_Proviso (pdf)
  - a2_DOT_RADIOAVL_FundingRelease.doc
  - a3_PRBBrief_TRSProject_PRBReview_FundRelease (pdf)
  - b_DOT_RadioAVL_fundingreleasematerials_checklist.pdf
  - c_DOT_RADIO_AVL_ProjectPlan
  - d1_DOT_RADIO_AVL_PossibleContractorList
  - d2_DOT_RADIO_AVL_ContractorsProv_On-Boar Equipment
  - e_DOT_RAVL_RFC-OBS-TRS_HighLevelSchedule
  - f_DOT_RADIO_AVL_Business_Case
  - g_DOT_RADIO_AVL_PhaseIIIBudget_FTEs
  - h_DOT_RadioAVL_TransitProgramOverview
  - i1_RadioAVL_RadioProjectCharter3-21-06.doc
  - j_DOT_RADIO_AVL_MetroProgramOfficeStaffing
  - k0_DOTRADIO_AVL_Clarifiications with Macro & KCM cmt
  - k1_DOT_Radio_AVl_ClarificationsonPrjPlan -with KCM cmt
  - l0_DOT_RADIOAVL_PRBBrief_TRSProject_status (pdf)
  - l1DOT_RADIOAVL_PRBBrief_TRSProject_NextSteps (pdf)
  - m_DOT_RadioAVL_KCMFinalReport060317
  - n_DOT_RADIO_AVLKingCounty_Asmt_051216
  - n1_Conclusion_of_TRS_Proposal_Review_to_Metro_Final_Motorc
  - 02_DOT_Radio_AVL_CombSched_TRS_forPRBSub_28Feb06
  - o2_DOT_RADIO_AVL_ViewingCross-Project_Dependencies_28Feb06
  - p_DOT_RAD AVLWork O QA_for_MajorTransit_Projects_Req
  - q_DOT_RadioAVL_projplansignatures.pdf

- 2_DES_EMS_DatabaseSystemUpgrade
  - a_DES_EMS_BriefingE-911DatabaseCIOCondition2006
  - b_DES_EMS_911_DBUpgradePRB FundingRelease
  - c_DES_EMS_E-911DBUpgradeChecklist

To: _____ Date of Request: 02/03/06

Consultant

From: Transit — Quality Management for Major Transit Projects

Department/Agency — *Work Order/Project Name*

Work Order Response is due to requesting Agency by: 02/17/06

Please check appropriate box

- ☐ Category A – IT PM
- ☐ Category B – IT Solutions
- ☐ Category C – Tech Plan and Consult
- ☐ Category D – Security & Privacy
- ☐ Category E – Training
- ☐ Category F – Tech Writing & Documentation
- ☒ Category G – Quality Management

Scope of Work (Sections A – D) Responses to this Work Order must be in alignment with the Master contract:

- ☐ - Agency to complete
- ☐ – Consultant to complete

Section A. Objective

***Agency:* Fill in objective of the work order.**

Will your Work Order need:

**Hardware*	*Yes* ☐	*No* ☒
**Software*	*Yes* ☐	*No* ☒
**Intellectual Property*	*Yes* ☐	*No* ☒
**Non Disclosure Agreement*	*Yes* ☒	*No* ☐
**FTA*	*Yes* ☒	*No* ☐

** For each **Yes** item identified, attach the correct and completed Addendum to this Work Order*

King County Metro Transit is seeking assistance in the area of Quality Management – Category G – for two major transit technology projects: the On-Board Systems/ Communication Center System (OBS/CCS) Project and the Transit Radio System (TRS) Project. The two projects are linked by critical interfaces and will require close coordination during design, installation, testing and acceptance.

A third project, the Regional Fare Coordination System (RFCS) project, will provide a Driver Display Unit that also supports OBS and Radio functionality. However, QA analysis of the RFCS is not included in the scope of this contract. Attachment 1 provides a summary of all three projects, and a copy of the current integrated project schedule is provided separately as an MS Project file.

The OBS/CCS project will provide Metro Transit with the technology and processes to deliver essential business and customer service functions on the fixed-route revenue bus fleet, including automatic vehicle location with route and schedule adherence reporting, automatic passenger counting, automatic stop announcements for on-board customers, automatic vehicle monitoring, vehicle systems reporting and computer-aided dispatch. It also provides related emergency management and communications functions including the management of the radio system, vehicle area network, and wireless LAN. The OBS/CCS project includes interfaces to other transit enterprise management systems, and back-office functions for data management, distribution and reporting. The OBS/CCS project is currently evaluating Best & Final Offers from two system vendors, with the expectation of selecting an apparent successful proposer to proceed to contract negotiations during the 3rd quarter of 2006.

The TRS project will deploy a new 700 MHz private land-mobile radio system with digital voice and data communications throughout the Metro service area. A key requirement for the TRS is to provide the data communications infrastructure to connect the on-board functions of OBS with the central management functions of the CCS. Contract negotiations are currently underway with the expectation of formal contract award during the 1st quarter of 2006.

In assisting with the coordination of the two projects, the Quality Assurance consultant will assist in the management and utilization of the Project Management Information System (PMIS) and participate in the joint Technical Interface Committee (TIC), a contractually required forum for addressing integration issues between the two contractors. The period of performance is expected to extend through completion in 2009.

For each of the two projects, the QA consultant will periodically review and report on the status of each project's set of deliverables and processes, including any current or potential impacts to that project's scope or schedule. Additionally the QA consultant will serve as a technical resource for the analysis of proposed technical deliverables specific to each project during the design and implementation phases.

The QA analysis will address deliverables for areas such as:
- Project management scope, schedule & budget;
- System architecture and design;
- Risk and risk mitigation;
- Change order management;
- System integration and interface plans;
- Installation, testing, training and acceptance plans; and

- System management, backup and recovery, system fail-over, security and ongoing maintenance.

The Project Managers, Project Sponsors and Steering Committees of each project will receive regular reports that summarize the outcome of the project's quality assurance processes for each project. The reports should address the topics of interest specific to each project, as well as the critical interdependencies and other issues that link them together. A King County budget proviso for the Radio Project requires monthly reports for that project to be delivered contemporaneously to the County Executive and King County Council.

King County seeks to hire a consultant team with both

- the ability to provide project management oversight and timely reviews of project deliverables as per the milestones identified in the Scope of Work between King County and the Selected Consultant, and
- demonstrated experience in the assessment or deployment of technologies similar or related to those that will be deployed in these projects, especially with regard to the communications technologies to be utilized within the two projects:
  1. Wireless Local Area Network (WLAN)
  2. Private Land Mobile Radio
  3. Vehicle Area Network (VAN)
  4. King County Wide Area Network integration (KC WAN).

Consultant: **Proposal (summary/overview)**

Section B. Description

Agency: **Description of Task/Service**

Scope of Work /Consultant Responsibilities:

a. Develop and Gain Approval of Quality Assurance Work Plan

In conjunction with the King County Project Managers, Transit's IT management team and the Project Steering Committees, the Quality Assurance provider will develop a Quality Assurance (QA) work plan and obtain approval of the Plan.

The plan must specifically define the following elements for performing the QA reviews and producing the QA reports identified:

- review components
- roles and responsibilities
- tasks
- schedule
- report content

King County will provide the selected QA consultant with reasonable access to project staff, work plans and documentation in order to prepare the QA work plan.

b. Perform QA Reviews and Produce QA Reports:

The consultant is expected to conduct reviews and submit reports documenting assessment of the Project deliverables as identified, and related activities scheduled for completion during each project's phases regarding:

- Project management – assistance in managing the PMIS;
- Risk assessment and mitigation;
- Scope and schedule adherence;
- Change order management
- Review and analysis of vendor design submittals;
- System development and testing;
- System migration plans;
- Go/No Go Decisions; and
- User, System, Integration and Acceptance Testing plans and documentation.

The intent of QA process is to overlay activities of the project, not drive the project schedule. The reviews should be tied to project deliverables and are expected to provide adequate visibility into actual project progress so that management can take corrective actions when the project's performance deviates significantly from the established plans. These reviews are expected to provide recommendations for corrective action to be taken, or possible mitigation steps to be pursued.

The frequency of the QA reviews may be modified during the development and approval of the QA work plan. King County reserves the right to request a review at any point in the project.

Findings and recommendations from the QA Reviews will be documented in detailed QA Reports submitted to the Project Managers and Steering Committees with an Executive Summary to be provided for the Executive Sponsor and Project Review Board. Monthly reports on the Transit Radio System Project will be sent to the King County Executive and the County

Council. In addition to the findings and recommendations from the QA review, the QA Reports will outline current and anticipated QA activities and provide an overall prospective of project progress and critical issues.

c. Perform Risk Assessments and Recommend Mitigation and Remedies

Based on the findings and recommendations from the QA reviews and covered in the QA reports, provide recommendations for remedial action, if any, at a level of detail sufficient to enable King County to develop and implement plans to ensure project success. Risk identification and mitigation is viewed as an ongoing process that requires regular discussion and analysis.

The QA consultant should describe their proposed approach below, including their expected level of involvement, their planned activities and their expected interactions with the project teams.

Consultant: **Proposal (Description of approach)**

Section C. Deliverables

Agency: **List required deliverables with frequency of status reports.** *(Identify if the consultants should include a sample of their work with their proposal)*

The expected deliverables for this process include:

- **Upon Initiation:** A Quality Assurance Plan that outlines the procedures, budget requirements, key milestone review, and reporting activities and requirements proposed by the Contractor.
- **Monthly:** QA reports that address the standard range of topics as identified in the QA Plan.
- **As Required:** Technical reviews of contractor submittals covering topics such

as system architecture and design; system integration and interface plans; performance requirements; installation, testing, training, migration and acceptance plans; and system management, maintenance, backup and recovery, system fail-over, security and ongoing maintenance.

- **Quarterly:** Updates of risk assessment and mitigation plans.

Consultant: **Proposal (Description of deliverables and timing)**

Section D. Duration of Work

Agency: **List expected start and completion dates.**

The consultant team selected for this effort must be available to participate in the projects, review and provide reports from April 1, 2006 for the TRS project (or an alternate date, to be negotiated) and from contract signing for the OBS/CCS project (expected to be October, 2006) through the completion of both projects, currently estimated to be the end of 2009.

This will be set up as a yearly work order, with renewals as appropriate on an annual basis, subject to the renewal and/or termination clauses in the Master Contract.

Consultant: **Proposal**
Include work plan, schedule and assignments. Estimate hours and rates.

Task	Schedule	Consultant Hours	Cost			

Consultant: Proposal Include work plan, schedule and assignments. Estimate hours and rates.						

Section E. Key Personnel

Please list the key personnel you will include in the project and their name, resume, role and hourly rate.

Consultant: Proposed Personnel List (resumes must be attached)		
Name	Role	Hourly Rate

Section F. Payment

(Consultant and agency will revise based on final negotiation)

Consultant: Proposed Payment Schedule		
Cost of all deliverables must equal fixed-price total.		
Deliverable	Cost	Due Date

Section G. Signatures

Consultant shall submit their invoice and other documents/deliverables as are required pursuant to this specific work order within thirty (30) calendar days of completion of the task(s)/deliverables.

IN WITNESS WHEREOF, the parties hereto have executed this Work Order (Sections A-G) as of the _____ day of _____, 20____.

AGREED TO:

Consultant Information:		King County Information:	
Consultant's Signature	Date	Project Manager's Signature	Date
Title		Agency Signing Authority	Date
Company Name			

Section H. Agency Coding (Completed by Agency after Consultant selection)

Please complete all information requested below and return to Procurement. The start date for the project should allow sufficient lead time for all required signatures and 24-hour processing of documents. Work should not commence until **Work Order contract number** has been assigned by **Procurement Services** and form has been signed.

Which Consultants were sent this request? *(Please identify which consultants submitted a proposal)*					
Why was this consultant selected?					
		FUNDING CODES:	Low Org Fund ARMS:	Cost Center Fund IBIS:	
Master Contract #:		*Project #:*			
		Phase #: (IBIS)			
		Task #: (ARMS)		Account #: 53127	

PROCESSED BY: _____ DATE _____

(COMPLETED BY PROCUREMENT & CONTRACT SERVICES SECTION)

*Work Order Contract Number*_____

Procurement Technical Services Section Signature: _____ Date _____

Attachment 1: Summary of Major Transit Technology Projects

1. Regional Fare Coordination Project

This project will plan and implement a regional fare coordination program that enables customers to use one fare card on multiple systems in their daily commute throughout the Central Puget Sound Region. Contactless smart card fare collection technology will be used. Agencies partnering in this effort include Community Transit, King County Metro Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit.

Specific project elements include:

- One regional fare card that supports electronic purse, pass, and voucher functionality
- New driver displays include the DDU (driver display unit) and smart card reader equipment for agency bus fleets
- Automatic, wireless uploads and downloads of data to and from agency bus fleets
- Integration with ticket vending machines at Sound Transit rail stations
- Automatic card revaluing for individuals and institutional customers
- A 10-year operating agreement with ERG Ltd., to operate a central clearinghouse
- A regional Website for customer service
- A regional mail center and card distribution office
- Regional agreements on revenue sharing and fare reconciliation

RFCS PROJECT MILESTONES:

May 2003	Contract Award
July 2005	Complete Final Design
July 2006	Conduct Beta Test at selected agency sites
January 2008	Final acceptance (estimated)

2. On-Board Systems/Communications Center System Project

The project is organized in two stages, called Level 1 and Level 2. Level 1 involves systems and functionality on-board the fixed-route bus fleets and at the transit bases. Level 2 connects on-board functions to the Communications Center via the new radio system provided by the TRS project, and provides all-new fleet management software functionality in the Communications Center. This project will use the Driver Display Unit and Wireless LAN system implemented by the RFCS project.

Level 1: OBS

This first phase of the OBS/CCS project will design, test, install and implement on-board systems (OBS) and "back-office" base operations systems. The current plan is for this implementation to follow successful RFCS implementation. Functionality includes:

- Vehicle logic unit (VLU) to network, interface with and manage all major on-board systems
- GPS-based automated vehicle location (AVL),
- Automated "next stop" announcements and displays (including a new LED interior sign),
- Integrated automatic passenger counters,
- Automated destination signs,
- Automatic Vehicle Monitoring and data offload from engine control modules,
- Enhanced transit signal priority,

- Integrated controls and data off-load from the vehicles to the KC WAN for OBS, RFCS and the existing security camera system,
- A "back office" system on the KC WAN for managing data exchanges between the vehicles and Transit's enterprise datasets, and
- An upgraded wireless local area network (WLAN) at each transit base to provide the connectivity between the revenue vehicles and KC WAN

Level 2: CCS and OBS (in conjunction with the Transit Radio System project)

The second phase of the OBS/CCS project will design, test, install and implement a new Computer-Aided Dispatch/Automatic Vehicle Location (CAD/AVL) system to work with the new 700 MHz Transit Radio System (TRS).

- Level 2: CCS and the TRS implementation will occur simultaneously, with the CCS and fixed end portion of the TRS being installed at the newly constructed Communications Center at Central Base.
- On board, modifications to the Level 1 OBS will be made to manage new mobile radio communications processing when the new TRS mobile radios are installed.
- Enhanced CAD/AVL functions including:
    - Text messaging
    - Off-route vehicle tracking
    - Security microphone for emergency alarm (EA) monitoring

OBS/CCS PROJECT MILESTONES:

November 2004	Receive Proposals
October 2006	Award Contract (estimated)
November 2007	Begin Revenue Fleet Pilot (estimated)
November 2009	Level 1: Conditional Acceptance (estimated)
Feb. 2008	Joint TRS/CCS Pilot Test (estimated)
May 2009	OBS/CCS Full System Acceptance (estimated)

3. Transit Radio System Replacement Project

This project will replace the existing transit 450 MHz system with a new 700 MHz system to provide voice and data communications for all transit stakeholders. Integrate with other on-board systems and provide operational continuity throughout the replacement period. Implementation of this project will require successful deployment of the Driver Display Unit and on-board network provided by RFCS, the On-Board Systems equipment and Communications Center System provided by OBS/CCS.

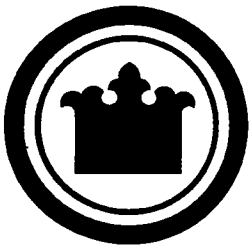
Detailed project elements include:

- Acquire FCC licenses for the 700 MHz frequencies
- Negotiate leases for up to 14 tower sites, and complete all necessary site modifications such as: new buildings or building modifications, tower upgrades, generator and HVAC upgrades
- Construct radio network infrastructure and microwave linking the tower sites
- Install common radio control and console equipment in the new Communications Center
- Integrate with Sound Transit's tunnel radio system, to support joint tunnel operations
- Install mobile radios for revenue and non-revenue vehicles
- Provide portable radios for Service Quality and other Transit personnel
- Upgrade the back-up communications center at North Base
- Provide voice and data radio network interfaces to integrate with On-Board Systems

- Provide funding for Communications Center System procurement and implementation (via the On-Board Systems/Communications Center System procurement)
- Provide training for all users and for maintenance staff
- As needed, provide mitigation for any interference problems prior to new radio system operation

TRS MAJOR MILESTONES:

January 2005	Receive Proposals
March 2006	Award Contract (estimated)
June 2007	Install and integrate systems in new Communications Center (estimated)
February 2008	Joint TRS/CCS Pilot Test (estimated)
December 2009	Final acceptance (estimated)



King County

Transit Radio System Replacement

Project Charter

March 20, 2006

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1.0 Purpose

The purpose of this Charter is to specify how the Transit Radio Replacement Project will be governed, managed and overseen. It also includes project vision, objective, goals, scope, deliverables, approach, success factors, risks, constraints and assumptions. Additional information on roles and responsibilities, schedules, budget, communication and reporting, change management, quality management and risk factors are provided in the Project Plan.

2.0 Problem Statement

The transit radio system was installed in 1990-1991. The system uses ten 450 MHz channels for voice and data communications with the revenue fleet, and voice communications for supervisors and other support staff. Two 800 MHz channels provide voice communications for Power Distribution and Facilities Maintenance staff.

The system needs to be replaced because many parts of the system are obsolete and no longer available. For several years, Radio Maintenance has monitored the "gray market" and purchased old surplus radios that have been discarded by other agencies, but even this source of parts has been depleted. Vendor support is no longer available and some of the manufacturers of the original equipment have gone out of business. By federal law, the FCC regulates all non-military radio systems, including all those operated by public agencies. In 1995, the FCC adopted a broad new set of "refarming" rules affecting radio spectrum below 512 MHz. As a result of the new rules, the transit radio system must be replaced in its entirety. Macro Corporation, Transit's radio engineering consultants, recommends that Transit relocate the system into new spectrum that the FCC is opening up in the 700 MHz band. Because the 700 MHz spectrum has different characteristics, the system still needs to be redesigned to obtain adequate coverage. No refarming is planned for the 700 MHz band, and it is set aside for public agencies. If Transit tried to stay in the 450 MHz band, there would always be competition with other private and commercial interests.

The budget for this project also includes funding for the replacement of the Computer-Aided Dispatch and Automatic Vehicle Location display functions in the Communications Center, such as workstations, servers, software, system integration and testing. However, the project management, procurement and implementation of this element of the project is bundled with the On-Board Systems project. Because the CCS & OBS communicate with each other via the radio "pipeline", the decision was made to procure them together to ensure compatibility. Detailed project planning information on this element is included in the On-Board Systems / Communication Center System (OBS/CCS) Project Plan.

3.0 Vision

This project will provide a life cycle replacement of the existing Transit radio and Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL) systems and ensure the continuity of operational communications during the replacement period.

The project is compatible with the role of technology listed in the Transit Technology Systems Strategic Plan, which is to achieve operational efficiencies and enhance service effectiveness. Technology will be used to help achieve the goal of a safe, reliable, convenient and responsive public transportation system.

4.0 Mission

The Transit Radio System is a mission-critical communication system for Operations, Vehicle Maintenance, Power and Facilities, Transit Safety and Transit Security, providing essential voice and data communications for field staff, bus operators and, indirectly, for all customers served by Metro Transit.

This project will replace the existing, obsolete 450 MHz radio system with a new mobile radio system with radio coverage and performance characteristics as good as or better than the existing system.

5.0 Project Scope

The project scope includes the following:

- Replace the transit radio system infrastructure, Communication Center radio equipment, audio recording system and all mobile and portable radios;
- Integrate with On-Board Systems / Communication Center System (OBS/CCS) functionality and equipment on-board the revenue vehicles and in the Communications Center, to be provided under a separate contract;
- Integrate with the 800 MHz radio system in the DSTT; and
- Install, test and implement the new system in the new Communication Center facility at 6th Avenue South and South Atlantic Street.

The following will <u>not</u> be done by the project:

- Complete software or hardware modifications to OBS/CCS contractor's products;
- Provide furniture for the new Communications Center; and
- Provide a telephone system for the new Communications Center.

6.0 Project Guiding Principles and Business Goals

The Transit Radio System Replacement Project aligns with the King County Strategic Plan, Transit Technology Systems Strategic Plan and Transit Business Plan.

6.1 Alignment with Technology Plans

The Radio AVL Replacement project is included in the Service Management section of the Transit Technology Systems Strategic Plan.

It follows several of the key strategies for managing technology systems listed in that plan:

- Maintain and fund asset maintenance and replacement programs for hardware and software.
- Meet national technology architecture standards on all new systems.
- Leverage technology investments by developing evolutionary deployment plans that build upon previous investments in technology.
- Leverage Transit funding by pursuing partnerships with federal, state and local governments and private sector companies.
- Establish working groups to provide cross project coordination.

This lifecycle replacement project is also consistent with the following strategies of the 2003-2005 King County Strategic Technology Plan:

- **B3: Strengthen system security.** The 700 MHz digital radio system will be capable of operating in encrypted mode. The system will be deployed with state of the art firewalls, anti-virus software and related security measures.
- **B4: Strengthen business continuity capabilities.** The system design includes a dedicated microwave communications loop and other hardware redundancies, to achieve a "three nines" (99.9%) level of system availability and reliability.
- **C4: Purchase and integrate top quality, commercially packaged software where possible and cost effective.** This system is a commercial off-the-shelf product from the leading vendor in this market. The system will have no unique software customizations, and will receive on-going support from the manufacturer through a contractually managed support plan.

6.2 Specific Business Objectives

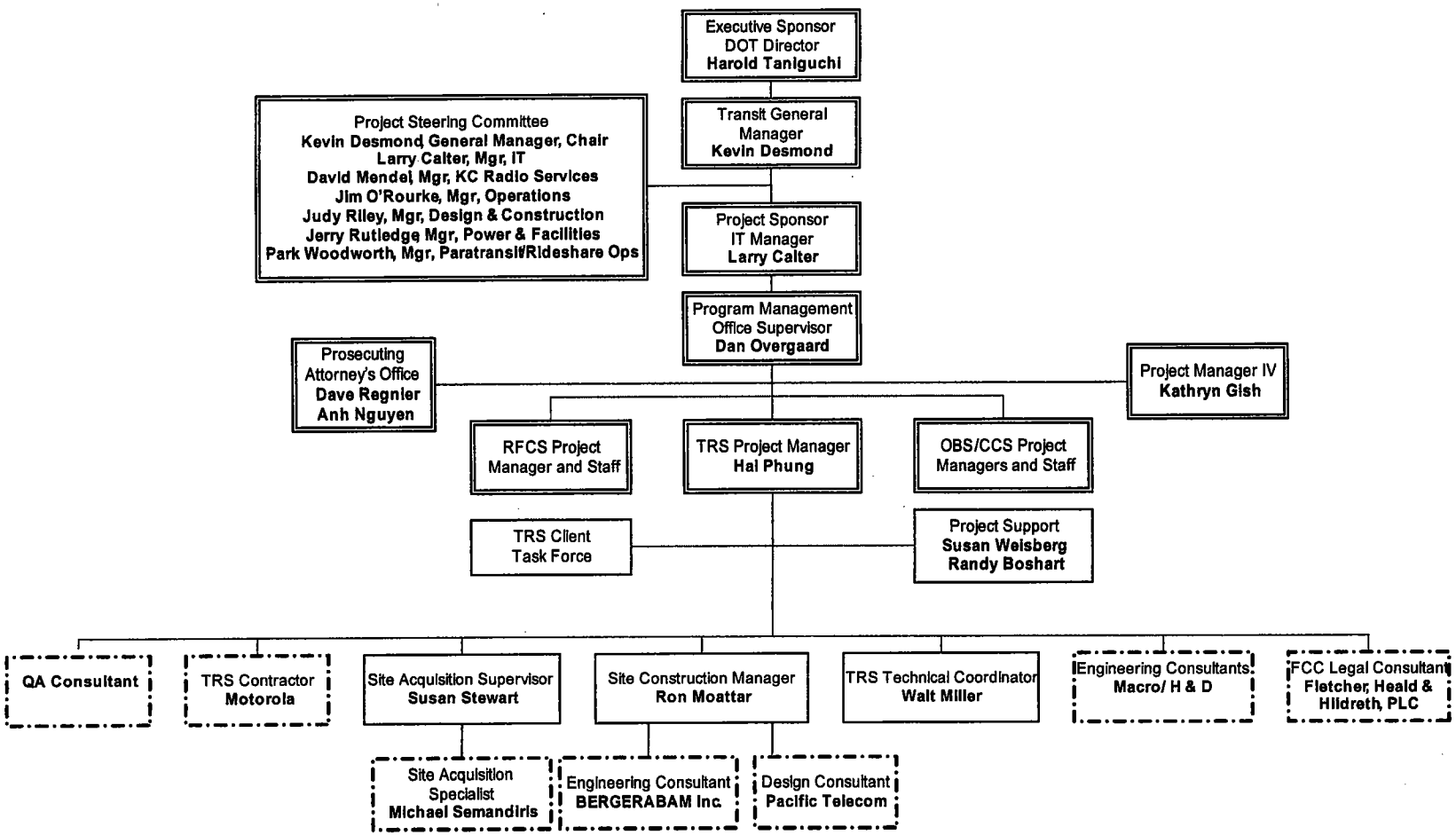
The project supports two of Metro Transit's core businesses listed in the Department of Transportation 2005 Business Plan: providing regularly scheduled bus services and providing contracted services. The project may also provide support for paratransit service for the disabled. Specific project goals are listed below:

1. Replace the existing, obsolete 450 MHz radio system with a new mobile radio system with radio coverage and performance characteristics as good as or better than the existing system;
2. Integrate with and provide data communications for new On-Board System and Communication Center System, which is being procured under a separate contract;
3. Comply with all FCC regulations and requirements applicable to the new system;
4. Implement the new radio system in a new, purpose-built Transit Control Center;
5. Support future bus/rail operations in the Downtown Transit Tunnel by integrating the bus and rail communication systems as required; and
6. Ensure smooth transition for all radio users throughout the process of installation, testing, and cutover to the new radio system.

7.0 Program Governance and Structure

Program governance is a key component of the success of the Transit Radio System (TRS) program. TRS Governance includes bodies that provide policy direction, oversight and program management. The organizational structure takes advantage of leadership groups that already are in existence. The description of each body and roles and responsibilities of each group are described in more detail below the project organization chart on the following page.

Transit Radio System (TRS) Project
Organization Chart



7.1 Executive Sponsor

The executive sponsor of TRS is the Director of the Department of Transportation (DOT) who is responsible for program implementation and accountable for the program's success. The Director is the program's advocate with the Executive and is responsible for articulating the project goals and business needs and dealing with groups external to the department. The executive sponsor is responsible for ensuring that policy and funding support for the program is sustained and that the project deliverables are achieved in a timely manner. He does this in part through monthly department technology project meetings that include the Transit General Manager and Project Sponsor, and by reviewing periodic project materials submitted to the Project Review Board (PRB). The Department Director ensures that political and organizational obstacles are identified and resolved in a timely fashion at the appropriate level.

7.2 Transit General Manager

The Transit General Manager is responsible for senior-level policy and operational leadership for the entire project. He determines program and project priorities, resolves issues escalated by the Steering Committee, works with the DOT Director on issues external to the Transit Division and works with the Prosecuting Attorneys Office (PAO) representative on legal issues. The Transit General Manager and his staff provide advice and recommendations on funding sources and structure. The Transit General manager approves vendor contracts. He reviews periodic project reports and documentation and provides recommendations to the DOT Director.

7.3 Project Sponsor

The Project Sponsor is the Transit Information Technology (IT) Manager, Larry Calter, who reports to the Transit General Manager. The Project Sponsor has the ultimate responsibility for the project. He participates in the monthly department technology review meetings and leads the Project Steering Committee. Program management staff, project management staff and technical transit staff all report to the Transit IT Manager. He is responsible for the following:

- Develop policy and operational advice and recommendations on technology change management and technology governance;
- Tactical oversight of program management to provide day-to-day direction and act as the first line of support for conflict resolution or policy recommendations;
- Develop the program charter;
- Implement policy direction;

- Advocate for the project within Transit and DOT
- Assure project and process quality;
- Manage benefit realization and risk;
- Conduct cost/benefit assessments;
- Authorize project contracts;
- Ensure that the program adheres to scope, schedule, and budget;
- Communicating the program vision, strategic objectives, and needs to county agencies;
- Ensure funding and other resources are available and are allocated appropriately for the program's duration; and
- Accept final program deliverables from staff and consultants.

7.4 TRS Steering Committee

The Transit General Manager has established the TRS Steering Committee to serve as the oversight group for the TRS project. This group meets monthly. Many members also serve on the Steering Committees of related projects. The TRS Steering Committee will be chaired by the Transit IT Manager. Voting members will include the Manager of King County Radio Services, and managers from the Transit Sections listed below. The TRS project manager, the head of the Project Management Office, the Technical Coordinator, the CCS project manager, project support staff and Transit IT budget staff also attends the meetings. Other project team staff attend on an as needed basis.

- Budget and Finance
- Design and Construction
- Transit Operations
- Power and Facilities
- Paratransit and Rideshare Operations

The Steering Committee is the forum for providing advice and input to the Project Sponsor, and the project team. Members review draft program deliverables, approve proposed changes to scope, schedule and budget, and ensure that the perspectives and understanding of different stakeholders are factored into policy level discussions and decisions.

The committee's responsibilities include:

- Provide oversight and direction for the implementation of the Transit Radio System;
- Monitor and approve changes to project scope, schedule and budget;
- Review and approve project schedules and priorities;
- Assist project team with risk management;
- Assist the project team with obtaining and assigning internal resources required for project execution;

- Ensure that business issues that involve multiple sections or systems are addressed;
- Resolve issues that cannot be handled by the project team and escalate appropriate issues to the Transit General Manager or DOT Director;
- Promote the functional and technical needs of stakeholders;
- Authorize an independent program oversight provider for the program;
- Receive regular reports from oversight provider, and evaluating the reports for quality and completeness
- Provide guidance on process change issues;
- Ensure that the operational groups have the capability to use and maintain the systems after they are delivered; and
- Monitor benefit realization.

7.5 Program Manager and Program Management Office

The Program Management Office is a management structure created to manage the daily activities of the TRS Program and its projects as well as two related capital projects to ensure integrated program delivery: the Regional Fare Coordination Project and the On-Board Systems / Communication Center System Project. These projects are inter-dependent and closely related because they each provide essential "building blocks" of on-board hardware and software that will integrate with other components and provide a stable, supportable, integrated and functional suite of systems for transit operations.

The Program Manager, Dan Overgaard, directs the Transit Technology Program Management Office and manages the program scope, schedule and budget, provides direction to the project managers and support staff that will oversee TRS and related projects, ensures that all critical-path issues are resolved and that all success factors are in place. The Program Manager reports to the Transit IT Manager and has day-to-day responsibility and authority for decision-making.

The Program Manager's responsibilities include:

- Manage the implementation of projects and related ancillary efforts;
- Hire and manage the project managers, and PMO staff;
- Manage program risk and escalate concerns to the Transit General Manager and project Steering Committees;
- Work closely with the Prosecuting Attorney's Office on legal and risk issues;
- Oversee activities of all projects to ensure that the program is integrated and cohesive;
- Review work products from project staff, contractors and consultants;
- Provide a single point of contact between management and the project teams,

- Establish a standard project management methodology, including tools and communication;
- Establish program boundaries and responsibilities and coordination of deliverables;
- Maintain awareness of the "big picture" in order to monitor trends and recognize issues;
- Establish a structured process for accomplishing program goals and objectives, monitoring the progress and schedule of the program against that process;
- Resolve program conflicts, roadblocks, and other issues and escalate those that cannot be resolved internally to Project Sponsor and Steering Committees;
- Recommend business process changes and policies for consideration by the Transit General Manager, Project Sponsor and Steering Committees;
- Monitor benefit realization and reporting to Transit General Manager and Director of DOT;
- Ensure the right technical function and expertise is available and identifying staff resource concerns;
- Work with supervisors in other Transit IT groups to ensure that right solutions are being provided;
- Ensure quality control;
- Receive regular reports from oversight provider, and evaluate the reports for quality and completeness; and
- Make decisions on all aspects of the program to facilitate program progress and adherence to scope, schedule, budget, and vision.

The responsibilities of the TRS project manager, Hai Phung, include:

- Update, maintain, and communicate project requirements;
- Prepare and update project schedule;
- Serve as the main point of vendor contact;
- Review vendor deliverables
- Approve invoice payments
- Day to day contact with function leads
- Develop work plans
- Identify issues and roadblocks, maintain issues, change and risk logs, monitor issues resolution and timeliness;
- Develop Outcome measures;
- Prepare status reports;
- Provide information and reports to senior management and the Steering Committees;
- Prepare agendas for Steering Committee meetings;
- Lead project team meetings; and
- Raise concerns about resource and allocation.

7.6 Independent Program Oversight

The goal of independent program oversight is to provide the DOT Director, Transit General Manager and Steering Committee with valid, unbiased information about the program's status, performance trends, and forecast for completion. Independent program oversight, operating in a proactive, problem avoidance manner will be utilized throughout TRS program implementation. The adequacy of the program oversight and responsibility for the success of the independent program oversight rests with the Program Manager, and Project Sponsor.

7.7 King County Technology Governance

As an integral part of the county's governance structure for its technology environment, the Project Review Board provides a high-level of oversight over all technology projects including ongoing funding approval and continuous project review and reporting throughout the project implementation. The TRS program is subject to the normal county technology governance process.

8.0 Project Deliverables

The major deliverables for the Transit Radio System project are as follows:

- A new 700 MHz radio system infrastructure and communications network, including fixed end and field equipment at remote sites, all radio and communications equipment needed for the new transit Communications Center;
- New mobile and portable radios and spare parts for the fixed route and non-revenue fleets and support staff;
- System design documents and plans detailing system architecture, equipment, interfaces, installation, testing, training and maintenance;
- Frequency licensing and technical support during implementation;
- Remote site leases, permits, structural modifications and facility upgrades;
- Equipment for a limited-function, backup Communications Center;
- Integration with Sound Transit's 800 MHz tunnel radio distribution system; and
- As an option, Access Transportation's paratransit fleet may be included in the system.

9.0 Project Approach

The overall management of this project is within the IT section of King County Metro Transit. The project is following an industry-standard engineering design approach that is typically used for the implementation of new and replacement land mobile radio systems. The Transit Design & Construction section is providing project management, engineering and support for the facility modifications that are needed at the remote sites in the system.

The following approaches and techniques will be used to complete the work:

- Standard radio engineering and planning processes have been used to identify technical, functional and performance requirements for the system. Specialized industry standard tools and metrics were used to complete radio traffic analyses, radio coverage and interference studies, spectrum availability searches, microwave path analyses and remote site assessments.
- The engineering team from Macro Corporation will provide expert review of key contractor deliverables during design, testing and implementation.
- Transit Right-of-Way and Design & Construction management staff are assisting in the acquisition of remote site leases, construction plans, estimates and the management of facility upgrades.
- A performance-based contract that provides for milestone payments associated with clearly defined deliverables and graduated stages of acceptance for design, factory acceptance, system installation, system testing and integration, and fleet installation.
- Radio system testing to verify coverage and system performance will be done by drive tests throughout 1,000 test grids in the Transit service area. Data system performance will be checked with the use of automated communications tools that calculate the "bit error rates" of received test messages as defined in an industry standard. Voice system performance will be verified by human participants who evaluate "delivered audio quality" against an industry standard matrix of performance.
- Use of MS Project and Access for project scheduling, tracking and reporting. An integrated master schedule that includes the OBS/CCS design and implementation process will ensure coordination between the two project teams and their contractors.
- Coordination between the TRS and OBS/CCS contractors will be managed in a working forum called the Technical Interface Committee. Participation in this process is contractually required of both contractors, and will be managed by KCM project managers. It is designed as a mechanism to manage contractor collaboration and the resolution of system integration and implementation issues.

The integration of radio communications in the downtown tunnel will be achieved with hardware connections between the 700 MHz radio system and the 800 MHz tunnel radio system. The KCM radio contractor will collaborate with Sound Transit's communications contractor to implement the integrated system. The On-Board Systems contractor will provide functionality to support the tunnel radio operation.

- A Radio User Task Force participated in requirements definition and will continue to provide input through implementation planning and execution.
- Radio and OBS/CCS project managers routinely review and provide comment on contractor proposals with cross-project dependencies related to system integration and implementation. Since
- A project Steering Committee provides oversight of scope, schedule and budget. Most of the Steering Committee members of this project also serve in the same capacity on the OBS/CCS Project.
- Ongoing Quality Assurance will be provided by a contractor selected from the IT Master Contract list of Quality Management firms.

Following contract award and notice to proceed, the radio contractor's work is organized into five stages. The contractor's work is structured so that certain conditions must be met before moving from one stage to another. Some stages have intermediate milestones to measure incremental progress on activities with extended phases of activity. The completion of each stage is also contingent upon the issuance of a "Notice of Apparent Completion" (NAC). The five stages of work are summarized below:

- **Stage 1** includes contractor mobilization, system design review, and radio license applications. Interface requirements and design specifications will be exchanged and verified with the OBS/CCS contractor during this stage.
- **Stage 2** involves Factory Acceptance Testing for the microwave system and the 700 MHz radio system infrastructure. Following successful testing, the microwave system and some communications center equipment will be delivered to Seattle and installed at radio sites. If OBS/CCS equipment is available during this stage, it may be integrated and tested in the factory environment.
- **Stage 3** includes the delivery, installation and testing of the radio system infrastructure, training for maintenance staff and the delivery of system documentation. Following installation, the system will be optimized and tested for coverage and other critical performance characteristics.
- **Stage 4** will see the delivery, installation and testing of mobile radios, and the distribution of portable radios to assigned transit users. As these activities occur, transit radio users will gradually migrate over to the new system. This Stage will require close coordination with the OBS/CCS contractor. On-Board Systems equipment may be installed prior to bus radios or in a combined installation. The Communication Center System, will be installed, integrated and tested with the radio system infrastructure prior to the installation of any bus radios.
- **Stage 5** includes Final Acceptance Testing, warranty support and the delivery of final documentation.

10.0 Critical Success Factors

The Radio/AVL Replacement project will be deemed successful when the following have occurred:

- The existing radio system has been replaced with an operational system that meets current technology standards and new FCC requirements, before FCC regulations require the existing 450 MHz system to cease operation in 2013.
- The DDU, VLU and 700MHz mobile radio interfaces function correctly and the CCS and OBS radio control functionality meets contract requirements.
- Service Communications has relocated to the new Communications Center and is using the new system.
- Tunnel radio communications functions in an integrated manner so that all radio users within the tunnel facility can communicate seamlessly between the 700 MHz radio system and the 800 MHz radio system.
- Transit Operators, Communications Coordinators and Radio Maintenance staff are fully trained and equipped to operate and maintain the new system.

11.0 Key Risk Factors

The Radio/AVL Replacement project will be working with an experienced vendor team to configure and implement an off-the-shelf solution that will interface to

The significant project risks that have been identified at this time, and their status as of March, 2006, are as follows:

- *Unavailability of spectrum for new radio system.* This risk was identified during project planning and has been mitigated by the FCC's reallocation of the 700 MHz band to public safety use. The Regional Planning Committee responsible for the management of 700 MHz assignments within Washington State has preliminarily allocated nine 25-KHz channels for the new Transit Radio System. The regulatory process to move from this preliminary allocation to formal licensing is in progress and does not appear to present a significant risk at this time.
- *Unavailability of remote sites for new system.* Transit has obtained site agreements or lease options on five of the seven remote sites that are planned for the new system. Negotiations on two remaining sites, owned by the City of Seattle and the City of Bothell, are in progress.
- *Interference on existing 450 MHz channels.* An interference mitigation plan has been developed, with funding set aside in the project budget for its implementation.

- *Installation of new radios in the bus fleet requires implementation of OBS/CCS, which is being procured separately. Project schedules need to be aligned for this to occur.* This issue is actively monitored by the Program Manager, and schedule coordination discussions have taken place with the OBS/CCS proposers as well as the radio contractor. Schedules are currently aligned and there is some flexibility to accommodate changes without significant impacts.
- *Radio controls for the bus operator will be developed by the OBS/CCS contractor.* The Regional Fare Coordination contractor, ERG Ltd, is providing the Driver Display Unit and the Third Party Integration software development kit and documentation. The OBS/CCS proposers have already reviewed this information and submitted their initial technical questions to ERG.
- *Service Communications may not be able to support the staffing requirements for a parallel operation of two communication centers while the fleet is installed.* The project team has identified an alternate migration plan that involves relocating Service Communications to the new Communications Center and operating the 450 MHz system via a remote connection to the Exchange Building. An engineering contractor will be analyzing the technical feasibility, costs, and potential risks of several sub-options within this alternative and issuing a report for Steering Committee consideration in mid-2006.
- *Microwave system design risk: The tower at Norway Hill does not have sufficient capacity for the microwave dishes required to complete the microwave loop.* The City of Bothell is planning to replace the existing tower but has not scheduled this modification. There is room on the tower for the 700 MHz antennas. It may be possible to install smaller microwave antennas for a short intermediate hop to another site, or use commercial telecommunications circuits as an interim measure until the new tower is installed. This issue will be evaluated in greater detail during the microwave system design process after Notice To Proceed.
- *Microwave system design risk: The Capitol Hill tower may not have a straight shot to the Communications Center.* This design issue will be addressed during the microwave system design process after Notice To Proceed. Potential options include rerouting this microwave link with a short hop to another County-owned building on the Central/Atlantic campus, or installing a back-to-back passive repeater on the other radio tower that appears to be in the way.

12.0 Constraints and Assumptions

As stated in the Project Plan, the Transit Radio Replacement project is currently operating under the following constraints and assumptions.

12.1 Constraints

- There are constraints on the timing of radio frequency license applications for the system. The 700 MHz spectrum identified for the system is new spectrum that the FCC has reassigned from television channels 60-69 to public safety uses. Each FCC-designated region must submit a Regional 700 MHz Plan, and receive FCC approval of the Plan, before any license applications can be filed. As of January 30, 2006, the Region 43 Plan was in the final stages of preparation for submittal to the FCC. The FCC has committed to a 120-day turnaround on plan approval. The project expects to be able to file for licenses at some point during Stage 1 of the project, which is expected to be completed within 6 months of Notice to Proceed. At present, the timing of Plan approval does not appear to present a problem to the project schedule, but this could change if Plan submittal does not occur within the 1st quarter of 2006.
- Radio tower availability is a project constraint. The topography and heavily built up urban area served by Metro Transit present significant design challenges and constraints for a new radio system. The engineering consultant identified all potential, existing, radio sites within the service area and developed a Conceptual Design using a subset of those sites. The proposing radio contractors also used a subset of those sites for their proposed system designs. The project team commenced lease negotiations with all of the owners of sites in the Conceptual Design, then narrowed the focus to the specific sites in the design selected by the apparent successful proposer. Successful lease negotiations have been completed on five of these seven sites. The two remaining sites are still in negotiations. If access to these two sites cannot be assured, the project will be forced to negotiate with the owners of other potential tower sites, which may not provide comparable coverage for the system. This in turn could mean that an additional site or two must be added to obtain coverage, which would increase project costs and result in a schedule impact.
- This project requires the successful procurement, development and installation of the OBS/CCS equipment and functionality before new radios can be installed in the revenue fleet, and Communication Center operations can be migrated to the new radio system. These systems will be procured under a separate contract, also managed by the Transit IT section.
- Staffing resources in Radio Maintenance are a constraint for the installation of mobile radios in the non-revenue and revenue fleet. All radio infrastructure at the remote sites and in the Communications Center will be installed by Day Wireless, a Motorola sub-contractor.
- Staffing resources for Transit's Service Communications group – the "communications coordinators" who are the bus dispatchers and primary users of the radio system – present a constraint on system migration plans. Two migration plans are under consideration, with

staffing as a key criteria for determining which plan is ultimately selected.

12.2 Assumptions

1. The FCC will approve Region 43's 700 MHz Plan, which includes a preliminary allocation of nine 25-KHz channels for Metro Transit.
2. License applications submitted following the approval of the Plan will also receive FCC approval in a timely way.
3. Transit will be able to obtain long-term leases with the various owners of the selected remote sites identified as preferred tower locations for the system.
4. KCM staff in Transit's Design & Construction section will manage the site acquisition process and the engineering, permitting and construction management required to complete the modification of remote sites to accommodate the system.
5. The sites can be linked by a private microwave system, or by alternate paths such as fiber or leased network, if microwave paths are obstructed.
6. The Regional Fare Coordination System contractor, ERG, will provide a Driver Display Unit that will support the required radio functions such as Request To Talk, Priority Request To Talk, and related operator controls and alerts.
7. The Driver Display Unit will be successfully installed and tested before the Vehicle Logic Unit and Radio can be installed.
8. The Radio and OBS/CCS Contractors will comply with specific contractual requirements for joint project coordination on integration, testing and system implementation.
9. The Radio contractor will not develop any King County-specific software for this project. The radio system software and network management system provided will be stock, vendor-supported products with published and supported interfaces.
10. Radio system interfaces and interface documentation will be made available to the OBS/CCS contractor to develop their required interfaces for on-board equipment and at the Communication Center.
11. The Radio contractor will provide long-term support for their full suite of products, including system hardware, software. Support will include a variety of services such as bug fixes, updates and enhancements, technical bulletins and websites or other documentation for maintenance technicians. The contract is structured to require and establish long-term support.

12. The OBS/CCS contractor will develop radio-related DDU screens and functions, so that the Vehicle Logic Unit can perform the functions of the radio control head. The OBS/CCS contractor will support Motorola's specified interface to the mobile radio.
13. All radio system infrastructure will be installed by the Contractor.
14. On-board radio equipment, for revenue and non-revenue vehicles, will be installed and tested at KCM bases by internal staff. A combined installation of radio and OBS equipment is being planned. The Contractor will work with Vehicle Maintenance and Radio Maintenance staff to prototype the installation procedure for each vehicle type in the fleet.

13.0 Charter Amendments

Amendments to this charter can be initiated from any stakeholder. Initiated amendments will be discussed by the Steering Committee and presented to the Transit General Manager and DOT Director if necessary.

King County Office of
INFORMATION RESOURCE MANAGEMENT

Radio/AVL Replacement Project Plan

March 2006

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Project Summary

The Radio/AVL Replacement project will replace Metro Transit's existing, obsolete 450 MHz land mobile radio system with a new, 700 MHz radio system that supports voice and data communications and integrates with other Transit business applications

Project Goals:

The goals identified for this project include the following:

1. Replace the existing, obsolete 450 MHz radio system with a new mobile radio system with radio coverage and performance characteristics as good as or better than the existing system;

2. Integrate with and provide data communications for new On-Board System and Communication Center System, which is being procured under a separate contract;

3. Comply with all FCC regulations and requirements applicable to the new system;

4. Implement the new radio system in a new, purpose-built Transit Control Center;

5. Support future bus/rail operations in the Downtown Transit Tunnel by integrating the bus and rail communication systems as required; and

6. Ensure smooth transition for all radio users throughout the process of installation, testing, and cut-over to the new radio system.

Project Scope

The project involves a complete replacement of the existing Transit Radio System, installed in the early 1990s. The following elements are included in the project scope:

- Installation of a new 700 MHz radio system infrastructure and communications network, including fixed end and field equipment at remote sites, all radio and communications equipment needed for the new transit Communications Center,

- Provision of mobile and portable radios and spare parts for the fixed route and non-revenue fleets and support staff;

- System design, integration, installation, testing, training and documentation;

- Frequency licensing and technical support during implementation;

- Remote site leases and applicable permits, and a variety of facility modifications and upgrades at each site;

- Equipment for a limited-function, backup Communications Center;

- Integration with Sound Transit's 800 MHz tunnel radio distribution system;
- Consultant services for technical support and quality management; and
- As an option, Access Transportation's paratransit fleet may be included in the system.

The budget for this project also includes funding for the replacement of the Computer-Aided Dispatch and Automatic Vehicle Location display functions in the Communications Center, such as workstations, servers, software, system integration and testing. However, the project management, procurement and implementation of this element of the project is bundled with the On-Board Systems project. Detailed project planning information on this element is included in the On-Board Systems / Communication Center System (OBS/CCS) Project Plan.

Project Approach

The overall management of this project is within the IT section of King County Metro Transit. The project is following an industry-standard engineering design approach that is typically used for the implementation of new and replacement land mobile radio systems. The Transit Design & Construction section is providing project management, engineering and support for the facility modifications that are needed at the remote sites in the system.

Transit selected Macro Corporation, a qualified radio engineering firm with transit radio implementation experience, to complete system planning and engineering activities, leading up to a Request for Proposals. Their work to date has included the following:

- An analysis of the existing radio system operation to determine radio traffic volumes, coverage and other technical, functional and system performance requirements
- A spectrum search to identify an appropriate and available block of radio spectrum within Metro Transit's service area that could be used to build the system. An FCC database is the primary source of information on available spectrum.
- Identification of all potentially suitable, existing remote sites within the Transit service area. As with spectrum, an FCC database is a primary source of information on existing remote site locations.
- Development of a conceptual design, assuming the selected spectrum in the 700 MHz band, given the characteristics of that spectrum and applicable FCC rules. Specialized radio analysis tools, modeled on GIS but with additional features related to frequency propagation and land use characteristics (terrain, urban clutter, etc) are used for this analysis.
- Development of more detailed requirements which formed the basis of a competitive Request For Proposals. The Project team combined the technical specifications with King County's terms and conditions and issued a Request for Proposals. Macro participated in proposal evaluation and provided a punch-list of issues to be addressed during contract negotiations.

Following contract award and notice to proceed, the radio contractor's work is organized into five stages. The contractor's work is structured so that certain conditions must be met before moving from one stage to another. Some stages have intermediate milestones to measure incremental progress on activities with extended phases of activity. The completion of each stage is also contingent upon the issuance of a "Notice of Apparent Completion" (NAC). The five stages of work are summarized below:

- **Stage 1** includes contractor mobilization, system design review, and radio license applications. Interface requirements and design specifications will be exchanged and verified with the OBS/CCS contractor during this stage.

- **Stage 2** involves Factory Acceptance Testing for the microwave system and the 700 MHz radio system infrastructure. Following successful testing, the microwave system and some communications center equipment will be delivered to Seattle and installed at radio sites. If OBS/CCS equipment is available during this stage, it may be integrated and tested in the factory environment.

- **Stage 3** includes the delivery, installation and testing of the radio system infrastructure, training for maintenance staff and the delivery of system documentation. Following installation, the system will be optimized and tested for coverage and other critical performance characteristics.

- **Stage 4** will see the delivery, installation and testing of mobile radios, and the distribution of portable radios to assigned transit users. As these activities occur, transit radio users will gradually migrate over to the new system. This Stage will require close coordination with the OBS/CCS contractor. On-Board Systems equipment may be installed prior to bus radios or in a combined installation. The Communication Center System, will be installed, integrated and tested with the radio system infrastructure prior to the installation of any bus radios.

- **Stage 5** includes Final Acceptance Testing, warranty support and the delivery of final documentation.

The acquisition and preparation of remote sites is essential for radio system installation. This aspect of the project involves civil and structural engineering and construction, rather than technology acquisition. Rather than bundle this work with the radio system procurement, the project team opted to manage the site acquisition process separately, with dedicated and expert assistance from Transit's Design & Construction section. Separating the construction-related work from the technology acquisition greatly simplified the procurement process for these two major aspects of the project, and allowed the project to accelerate site acquisition in parallel with the system procurement, and ensure that sites would be available to the radio vendor as soon as possible.

Starting with the sites identified in the Conceptual Design provided by Macro, the project team met with remote site owners and evaluated the characteristics of each site, including building spaces, power, tower loading, site access and related conditions. An engineering pre-design analysis, completed by a contracted A&E firm, identified preliminary costs for the required modifications at each site. As the radio system procurement moved into negotiations with an apparent successful proposer, the project team was able to focus on

the seven specific sites identified in that proposal. A construction firm with radio site construction experience will be selected to complete the site modifications.

Standard project management processes for contract administration, engineering, design review, and inspection will be used to manage the facility upgrades and preparation.

Project Phases & Milestones

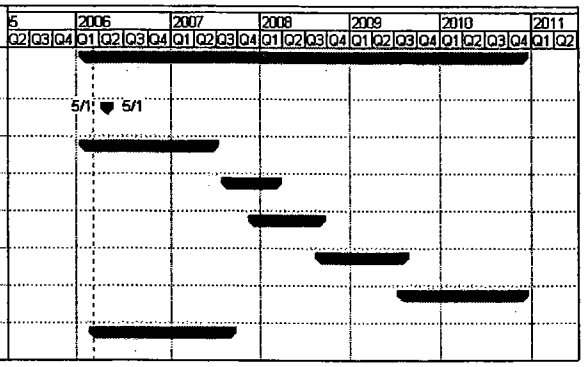
The table below identifies the major stages and milestones that are built in to the radio contract. The milestone dates provided are based on the assumption of a May 1, 2006 issuance of Notice To Proceed.

Contract Stage	Completion Milestone
Stage 1, System Design	June 19, 2007
Stage 2, Factory Acceptance Testing and Microwave Installation	March 5, 2008
Stage 3, Installation of Radio System Infrastructure	July 29, 2008
Stage 4, Fleet Installation and Testing	July 4, 2009
Stage 5, Final Acceptance	November 25, 2009

Schedule

A summary view of the project schedule is provided below.

ID	Task Name	Start	Finish	Duration
493	**TRS System Schedule**	2/7/06	11/25/10	1253 days
494	Notice to Proceed	5/1/06	5/1/06	1 day
495	Stage One (Complete Final Design Deliverables & License Applications)	2/7/06	6/19/07	356 days
766	Stage Two (Complete Installation and Testing Of Digital Loop Microwave System & FNE	8/14/07	3/5/08	147 days
799	Stage Three (Install/Test Base Station Equipment - All Sites)	12/3/07	8/29/08	195 days
860	Stage Four (Installation of mobile Equipment)	9/1/08	8/4/09	242 days
892	Stage Five (TRS Implementation and Warranty Support)	8/5/09	11/25/10	342 days
899	TRS Architecture & Engineering	3/13/06	8/30/07	384 days



Budget

A summary of the project budget is provided below:

	Cost in Millions
Radio, non-Vendor Contract Costs	
▪ King County labor, project management and technical support	$4.2
▪ Interference mitigation labor and additional licensing	$0.4
▪ Site leases: options, leases and related labor	$1.7
▪ Consultant Support	$1.7
▪ Transmitter Site Elements	$2.8
Radio Vendor Contract	
▪ Fixed Equipment—Radio Communication Hardware at Remote Sites	$12.2
▪ Field Equipment—Mobile & Portable Radios and Repeaters, including Access (Note 3)	$12.8
▪ Microwave Loop—Network Connections to the Transit Communication Center	$1.6
▪ Technical services, Licensing, Performance Security & 1st Year Maintenance	$2.4
Radio Contingency (Note 1)	$5.1
AVL Software at the Communication Center, and Contingency (Note 2)	$10.4
TOTAL	**$55.3**

Budget Notes

1. Contingency plan: 20% for microwave loop; 15% for rest of radio contract; 10% for remainder of project.
2. Communication Center System (CCS) is being procured with the OBS, and managed separately
3. Sound Transit will reimburse King County for radios that are installed on their fleet.

1. Scope and Schedule

1.0 Summary

The Radio/AVL Replacement project will replace Metro Transit's existing, obsolete 450 MHz land mobile radio system with a new, 700 MHz radio system that supports voice and data communications and integrates with other Transit business applications

This Project Plan describes the project scope, schedule and budget in detail, and provides information on the project organization, project management processes and procedures that will be used to manage the project.

This Project Plan will be updated as major phases of the project are completed and approval is requested to move to the next phase of work.

1.1 Terminology

This section contains a list of acronyms, abbreviations and terms used in this document.

1.1.1 Acronyms and Abbreviations

Acronym or Abbreviation	Definition
CAD/AVL	Computer Aided Dispatch/Automated Vehicle Location
CCS	Communications Center System (replaces legacy CAD/AVL system)
DDU	Driver Display Unit
GPS	Global Positioning System
KC WAN	King County Wide Area Network
KCM	King County Metro (Transit Division, Department of Transportation)
NAC	Notice of Apparent Completion
OBS	On-Board Systems
PA	Public Address (system)
RFCS	Regional Fare Coordination System
RFP	Request For Proposals
TRS	Transit Radio System
TSP	Transit Signal Priority
VLU	Vehicle Logic Unit
IT	Information Technology Section, Transit Division
SMA	Systems Management & Analysis (group in the IT Section)
VM	Vehicle Maintenance (section in KCM Transit Division)
RM	Radio Maintenance (group in the Power & Facilities Section)
I&I	Infrastructure & Integration (group in the IT Section)
TSS	Transit Systems Support (group in the IT Section)
TIC	Technical Interface Committee

1.1.2 Terms

Term	Definition
Remote site	A radio antenna tower site, typically "remote" in relation to the Communication Center.
Coordinator	A radio dispatcher who works in the Communication Center.

1.2 Project Description

This project will replace Metro Transit's existing 450 MHz radio system, which is obsolete and due for life cycle replacement. The new system will be built in the 700 MHz band, and in compliance with applicable FCC rules will be a fully digital system supporting Transit's voice and data requirements. The system will include new base stations and related infrastructure at seven remote sites, a dedicated microwave backbone communication system connecting those sites to the new Transit Communications Center, all of the required master control systems at the Communications Center, and the necessary console equipment to support Transit radio coordinators in their daily operation.

In addition, the project will include interfaces to the On-Board Systems (OBS) installed on the revenue fleet, and interfaces to the Communication Center System (CCS) providing Computer-Aided Dispatch and Automatic Vehicle Location monitoring functionality to the radio coordinators. OBS and CCS functionality are being procured under a separate contract.

1.2.1 Background

The transit radio system was installed in 1990-1991. The system uses ten 450 MHz channels for voice and data communications with the revenue fleet, and voice communications for supervisors and other support staff. Two 800 MHz channels provide voice communications for Power Distribution and Facilities Maintenance staff.

The system needs to be replaced because many parts of the system are obsolete and no longer available. For several years, Radio Maintenance has watched the "gray market" and purchased old surplus radios that have been discarded by other agencies, but even this source of parts has been depleted. Vendor support is no longer available, and some of the manufacturers of the original equipment have gone out of business. By federal law, the FCC regulates all non-military radio systems, including all those operated by public agencies. In 1995, the FCC adopted a broad new set of "refarming" rules affecting radio spectrum below 512 MHz. As a result of the new rules, the transit radio system must be redesigned from end to end, and replaced in its entirety. Macro Corporation, Transit's radio engineering consultants, recommend that transit relocate the system into new spectrum that the FCC is opening up in the 700 MHz band. Because 700 MHz spectrum has different characteristics, the system still needs to be redesigned to obtain adequate coverage. No refarming is planned for the 700 MHz band, and it is set aside for public agencies. If Transit tried to stay in the 450 MHz band, there would always be competition with other private and commercial interests.

The budget for this project also includes funding for the replacement of the Computer-Aided Dispatch and Automatic Vehicle Location display functions in the Communications Center, such as workstations, servers, software, system integration and testing. However, the project management, procurement and implementation of this element of the project is

bundled with the On-Board Systems project. Because the CCS & OBS communicate with each other via the radio "pipeline", the decision was made to procure them together to ensure compatibility. Detailed project planning information on this element is included in the On-Board Systems / Communication Center System (OBS/CCS) Project Plan.

1.2.2 Objectives

The project objectives are as follows:

1. Replace the existing, obsolete 450 MHz radio system with a new mobile radio system with radio coverage and performance characteristics as good as or better than the existing system.
2. Integrate with and provide data communications for new On-Board System and Communication Center System, which is being procured under a separate contract.
3. Comply with all FCC regulations and requirements applicable to the new system.
4. Implement the new radio system in a new, purpose-built Transit Control Center.
5. Support future bus/rail operations in the Downtown Transit Tunnel by integrating the bus and rail communication systems as required.
6. Ensure smooth transition for Operations throughout the process of installation, testing, and cutover to the new radio system.

1.2.3 Major Deliverables

The major deliverables for the project are as follows:

- A new 700 MHz radio system infrastructure and communications network, including fixed end and field equipment at remote sites, all radio and communications equipment needed for the new transit Communications Center,
- New mobile and portable radios and spare parts for the fixed route and non-revenue fleets and support staff;
- System design documents and plans detailing system architecture, equipment, interfaces, installation, testing, training and maintenance;
- Frequency licensing and technical support during implementation;
- Remote site leases, permits, structural modifications and facility upgrades;
- Equipment for a limited-function, backup Communications Center;
- Integration with Sound Transit's 800 MHz tunnel radio distribution system; and
- As an option, Access Transportation's paratransit fleet may be included in the system.

1.2.4 KCM Concurrent Projects

Successful implementation of the new radio system requires the coordination and completion of several concurrent projects. Some are budgeted within this project but managed separately, others are budgeted and managed separately.

Project	Description	Responsibility
Remote Site Leases and Agreements	Negotiate and secure agreements with site owners for the remote sites in the system. (Included in this project scope and budget.)	Transit Design & Construction is the lead
Remote Site Facility Modifications	Complete engineering and design, obtain permits and manage the construction modifications to each site as required. (Included in this project scope and budget.)	Transit Design & Construction is the lead
Construction of New Transit Communications Center	Construct a new Communication Center facility and provide facility systems to support user migration and the implementation of the new radio system. (Budgeted and managed separately.)	Transit Design & Construction is the lead
On-Board Systems & Communication Center System Implementation	Manage the procurement and implementation of new on-board systems and a communication center system to replace the legacy CAD/AVL system. (OBS/CCS is managed separately; CCS is budgeted within this project.)	Transit IT is the lead
Migration to new Communications Center	Move Service Communications staff and equipment to the new Communications Center. Two options are being considered. (Radio-related equipment and engineering is included in this budget. Some other costs, such as new telephones, are budgeted elsewhere.)	Transit IT is the lead for alternatives analysis
Deployment of Voice Radio Communications for Access Transportation	The Access (paratransit) fleet may be included in the system, under a contract option. This decision needs to be exercised within 1 year of Notice to Proceed. (Budget for Access-related equipment is included. Budget for Accessible Services staffing and coordination is not included.)	Transit IT is the lead for radio system deployment. Accessible Services should assign a client lead for internal coordination.

Project	Description	Responsibility
Interference Mitigation (If required)	Reprogram bus radios and modify existing Data Acquisition & Control System to use different channels. May or may not be required, depending on levels of radio interference on 450 MHz channels. (Included in this project scope and budget.)	Radio Maintenance is the lead

1.2.5 Approach and Techniques

This project will utilize the following approaches and techniques to complete its work.

- Standard radio engineering and planning processes have been used to identify technical, functional and performance requirements for the system. Specialized industry standard tools and metrics were used to complete radio traffic analyses, radio coverage and interference studies, spectrum availability searches, microwave path analyses and remote site assessments.
- The engineering team from Macro Corporation will provide expert review of key contractor deliverables during design, testing and implementation.
- Transit Right-of-Way and Design & Construction management staff are assisting in the acquisition of remote site leases, construction plans, estimates and the management of facility upgrades.
- A performance-based contract that provides for milestone payments associated with clearly defined deliverables and graduated stages of acceptance for design, factory acceptance, system installation, system testing and integration, and fleet installation.
- Radio system testing to verify coverage and system performance will be done by drive tests throughout 1,000 test grids in the Transit service area. Data system performance will be checked with the use of automated communications tools that calculate the "bit error rates" of received test messages as defined in an industry standard. Voice system performance will be verified by human participants who evaluate "delivered audio quality" against an industry standard matrix of performance.
- Use of MS Project and Access for project scheduling, tracking and reporting. An integrated master schedule that includes the OBS/CCS design and implementation process will ensure coordination between the two project teams and their contractors.
- Coordination between the TRS and OBS/CCS contractors will be managed in a working forum called the Technical Interface Committee. Participation in this process is contractually required of both contractors, and will be managed by KCM project managers. It is designed as a mechanism to manage contractor collaboration and the resolution of system integration and implementation issues.
- The integration of radio communications in the downtown tunnel will be achieved with hardware connections between the 700 MHz radio system and the 800 MHz tunnel radio system. The KCM radio contractor will collaborate with Sound Transit's communications contractor to implement the integrated system. The On-Board Systems contractor will provide functionality to support the tunnel radio operation.

- A Radio User Task Force participated in requirements definition and will continue to provide input through implementation planning and execution.
- Radio and OBS/CCS project managers routinely review and provide comment on contractor proposals with cross-project dependencies related to system integration and implementation.
- A project Steering Committee provides oversight of scope, schedule and budget. Most of the Steering Committee members of this project also serve in the same capacity on the OBS/CCS Project.
- Ongoing Quality Assurance will be provided by a contractor selected from the IT Master Contract list of Quality Management firms.

1.2.6 Impacted Business Areas

The following business areas will be impacted by this project.

Operations

The Operations section is the primary client for the radio system and has the majority of users. Deployment of the new system will affect the workgroups within Operations in different ways:

- Transit Operators will continue to use the familiar "Request To Talk" and "Priority Request To Talk" functions carried over from the existing system. However, the deployment of OBS/CCS in conjunction with the new radio system will enable some new functions such as the use of data messages, and a new mode of voice communications for joint bus/rail tunnel operations.
- Service Communications chiefs and first line supervisors – the radio coordinators who are the primary operators of the system -- will require training on the new radio console interface and, in conjunction with the deployment of CCS, a variety of new features and functions for call and incident management. The coordinators will also require training on the new on-board features and functionality provided by OBS/CCS, since they are a primary source of information for transit operators.
- Service Quality chiefs and first line supervisors are primary users of the voice radio system and will require training on the operation of mobile and portable radios. Like the coordinators, the first line supervisors in Service Quality will require training on the new on-board features and functionality provided by OBS/CCS, since they are a often respond, in the field, to transit operators who may be having problems with on-board equipment.
- Operations Training staff will require Train-The-Trainer training to enable them to train operators on the operation of the system and the new features in the Driver Display Unit that are enabled by the OBS/CCS deployment. Operations Training staff will be required to provide operator training courses at each base as new radios are installed in the revenue fleet.
- Base Operations staff are relatively infrequent users of the radio system but will need to learn the basic operation of mobile and portable radios. They also need a basic understanding of the features of the new radio and on-board systems that their operators will be using. Their support will be required during system deployment as operators are circulated through radio system training.

Other Radio Users

In addition to Operations staff, several other business groups within Transit use the existing radio system and will require training on the voice communications features of the new mobile and portable radios. These staff include:

- Metro Transit Police;
- Transit Safety Officers;
- Vehicle Maintenance staff;
- Power and Facilities staff; and
- Various senior management staff who occasionally use radios.

Transit Radio Maintenance

Radio maintenance staff will be required to: define requirements; evaluate selected products and design documents; participate in system and interface testing; work with VM on installation of OBS equipment on the revenue vehicles; provide training for Radio Technicians; participate in system oversight; and maintain the WLAN equipment.

Transit Information Technology

Transit's Information Technology section provides project oversight and supervision for the project. The IT Systems Management & Analysis group also supervises the Regional Fare Coordination System (RFCS) "smart card" project and the OBS/CCS project. All three projects are linked by scope and schedule interdependencies, primarily due to shared equipment on-board the revenue vehicle. The RFCS contractor, ERG Limited, is providing a Driver Display Unit that will support new functions delivered by the OBS/CCS contractor, as well as the operator radio controls required for the Transit Radio System project.

King County Radio Services

King County's Radio Services group in the ITS division is the site owner for several remote sites that are planned for the new radio system. An agreement covering the terms and conditions of Transit's access to these sites has been negotiated.

King County ITS, Telecommunications Services

The Telecom group in ITS is the lead for the procurement and installation of a new telephone system in the new Communications Center. There will be an interface between the independent radio network and the CCS servers and console equipment, which are located on the KC-WAN. There also will be an interface between the radio system consoles and the Communication Center telephone system.

Sound Transit Link

The Link light rail system will be operated by KCM under contract to Sound Transit. Link will have a dedicated rail operations and maintenance staff, and the rail operation as a whole will use the King County Regional 800 MHz Trunked Radio System, rather than the Metro Transit 700 MHz radio system. However, to ensure safety and coordination for joint bus/rail operation within the Downtown Seattle Transit Tunnel (DSTT), the two systems will be integrated so that radio calls on one system will be heard on the other, and vice versa. This integration will be achieved through deployment of radio control

stations and the use of special features in the new 700 MHz radios which will enable the use of shared talk groups on the two radio systems.

1.2.7 Project Success

The Radio/AVL Replacement project will be deemed successful when the following have occurred:

- The existing radio system has been replaced with a operational system that meets current technology standards and new FCC requirements, before FCC regulations require the existing 450 MHz system to cease operation in 2013.
- The DDU, VLU and 700MHz mobile radio interfaces function correctly and the CCS and OBS radio control functionality meets contract requirements.
- Service Communications has relocated to the new Communications Center and is using the new system.
- Tunnel radio communications functions in an integrated manner so that all radio users within the tunnel facility can communicate seamlessly between the 700 MHz radio system and the 800 MHz radio system.
- Transit Operators, Communications Coordinators and Radio Maintenance staff are fully trained and equipped to operate and maintain the new system.

1.3 Project Scope

1.3.1 Within the Project's Scope

The project scope includes the following:

- Replace the transit radio system infrastructure, Communication Center radio equipment, audio recording system and all mobile and portable radios;
- Integrate with OBS/CCS functionality and equipment on-board the revenue vehicles and in the Communications Center, to be provided under a separate contract;
- Integrate with the 800 MHz radio system in the DSTT; and
- Install, test and implement the new system in the new Communication Center facility at 6th Avenue South and South Atlantic Street.

1.3.2 Beyond Scope of the Project

The following will <u>not</u> be done by the project:

- Complete software or hardware modifications to OBS/CCS contractor's products;
- Provide furniture for the new Communications Center; and
- Provide a telephone system for the new Communications Center.

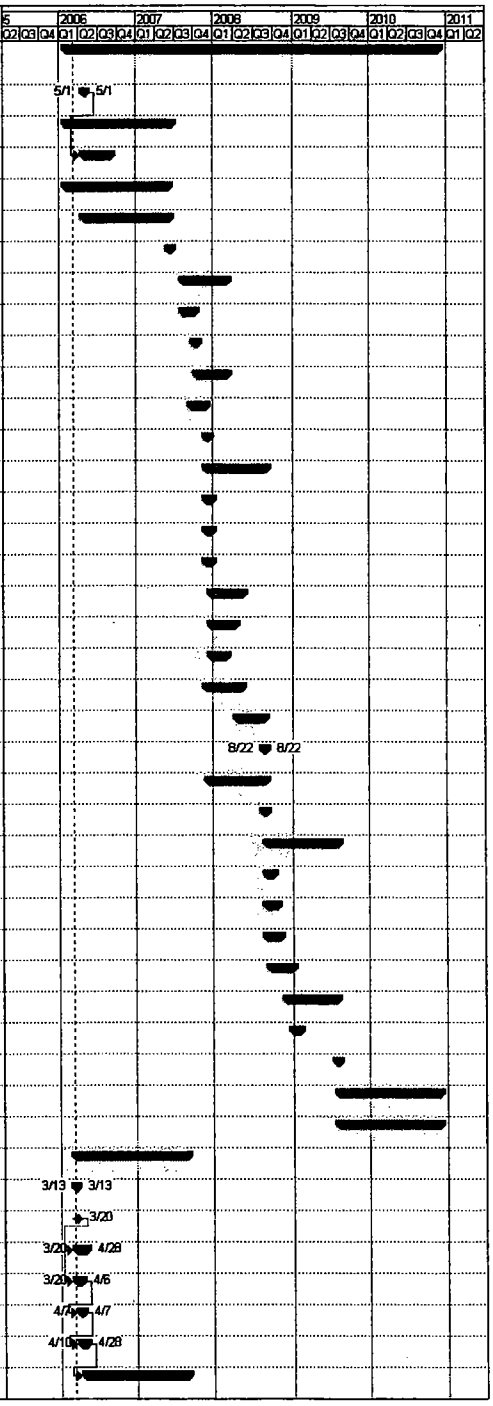
1.4 Schedule and Tasks

1.4.1 Schedule Dependencies

- A contractor must be selected and a contract negotiated before the project can be started and the schedule baseline confirmed.
- Project staff must secure lease agreements for the remote sites intended to be used by the radio system contractor.
- The necessary modifications for each site (structural, HVAC, electrical) must be completed before radio system infrastructure can be installed.
- The OBS/CCS contractor must integrate and support the interfaces between Motorola's radio system and their systems.
- Production units of the RFCS equipment and software must be provided to the OBS/CCS contractor, so that they can develop the Driver Display application, including the necessary functions for the new radio system.
- The radio system infrastructure must be installed and operational prior to CCS installation and testing.
- The new system must be operational before FCC regulations require the decommissioning of the existing 450 MHz radio system in 2013.
- Each of the five stages of the project have specific contractual requirements which must be successfully completed by the radio contractor prior to beginning work on the next project stage.
- Future tunnel radio communications for joint bus/rail operations requires integrated functionality from the OBS/CCS contractor and the radio contractor. The timing for implementation of this functionality depends on both contractors' schedules for installation and system deployment. In addition, Sound Transit's communications contractor must complete their installation and testing of the new tunnel radio distribution system.

1.4.2 Schedule and Time Line

ID	Task Name	Start	Finish	Duration
498	**TRS System Schedule**	2/7/06	11/25/10	1253 days
499	Notice to Proceed	5/1/06	5/1/06	1 day
500	Stage One (Complete Final Design Deliverables & License Applications)	2/7/06	6/19/07	356 days
501	Stage 1A. Milestone	5/2/06	9/1/06	89 days
531	Stage 1B. License Applications	2/7/06	6/4/07	345 days
561	Stage 1C. Final Design Deliverables	5/2/06	6/11/07	298 days
768	1D - Stage One NAC Issued	6/12/07	6/19/07	6 days
771	Stage Two (Complete Installation and Testing Of Digital Loop Microwave System & FNE	8/14/07	3/5/08	147 days
772	2A - Factory Acceptance Test Digital Loop Microwave	8/14/07	10/8/07	40 days
776	2B - Deliver & Secure Digital Loop-Microwave	10/9/07	10/22/07	10 days
780	2C - a. Installation and Testing of Digital Loop Microwave System Equipment	10/23/07	3/5/08	97 days
786	2D - FAT of FNE	9/24/07	11/30/07	50 days
801	2E - Stage Two NAC Issued	12/3/07	12/10/07	6 days
804	Stage Three (Install/Test Base Station Equipment - All Sites)	12/3/07	8/29/08	195 days
805	3A - Deliver & Secure	12/3/07	12/27/07	19 days
812	3B - Deliver & Secure Communications Center Equipment	12/3/07	12/27/07	19 days
816	3C - Deliver & Secure	12/3/07	12/27/07	19 days
823	3D - 1.Install & Test	12/28/07	5/15/08	100 days
833	3E - Install & Test Communications Center Equipment	12/28/07	4/10/08	75 days
838	3F - Install and Test Control Station Equip	12/28/07	2/28/08	45 days
847	3G - 1. Train Installation/Maintenance Personnel and Deliver System Docs	12/3/07	5/9/08	115 days
852	3H - System Optimize and Coverage Verification	4/25/08	8/21/08	85 days
857	3I - CCS Control Center Integration Test	8/22/08	8/22/08	1 day
858	3J - . Train Users and Deliver Manuals	12/11/07	8/22/08	184 days
862	3K - Stage Three NAC Issued	8/22/08	8/29/08	6 days
865	Stage Four (Installation of mobile Equipment)	9/1/08	8/4/09	242 days
866	4A - Deliver & Test Portable Radio Equipment	9/1/08	9/26/08	20 days
869	4B - Mobile Equipment - Field Tests	9/1/08	10/17/08	35 days
875	4C - Mobile Equipment - Mobile Non-Rev Equipment (359 Kits)	9/1/08	10/27/08	41 days
878	4D - Mobile Equipment - Pilot Test	9/22/08	12/26/08	70 days
882	4E - (Complete Delivery and testing of mobile Equipment) [1221 Kits]	12/1/08	7/27/09	171 days
891	4F - Deliver and Test Spare Equip	12/29/08	1/30/09	25 days
894	4H - Stage Four NAC Issued	7/28/09	8/4/09	6 days
897	Stage Five (TRS Implementation and Warranty Support)	8/5/09	11/25/10	342 days
898	5A - Full System Acceptance & Deliver Final System Documentation	8/5/09	11/25/10	342 days
904	TRS Architecture & Engineering	3/13/06	8/30/07	384 days
905	Project kick off	3/13/06	3/13/06	1 day
906	Site visit	3/20/06	3/20/06	0 days
907	Survey existing electrical systems	3/20/06	4/28/06	30 days
908	Zoning Analysis	3/20/06	4/6/06	14 days
909	Meeting with equipment manufacturer	4/7/06	4/7/06	1 day
910	Equipment specifications provided	4/10/06	4/28/06	15 days
911	Architecture & Engineering	4/28/06	8/30/07	349 days



1.5 Constraints and Assumptions

1.5.1 Constraints

- There are constraints on the timing of radio frequency license applications for the system. The 700 MHz spectrum identified for the system is new spectrum that the FCC has reassigned from television channels 60-69 to public safety uses. Each FCC-designated region must submit a Regional 700 MHz Plan, and receive FCC approval of the Plan, before any license applications can be filed. As of January 30, 2006, the Region 43 Plan was in the final stages of preparation for submittal to the FCC. The FCC has committed to a 120-day turnaround on plan approval.

  The project expects to be able to file for licenses at some point during Stage 1 of the project, which is expected to be completed within 6 months of Notice to Proceed. At present, the timing of Plan approval does not appear to present a problem to the project schedule, but this could change if Plan submittal does not occur within the 1st quarter of 2006.

- Radio tower availability is a project constraint. The topography and heavily built up urban area served by Metro Transit present significant design challenges and constraints for a new radio system. The engineering consultant identified all potential, existing, radio sites within the service area and developed a Conceptual Design using a subset of those sites. The proposing radio contractors also used a subset of those sites for their proposed system designs. The project team commenced lease negotiations with all of the owners of sites in the Conceptual Design, then narrowed the focus to the specific sites in the design selected by the apparent successful proposer.

  Successful lease negotiations have been completed on five of these seven sites. The two remaining sites are still in negotiations. If access to these two sites cannot be assured, the project will be forced to negotiate with the owners of other potential tower sites, which may not provide comparable coverage for the system. This in turn could mean that an additional site or two must be added to obtain coverage, which would increase project costs and result in a schedule impact.

- This project requires the successful procurement, development and installation of the OBS/CCS equipment and functionality before new radios can be installed in the revenue fleet, and Communication Center operations can be migrated to the new radio system. These systems will be procured under a separate contract, also managed by the Transit IT section.

- Staffing resources in Radio Maintenance are a constraint for the installation of mobile radios in the non-revenue and revenue fleet. All radio infrastructure at the remote sites and in the Communications Center will be installed by Day Wireless, a Motorola sub-contractor.

- Staffing resources for Transit's Service Communications group – the "communications coordinators" who are the bus dispatchers and primary users of the radio system – present a constraint on system migration plans. Two migration plans are under consideration, with staffing as a key criteria for determining which plan is ultimately selected.

1.5.2 Assumptions

Key assumptions related to this project are summarized below. Some items relate to the OBS/CCS contract, which is not expected to be negotiated until mid- to late 2006.

1) The FCC will approve Region 43's 700 MHz Plan, which includes a preliminary allocation of nine 25-KHz channels for Metro Transit.
2) License applications submitted following the approval of the Plan will also receive FCC approval in a timely way.
3) Transit will be able to obtain long-term leases with the various owners of the selected remote sites identified as preferred tower locations for the system.
4) KCM staff in Transit's Design & Construction section will manage the site acquisition process and the engineering, permitting and construction management required to complete the modification of remote sites to accommodate the system.
5) The sites can be linked by a private microwave system, or by alternate paths such as fiber or leased network, if microwave paths are obstructed.
6) The Regional Fare Coordination System contractor, ERG, will provide a Driver Display Unit that will support the required radio functions such as Request To Talk, Priority Request To Talk, and related operator controls and alerts.
7) The Driver Display Unit will be successfully installed and tested before the Vehicle Logic Unit and Radio can be installed.
8) The Radio and OBS/CCS Contractors will comply with specific contractual requirements for joint project coordination on integration, testing and system implementation.
9) The Radio contractor will not develop any King County-specific software for this project. The radio system software and network management system provided will be stock, vendor-supported products with published and supported interfaces.
10) Radio system interfaces and interface documentation will be made available to the OBS/CCS contractor to develop their required interfaces for on-board equipment and at the Communication Center.
11) The Radio contractor will provide long-term support for their full suite of products, including system hardware, software. Support will include a variety of services such as bug fixes, updates and enhancements, technical bulletins and websites or other documentation for maintenance technicians. The contract is structured to require and establish long-term support.
12) The OBS/CCS contractor will develop radio-related DDU screens and functions, so that the Vehicle Logic Unit can perform the functions of the radio control head. The OBS/CCS contractor will support Motorola's specified interface to the mobile radio.
13) All radio system infrastructure will be installed by the Contractor.
14) On-board radio equipment, for revenue and non-revenue vehicles, will be installed and tested at KCM bases by internal staff. A combined installation of radio and OBS equipment is being planned. The Contractor will work with

Vehicle Maintenance and Radio Maintenance staff to prototype the installation procedure for each vehicle type in the fleet.

1.6 Project Charter

The purpose of the Project Charter is to provide a formal agreement between the Project Sponsors, Clients, and Project Manager. These parties agree on the content of the project components contained in the following sections of the Project Plan.

Section 1.1.2	Project Objectives
Section 1.1.4	Project Approach
Section 1.2	Scope
Section 1.3	Schedule and Tasks
Section 2	Project Cost Management Plan
Section 3	Organizational and Management Plan
Section 4	Communication & Project Reporting Plan

Endorsement:

_____ _____

Jim O'Rourke
Manager, Transit Operations
Project Sponsor/Client

Date

_____ _____

Jerry Rutledge
Manager, Power and Facilities
Project Sponsor/Client

Date

_____ _____

Larry Calter
Manager, Information Technology
Project Sponsor/Client

Date

_____ _____

David Mendel

Date

Manager, King County Radio Services
Project Stakeholder

_____ _____

Park Woodworth Date
Manager, Paratransit and Rideshare Operations
Project Sponsor/Client

_____ _____

Judy Riley Date
Manager, Design and Construction
Project Sponsor/Client

_____ _____

Hai Phung Date
Project Manager, Information Technology

2. Project Cost Management Plan

2.0 Summary

A summary of the project budget is as follows:

	Cost in Millions
Radio, non-Vendor Contract Costs	
▪ King County labor, project management and technical support	$4.2
▪ Interference mitigation labor and additional licensing	$0.4
▪ Site leases: options, leases and related labor	$1.7
▪ Consultant Support	$1.7
▪ Transmitter Site Elements	$2.8
Radio Vendor Contract	
▪ Fixed Equipment—Radio Communication Hardware at Remote Sites	$12.2
▪ Field Equipment—Mobile & Portable Radios and Repeaters, including Access (Note 3)	$12.8
▪ Microwave Loop—Network Connections to the Transit Communication Center	$1.6
▪ Technical services, Licensing, Performance Security & 1st Year Maintenance	$2.4
Radio Contingency (Note 1)	$5.1
AVL Software at the Communication Center, and Contingency (Note 2)	$10.4
TOTAL	**$55.3**

Budget Notes

1. Contingency plan: 20% for microwave loop; 15% for rest of radio contract; 10% for remainder of project.
2. Communication Center System (CCS) is being procured with the OBS, and managed separately
3. Sound Transit will reimburse King County for radios that are installed on their fleet.

The project is funded through the Transit CIP. Federal grants will reimburse $7 million of project expense. Sound Transit will reimburse King County Metro for the cost of radio equipment and installation on their vehicles. No agreement has been negotiated, but the expected Sound Transit funding is $360,000.

2.1 Project Budget and Spending Plan

The project spending plan is summarized in the following table.

Radio/AVL Replacement Total Project Costs - Cash Flow

	LTD 2003	2004	2005	2006	2007	2008	2009	Total
Radio, non Vendor Contract Costs:								
King County project management and tech support	644,347	148,375	309,516	727,253	853,192	889,682	579,781	4,152,146
Interference mitigation labor, incl. additional licensing			30,000	370,000				400,000
Consultant Support	558,006	83,896	80,000	500,000	500,000			1,721,902
Site Leases: options, leases and related labor	88,105	161,376	195,648	584,894	235,956	200,000	200,000	1,665,979
Transmitter Site Elements			500,000	2,327,420				2,827,420
Radio Vendor Contract				3,776,519	14,267,750	7,615,163	3,334,373	28,993,805
Radio Contingency			61,516	394,666	2,836,062	1,251,243	578,517	5,122,004
CCS - AVL software and contingency	223,763	106,355	323,313	1,902,790	2,511,280	2,337,263	3,048,360	10,453,124
TOTAL	1,514,221	500,002	1,499,993	10,583,542	21,204,240	12,293,351	7,741,031	55,336,380

2.2 Cost Control Process

The project will use King County's standard methodologies for controlling project costs.

2.2.1 Timesheet Control

Project team members submit weekly timesheets that will document time spent on this project. The project manager will review monthly IBIS reports to confirm or check staff time accrued to the project. Subproject numbers will be used for related concurrent projects.

2.2.2 Approving and Tracking Project Expenditures

All project-related expenditures (labor, hardware, training, etc.) will be tracked on a monthly basis. Payments will be made only after a milestone has been successfully completed. All invoices must include a detailed description of the work and products delivered. The Radio Contract and the construction contract(s) to be managed by Transit Design & Construction include King County boilerplate requirements related to allowable contract costs.

2.2.3 Procuring Project Equipment and Supplies

Radio System procurement will be done by IT administration following County procurement practices and procedures.

The contract is for a fixed price and deliverable- and outcome-based. The Radio contract defines project outcome-, work product-, and deliverable verification procedures for each project milestone.

2.2.4 Spending the Contingency

Approval to spend the contingency funds must come from the project Steering Committee, with subsequent approval via a funding release authorized by the Project Review Board.

The radio engineering consultant recommended that additional contingency be set aside to accommodate potential uncertainties in the microwave system design. As a result, the proposed allocation of contingency for the project is as follows: 20% for microwave loop; 15% for rest of radio contract; 10% for remainder of project. These allocations are preliminary and may be adjusted by the steering committee as the project moves forward.

3. Organization and Management Plan

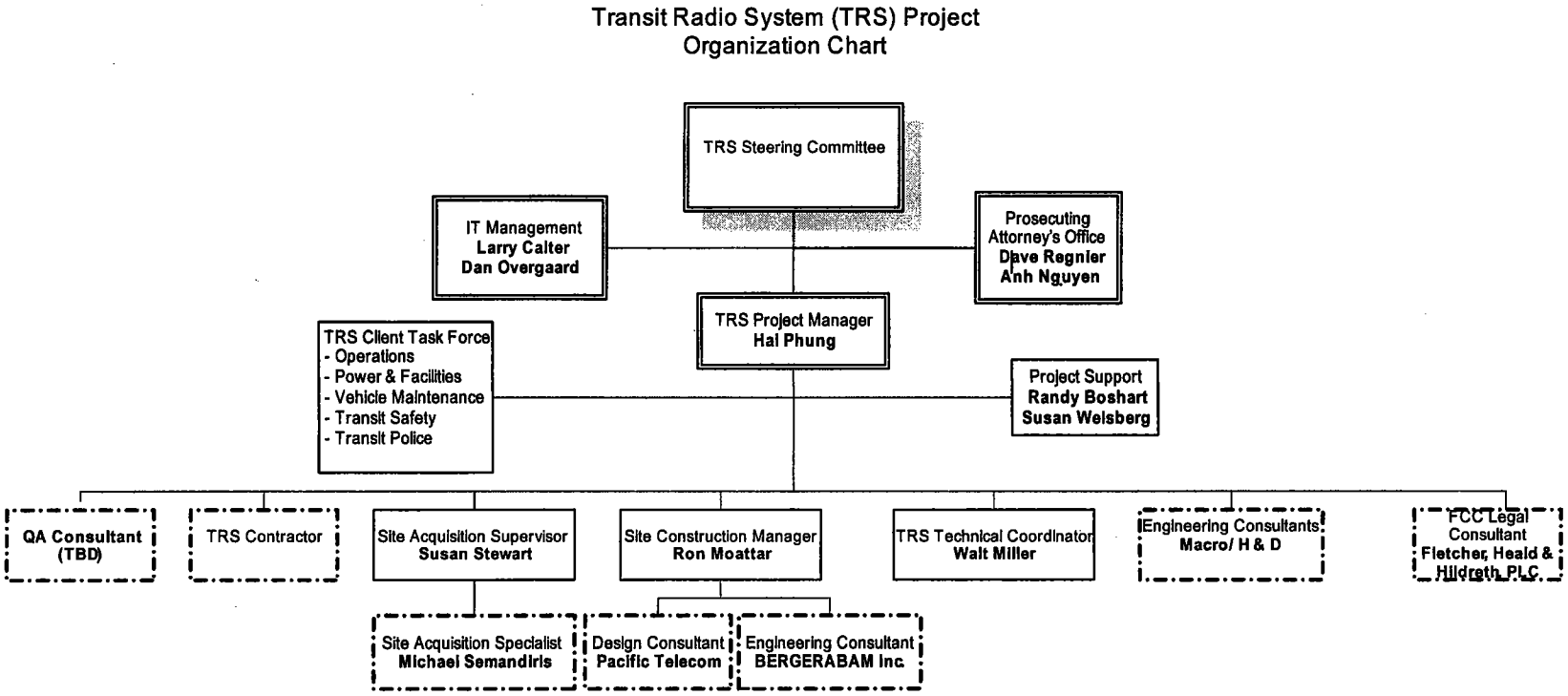
3.0 Summary

The project is being managed within the Information Technology (IT) Section of the Transit Division, specifically within the Systems Management and Analysis group. Larry Calter, Manager of the Information Technology (IT) section is on the project Steering Committee and Dan Overgaard, Systems Management and Analysis Supervisor, is the project supervisor. Dan also leads the project management office that oversees the OBS/CCS and Smart Card projects. Hai Phung is the Project Manager, responsible for overall contract administration and management. Hai is assisted by Walt Miller, Technical Coordinator, and Randy Boshart, PPM II, and Susan Weisberg, PPM I, to complete the Radio Project Management (PM) team.

3.1 Project Organization

A project organization chart is provided on the following page.

Figure 3.1.1 Radio Project Structure



3.1.1 Roles and Responsibilities

3.1.1.1 Project Team Roles and Responsibilities

Team Members	Roles and Responsibilities
Project Manager: Hai Phung, SMA	• Manage all aspects of the project • Report changes to scope, schedule, and budget to Steering Committee and the PRB • Provide regular status reports to Steering Committee and Core Teams • Facilitate weekly PM Team meetings • Coordinate design, testing and implementation of both phases
Technical Coordinator: Walt Miller	• Represent Radio Maintenance and their ongoing interests for system installation, testing, support and maintenance • Provide technical guidance, review and consultative support to the project team • Participate in PM meetings and activities
Project Support: Randy Boshart	• Maintain integrated project schedule and related reports, and provide project support
Project Support: Susan Weisberg	• Maintain project documentation and provide project support
Project Supervisor: Dan Overgaard	• Provide supervisory oversight for project team, and ensure effective coordination and communications between and with related projects such as OBS/CCS and RFCS.
IT Manager: Larry Calter	• Provide management oversight to project team
Site Acquisition Supervisor: Susan Stewart	• Provide expert right-of-way oversight and assistance for the development and approval of site leases and agreements
Site Acquisition Specialist: Mike Semandiris	• Coordinate and negotiate with remote site owners, as required, to facilitate site leases and agreements
Site Construction Manager: Ron Moattar	• Manage the procurement of engineering and construction contractors to complete site engineering and physical site modifications

FCC Legal Consultant: Bob Gurss, Fletcher, Heald & Heldrith	• Provide expert telecommunications legal support, as needed, for license applications and other regulatory issues
Prosecuting Attorney's Office: Dave Regnier Anh Nguyen	• Provide legal services and consultation throughout the project, including procurement, project execution and close-out.

3.1.1.2 Sponsor Roles and Responsibilities

The project's Steering Committee are the project sponsors. They will:

- Provide oversight and direction for the implementation of the Transit Radio System;
- Monitor project scope, schedule and budget;
- Review and approve project schedules and priorities;
- Assist project team with risk management;
- Assist the project team with obtaining and assigning internal resources required for project execution; and
- Ensure that business issues that involve multiple sections or systems are addressed.

3.1.1.3 Steering Committee

The Steering Committee is comprised of the following:

Voting Members:

Jim O'Rourke	Manager	Operations
David Mendel	Manager	King County Radio Services
Jerry Rutledge	Manager	Power & Facilities
Larry Calter	Manager	Information Technology
Park Woodworth	Manager	Paratransit & Rideshare Operations
Judy Riley	Manager	Design & Construction

Advisory Members:

Dan Overgaard	Supervisor SMA Information Technology
Libby Krochalis	Management Analyst, Information Technology

Coordination and meeting facilitation:

Hai Phung	Radio Project Manager	SMA/IT/Transit

3.2 Project Team Operations

3.2.1 Team Location

The Project Manager and Technical Coordinator are located in the Exchange Building and will likely stay there until the contractor starts the installation of radio system infrastructure in the new Communications Center. At that time, they will relocate to the designated IT office space in the new Communications Center. Project support staff, as well as the supervisor and manger providing management oversight, are located in King Street Center. No additional space is needed for the project teams. Radio maintenance staff are located at the Power Distribution Headquarters and will remain there throughout the project, although they will also use a designated Radio Maintenance room in the new Communications Center.

3.3 Team Processes

3.3.1 Team Building

Members of the Project Team have worked closely through the development of technical and functional requirements and through RFP development and proposal evaluation. Team building activities will include regular meetings, discussion of open issues and ongoing dialog about project dependencies and any technical and organizational concerns.

3.3.2 Decision-Making and Escalation Process

The Project team endeavors to make all decisions using consensus. In cases where this is not feasible or practical, the Project Manager will summarize the issue and seek direction from the IT management group, the project Steering Committee or higher decision-makers in the organization, if appropriate.

Major decisions impacting project scope, schedule, or budget will be presented to the Steering Committee for resolution with an appropriate level of background analysis and supporting information to support effective decision-making. Issues between the project team and client representatives should be resolved at the lowest level possible, or escalated to the Steering Committee in a timely manner if resolution is not possible.

3.3.3 Conflict Resolution Approach

The early identification and resolution of conflicts is important to an effective project team. The Project Manager will be responsible for identifying conflicts and calling team meetings to discuss and resolve any related issues. All team members will have the opportunity to bring unresolved issues before supervisors or the Steering Committee.

3.4 Critical Success Factors

These things must be in place for the project succeed:

- A contract with a radio vendor that can design, install, test, implement and support a state-of-the-art digital voice and data radio system.

- Site location agreements with the owners of the remote sites selected for the new system.
- A contract with a construction firm (or firms) to complete the necessary facility modifications at each remote site.
- A contract with an OBS/CCS vendor who can integrate their on-board systems and communication center systems with the radio system.
- Successful delivery, testing and deployment of the on-board equipment provided by ERG, the RFCS contractor.
- OBS and CCS testing successfully completed, and equipment installed and operational.
- Sound Transit's communications contractor must complete the installation and testing of the new tunnel antenna system, and work with the TRS contractor to integrate 700 MHz and 800 MHz communications.
- Resolution of all TRS and OBS/CCS Contractor issues and concerns.
- Resources from Radio Maintenance to support the installation of mobile radios in revenue and non-revenue vehicles.
- Project coordination from Accessible Services if the contract option is exercised to include Access voice communications in the system.

4. Communications & Project Reporting Plan

4.0 Summary

The project will communicate:

- In person through Project Team and Steering Committee meetings.
- Electronically through e-mail between team members and the client groups.
- Officially through published project status reports to the IT Manager, Steering Committee and the PRB.
- In regular meetings of the Technical Interface Committee, a contractually required forum which includes the Radio contractor, OBS/CCS contractor and KCM project management staff.
- Project documents will be stored in shared network folders.

4.1 Communications

The project team and stakeholders will use typical communications measures as discussed below.

4.1.1 Project Team Communications

The project will communicate in regular and ad hoc meetings, in-person and by telephone, and via e-mail as required.

4.1.1.1 Team Meetings

The PM Team conducts regular weekly team meetings. The project team will meet regularly with the Contractor when the contract has been awarded. Weekly coordination meetings are held with Design & Construction staff responsible for site acquisition and facility modifications.

4.1.1.2 Team Status Reports

The PM Team holds weekly team meetings to discuss status and agree on action plans.

The Project Manager develops monthly status reports for the Project Advisor, IT Manager, Project Steering Committee and the PRB.

4.1.1.3 Project Library and Shared Information Resources

Project documents will be stored in a shared network folder that is backed up nightly. All team members will have access to this area.

The Contractor is also required to maintain a project website with detailed project information with controlled access for authorized KCM users.

4.1.1.4 Team Contact

Team members are in contact with one another through e-mail, phone, and in person.

4.1.2 Steering Committee Communications

The Steering Committee provides management oversight of the project

4.1.2.1 Status Meetings

Status meetings with the project Steering Committee will be held monthly or more frequently as needed. Minutes will be taken during the meetings and published to all attendees.

Individual briefing by the Project team will be held for Steering Committee members as requested.

4.1.2.2 Project Status Reports

Project status reports will be provided to the Steering Committee at the status meeting or more frequently as needed. The PRB's monthly checklists will also be provided to the Steering Committee. IT management will receive the Capital Project Status Report monthly.

As required by Council proviso in the 2006 budget, a Quality Assurance contractor will be engaged for the life of the project. This contractor will provide regular status reports to the County Council and Executive. Copies of these reports also will be provided to the Project Steering Committee and IT management.

4.1.3 External Project Communications

4.1.3.1 Status Meetings

The project team will meet regularly with the Radio contractor during the execution of the contract.

A Quality Assurance contractor selected from OIRM's master services IT contract will participate in project meetings as required to fulfill their oversight and monitoring role.

4.1.3.2 Technical Interface Committee

The radio contractor is required, by contract provision, to attend and participate in regular technical coordination meetings with the OBS/CCS contractor and KCM project staff. The committee is managed by KCM project managers, and is a forum for the contractors to exchange materials and resolve integration and implementation issues.

4.1.3.3 Written Communications

The project will provide the following written communication to County staff who are not part of the project organization:

Type of Communication	Frequency	To Whom	How Distributed
PRB Status Report	Monthly	PRB	E-mail
QA Status Report	Monthly	Executive, County Council, IT Management and Steering Committee	E-mail
Capital Project Status Report	Monthly	IT Management and Steering Committee	E-mail
General Project Information	As required	Steering Committee, IT Management and User Task Force, as appropriate	E-mail
Detailed Project Information	As required	Steering Committee, IT Management and User Task Force, as appropriate	E-mail
FTA Grant Report	Quarterly	Grants Management Office	E-mail

Meetings will be held to discuss the project with additional Operations, Radio Maintenance and IT staff as the project approaches implementation.

Focus groups with the User Task Force will be conducted as part of the design and testing phases.

PM Team members attend section staff meetings or other gatherings upon request to provide presentations on the project.

4.2 Project Reporting

As discussed above, the project team will provide regular reports to a variety of audiences.

4.2.1 Status Reports

Regular monthly reports will be provided to the PRB, IT management and the project Steering Committee.

4.2.2 Quality Assurance Reports

Under the 2006 Radio Budget proviso, the project is required to provide regular QA reports contemporaneously to the Executive and the King County Council. A format for these reports will be included in the Project Plan, when it has been finalized with the selected QA contractor.

In addition to generating monthly reports, the QA contractor will report out at the completion of each of the five major stages identified in the radio contract.

5. Issue and Action Item Management Plan

5.0 Summary

Any client, or member of the project team or Steering Committee can identify issues and action items. Issues will be communicated to the project manager for tracking. An appropriate mitigation strategy will be identified for each issue. Action items will be assigned a resource and tracked along with other project tasks. The severity of an issue or action item and its impact on the scope, schedule, or budget will determine when it will be communicated to the Steering Committee.

5.1 Definitions

- **Issues** An item that will have a detrimental impact on the project if left unresolved. Issues, therefore, may pose a risk to the project. An issue will likely require a decision to be made from several alternatives. Issues may result from the investigation of action items. A decision on how to proceed to resolve an issue may also lead to additional action items.

- **Action Items** Work not originally in the project plan that requires follow-up execution. Action items may have an impact to the schedule or require additional resources/expertise to complete. Researching an action item may uncover an issue.

5.2 Issue and Action Item Control Process

5.2.1 Identifying Issues and Action Items

Issues and action items will be identified using the following process

- Any client, member of the project team or Steering Committee can identify issues and action items. Each is responsible for communicating these to the project manager via email so they can be recorded and tracked immediately.
- Depending on the impacts an issue or action item has on scope, schedule, or budget, the project manager will identify who should be notified and by what mechanism (e.g., e-mail, regularly scheduled status meeting, special meeting).

5.2.2 Prioritizing Issues

All issues by their definition must be mitigated for the project to be successful. The project manager will prioritize issues in consultation with the project team based on the following factors:

- The impacts to scope, schedule, or budget.
- The necessity for the Steering Committee to be involved.

- The availability of resources to address work tasks to resolve the issue.
- Any issues that will impact scope, schedule, or budget will be taken to the Steering Committee for review and prioritization.

5.2.3 Tracking Issues and Action Items

Action items (when identified) will be tracked by including them on the project work plan. A begin date and end date will be identified and a resource will be assigned. They will then be managed and tracked along with other project tasks.

Issues will be tracked separately on the project issues tracking log (see below). A resolution action and resolution date will be identified for each issue.

The project manager is responsible for tracking and updating action items and issues. The Issues Tracking log and the project work plan will be updated as action items and issues are identified.

The majority of the issues documented below were identified during the evaluation of vendor proposals, either by the evaluation team or by the radio engineering consultant team, Macro Corporation. They were addressed during contract negotiations.

Radio Project Issue Log

Description	Assigned To	Date Assigned	Resolution Action	Resolution Date
Evaluation issue: Motorola's system uses fewer sites than specified in the RFP.	Project team	August 2005	Resolved in contract negotiations. Any added sites will be the contractor's expense.	December 2005
Evaluation issue: Motorola does not guarantee the specified 99.9% annual availability measure.	Project team	August 2005	Resolved in contract negotiations.	December 2005
Evaluation comment: Motorola takes partial or full exception to almost every item in the Receiver Multi-couplers section.	Project team	August 2005	Resolved in contract negotiations.	December 2005
Evaluation issue: Motorola does not offer a mobile radio with GPS that we could use for non-revenue vehicles.	Project team	August 2005	Not an essential user requirement. Radios do have emergency alarm feature.	December 2005
Evaluation issue: Proposed portable radios lack user-configurable scan functionality. Some users may require more than 10 talk groups.	Project team	August 2005	Consider a model upgrade for those users?	December 2005

Description	Assigned To	Date Assigned	Resolution Action	Resolution Date
Evaluation issue: The data for some specified management reports are available in the system, but the reports will have to be developed by the OBS/CCS vendor.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: Some alarms specified in the Power section (7.7) are not provided as standard features of the console system.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: Motorola's dispatch console does not include a VU display.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: The proposal did not include data communications for Access	Project team	August 2005	Data communications not required by Access; they will retain existing commercial provider.	December 2005
Evaluation issue: References did not include much information on other transit projects.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: The specific mix of technologies (FDMA for data and TDMA for voice) is something of a hybrid. Motorola hasn't deployed this configuration previously, and as a result we may face some early life-cycle issues with this system.	Project team	August 2005	Motorola has clarified that they have implemented hundreds of FDMA and TDMA systems worldwide and the base stations have been shipped since early 2004 and portables/mobiles have been shipped since 2003. The proposed radio system combines both technologies.	December 2005
Evaluation issue: Division of roles and responsibilities between the vendor's proposed Project Director and Program Manager are unclear.	Project team	August 2005	Resolved by contractor clarification.	December 2005

Description	Assigned To	Date Assigned	Resolution Action	Resolution Date
Evaluation issue: Proposal summary didn't include a statement of understanding of the County's needs, or the Motorola's understanding of the project goals and objectives.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: Roles for Day Wireless, installation subcontractor, seemed unclear in the proposal.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: Motorola takes significant exceptions to Terms & Conditions.	Project team	August 2005	Resolved in contract negotiations.	December 2005
Evaluation issue: The initial proposal missed the mark on Transit's coverage needs. The revised proposal is better but there are still some issues related to testing and verification that need to be resolved.	Project team	August 2005	Resolved in contract negotiations.	December 2005
Evaluation issue: The Motorola takes exception on the progression of work	Project team	August 2005	Resolved in contract negotiations.	December 2005
Evaluation issue: A one-day turnaround for KCM review and comment on contractor submittals is not possible.	Project team	August 2005	Resolved in contract negotiations.	December 2005
Evaluation issue: Proposal did not address option of integrating with existing tunnel RF distribution system.	Project team	August 2005	KCM has decided not to pursue this option further.	December 2005
Evaluation issue: Proposed design is based on portable talk-in from head-level as opposed to belt-level.	Project team	August 2005	Resolved by contractor clarification.	December 2005
Evaluation issue: Proposed coverage test verification is not stringent enough to ensure that the radio system meets coverage requirements.	Project team	August 2005	Motorola has confirmed that the entire service area will be tested under full foliage conditions and that both objective (signal measurement) and subjective (listening) tests will be conducted to verify coverage.	December 2005

Description	Assigned To	Date Assigned	Resolution Action	Resolution Date
Evaluation issue: The technology being proposed does not allow configuration changes to be made remotely (over the air).	Project team	August 2005	Motorola will have a system enhancement for over-the-air programming at the time of system installation. KCM has requested pricing for this enhancement.	December 2005
Evaluation issue: The entire service area is not being proposed to be tested.	Project team	August 2005	Motorola has confirmed that they will test the entire service area in accordance with TSB88-A. Motorola will provide all grid test maps for Metro approval before conducting the tests.	December 2005
Evaluation issue: Coverage verification testing is only being proposed for on revenue bus routes and a few selected areas and not areas between routes.	Project team	August 2005	Motorola has confirmed that they will test revenue routes, route terminals, transit bases, and the area between routes.	December 2005
Evaluation issue: Coverage verification testing is only being proposed for the grids that the vendor show on their maps as having coverage and that locations having less than the required performance is not included in the verification test calculations.	Project team	August 2005	Motorola has confirmed that locations having less than the required performance will be included in the calculations. Inaccessible grids will be excluded from the calculations.	December 2005
Evaluation issue: Recommend coverage testing using the Bounded Area Percent Coverage approach specified in TSB88-B to be followed.	Project team	August 2005	The TSB88-B coverage standard will be followed.	December 2005
Evaluation issue: System reliability parameters need to be defined.	Project team	August 2005	Motorola and KCM have identified a numerical reliability parameter and the conditions that will apply to its calculation.	December 2005

Description	Assigned To	Date Assigned	Resolution Action	Resolution Date
Evaluation issue: The use of UDP on the data channels do not provide for an acknowledgment that does not seem reliable for emergency messages.	Project team	August 2005	Emergency messages will also be sent on control channel. Motorola has confirmed that the control channel does provide an acknowledgment. This issue will be coordinated with the OBS/CCS contractor in the TIC forum.	December 2005
Evaluation issue: Proposed system capacity might be designed around averaged calls and not peak hour values.	Project team	August 2005	Motorola has confirmed that their design capacity is based on peak hour values.	December 2005
Microwave system design issue: The tower at Norway Hill does not have sufficient capacity for the microwave dishes required to complete the microwave loop.	Motorola	February 2006	Will be addressed during microwave system design process following NTP.	
Microwave system design issue: The Capitol Hill tower may not have a straight shot to the Communications Center.	Motorola	February 2006	Will be addressed during microwave system design process following NTP.	
Implementation issue: Service Communications may be able to support the staffing requirements for a parallel operation of two communication centers while the fleet is installed.	Diane Sutherland, for first phase of analysis.	February 2006	An engineering study will be completed to assess whether existing radio consoles can be relocated to the new communication center and operated remotely. Diane Sutherland will coordinate the engineering study. Subsequent steps and responsibilities are TBD.	

5.2.4 Resolving Issues

Issues will be considered resolved when a resolution has been determined, or an appropriate mitigation strategy has been detailed and associated action items have been added to the project work plan. In some cases, the mitigation strategy may require buy-off

from the client or approval from the Steering Committee if there is an impact on scope, schedule, or budget.

Issues with cross-project impacts or potential significance will be flagged for discussion with the affected project managers and may be forwarded to the Technical Interface Committee for further analysis and resolution.

5.2.5 Location of Issues and Action Item Log

The Project Risks and Issues Tracking log, and the Project Plan that will be used for tracking action items, will be located along with other project documents in a shared network folder. These are available to all team members.

6. Risk Management Plan

6.0 Summary

The Radio/AVL Replacement project will be working with an experienced vendor team to configure and implement an off-the-shelf solution that will interface to systems provided by other contractors.

The significant project risks that have been identified at this time are listed in the Risk Control Log below.

6.1 Risks and Mitigation

Radio Project -- Risk Control Log

Risk Description	Mitigation Strategy or Resolution	Severity	Impact	Status	Odds of Occurring
Unavailability of spectrum for new radio system	New 700 MHz spectrum, reallocated by FCC, is available for public safety use. The 700 MHz Plan for Region 43 (WA State) includes a preliminary allocation for Transit system. The project will file for licenses after Plan is approved by FCC and an established sequence of subsequent regulatory steps. No other band in Puget Sound provides adequate spectrum for this system. (Microwave frequencies are handled separately from 700 MHz, under a much simpler process.)	Significant	High	In progress. The Region 43 Plan was submitted to the FCC on Feb 7, 2006. Given the established sequence of regulatory activities, FCC approval of Transit's 700 MHz license applications can be expected by July, 2007. The project schedule does not require them to be in hand until the start of Stage 3, which is projected to start in December, 2007.	Low

Risk Description	Mitigation Strategy or Resolution	Severity	Impact	Status	Odds of Occurring
Unavailability of remote sites for new system	Lease options have been negotiated for five of the seven identified sites. Negotiations are still in progress on two sites. If agreements are not successful, we will pursue alternate sites that will provide similar coverage.	Significant	Medium	In progress. Revised agreement for West Seattle site is being resubmitted for review by City of Seattle staff. The agreement for Norway Hill is being discussed with City of Bothell. Analysis of other site alternatives is in progress with the site acquisition team.	Medium risk for two sites.
Interference on existing 450 MHz channels	Some combination of several mitigation steps may be taken, depending on impact of interference problem: Reduce operations on affected channels and reprogram bus radios if needed. Obtain temporary approval to operate on new 450/460 channel, if possible and modify the system to use these channels. Migrate NRV users to new system as soon as possible and reprogram bus radios.	Marginal	Medium	Assigned. Project team continues to monitor closely with Radio Maintenance.	Medium
Installation of new radios in the bus fleet requires implementation of the On-Board System and Communication Center System (OBS/CCS), which is being procured separately. Project schedules need to be aligned for this to occur.	The Radio and OBS/CCS contracts include specific integration and collaboration requirements for both contractors, as well as integrated testing and acceptance requirements. These are addressed in an integrated master schedule and will be closely monitored as the work progresses. If Radio is delayed, the OBS contractor could proceed with bus installations in a phased deployment.	Significant	High (in the event that schedules are not aligned)	In progress. At present (March 2006) the two project schedules are aligned for bus installation and system deployment in mid-2008. Schedule coordination is actively managed and evaluated on an ongoing basis.	Medium

Risk Description	Mitigation Strategy or Resolution	Severity	Impact	Status	Odds of Occurring
Radio controls for the bus operator will be developed by the OBS/CCS contractor	For Non-Revenue Vehicles, the Vehicle Logic Unit provided by OBS/CCS will act as the control head for the radio. The Driver Display Unit, a software development kit and integration documentation are provided by ERG, the RFCS contractor. The Radio and OBS/CCS contracts include specific language requiring cooperation on resolving integration issues in a Technical Interface Committee managed by King County. Additional technical information will be exchanged when an OBS/CCS proposer has been selected for contract negotiations.	Significant	High	In progress. The selected radio contractor and both OBS/CCS proposers have agreed to the required interface management process. Some technical concerns have been identified and are being tracked by OBS/CCS.	Medium
Service Communications may not be able to support the staffing requirements for a parallel operation of two communication centers while the fleet is installed.	Two options have been identified and are receiving ongoing analysis. Plan A is to maintain two Comm. Centers in parallel operation while radios are installed in the fleet (9-12 months). Plan B, which requires detailed engineering analysis, is to determine whether it is feasible to relocate the existing operation to the new Comm. Center with remote network connections back to the Exchange Building.	Significant	High	In progress. A scope of work for Plan B has been developed and contract is being signed with a mid-March NTP anticipated.	High

Risk Description	Mitigation Strategy or Resolution	Severity	Impact	Status	Odds of Occurring
Microwave system design risk: The tower at Norway Hill does not have sufficient capacity for the microwave dishes required to complete the microwave loop.	Use Telco circuits or an alternate path for this leg of the communications backbone. Could require acquisition or modification of another site.	Significant	Medium	Assigned. This issue will be addressed by Motorola during microwave system design following NTP.	High
Microwave system design risk: The Capitol Hill tower may not have a straight shot to the Communications Center.	Use Telco circuits or an alternate path for this leg of the communications backbone. Could require acquisition or modification of another site.	Significant	Medium	Assigned. This issue will be addressed by Motorola during microwave system design following NTP.	Medium

6.2 Risk Control Process

6.2.1 Risk Guidelines and Definitions

6.2.1.1 Risk Factor Definitions

- **Severity** The severity level will be rated as Critical, Significant and Marginal.
  - Critical – the project cannot move to the next phase and cannot be completed unless the identified risk is resolved.
  - Significant – project success will be adversely impacted unless the identified risk is resolved or appropriately mitigated.
  - Marginal – project can continue to move forward and may even be completed without resolution of identified risk.

- **Impact** The risk impact level will be rated as High, Medium or Low.
  - High (H) – very significant change to stated requirements or identified solutions
  - Medium (M) – likely change to stated requirements and/or identified solutions indicated
  - Low (L) – tangential or secondary effect upon project

- **Status** The status of an identified risk will be categorized as Identified, Assigned, In Progress or Resolved
  - Identified – the risk has been defined and brought to the attention of the project manager
  - Assigned – the project manager has assigned one or more team members to research the issue and develop a solution and/or mitigation plan
  - In Progress – the resolution plan and/or mitigation plan is in progress of being executed
  - Resolved – the risk has been eliminated (resolved) or satisfactorily mitigated

- **Odds** The estimated possibility that the identified risk will occur to this project and categorized High, Medium or Low.

6.2.1.2 Mitigation Criteria Guidelines

- **Mitigate Now** Risks rated with a Critical severity and Medium odds of occurring or greater will be mitigated immediately.

  Risks rated with a Critical severity, a High impact and High odds of occurring will be mitigated immediately.

- **Create Strategies** Risks rated with a Critical severity, a High impact and Medium odds of occurring will have a mitigation strategy developed.

  Risks rated with a Significant severity, a High impact and Medium odds occurring will also have a mitigation strategy developed.

- **Observe Risk** Risks rated with a Significant severity and Low odds of occurring will be observed and tracked.

  Risks rated with a Marginal severity and a High impact with Low odds of occurring will be observed and tracked.

- **Ignore Risk** Risks rated with a Marginal severity and Low odds of occurring will be ignored.

  Risks rated with a Low impact regardless of Odds of occurrence will be ignored.

6.2.2 Risk Monitoring and Controlling

6.2.2.1 Risk Control Log Management

The Project Risks and Issues Tracking log will be used to track the status of risks and the mitigation strategy.

6.2.2.2 Risk Identification Process

Clients, project team, Operations Review Team, or Steering Committee members can identify potential project risks. These should be communicated to the project manager via email. The project manager will evaluate the risks and coordinate identification of a mitigation strategy with other team members. All risks will be reviewed immediately.

6.2.2.3 Roles and Responsibilities for Risk Management

The following roles and responsibilities have been assigned to project team members and to the risk owner:

Project Manager	(1) Review and track risks. (2) Work with other team members to identify appropriate mitigation strategy and resulting action items. (3) Notify Steering Committee as necessary. (4) Manage associated tasks
Risk Owner	Notify project manager as to the status of any action items related to mitigation of the risk.
Team Members	(1) Notify project manager of any risks as identified. (2) Work with the project manager to identify appropriate mitigation strategy and resulting action items.
Steering Committee	(1) Identify risks. (2) Assist in prioritizing risks.

6.2.2.4 Process for Mitigated Risk Follow-up

Risks that have been mitigated will be re-assessed quarterly to determine if their risk has been minimized or eliminated. Status of each risk item will be reported to IT management and the Steering Committee during regular meetings.

7. Quality Management Plan

7.0 Summary

Quality will be ensured throughout the project on all deliverables by continuous attention to contractor deliverables, inter-project dependencies and schedule coordination, and communications with all project stakeholders and affected parties.

As required by a 2006 Budget Proviso approved by the King County Council, the project will hire a Quality Management consultant to provide ongoing QA oversight and reporting through the life of the project. The Radio contractor also has contractual requirements for submittal of a Quality Assurance Plan for their activities, and ongoing QA monitoring and reporting through the life of the project.

7.1 Quality Objective

- Customer requirements are clearly defined, understood, and agreed upon
- "Meeting customer requirements" is the guiding principle of all project work
- Errors and defects are caught early
- Project tasks rely on complete and error-free inputs
- Products delivered to the customer are error-free
- Standard project management processes are followed

7.2 Quality Control Process

7.2.1 Quality Control Procedures and Processes

Quality will be controlled using the following procedures and project processes:

- The project manager and project team will follow all standard project management processes outlined in the Project Plan, and administer the contract with attention to performance requirements and quality management expectations.
- Each major stage of the radio contract includes an acceptance and close-out process to ensure satisfactory completion of all required deliverables for that stage, and the successful resolution of any punch-list items identified by the project team.
- Testing procedures will be reviewed for compliance with the contract and approved by the Project Manager. Testing will be conducted for both system performance and functionality requirements. Testing will be conducted at both the functional module level and at the system level, in the factory and in revenue service.
- Each phase of testing represents a payment milestone for the contractor. Testing must be completely successfully and any problems resolved before the project manager will sign a notice of apparent completion, which is required before the contractor will be paid.

7.2.2 Deliverable and Project Activities to Monitor

Project deliverables and activities will be monitored for quality in the following ways:

- During Stage 1, the radio system contractor will develop and provide an extensive series of contractually required plans and documentation describing in detail their proposed design and their proposed approach for completing the successive stages of testing, installation, implementation and final acceptance. These documents are subject to review and approval by the King County project manager. A Quality Assurance Plan is among the required Stage 1 deliverables.
- Factory acceptance testing is a major activity within Stage 2. The microwave system and the land mobile radio system will be staged and tested separately. King County will send project team members to witness and verify that factory acceptance testing has been successfully completed.
- Installation of radio system infrastructure is the major activity in Stage 3. The project team will include technicians from Metro Transit's Radio Maintenance group, who will act as on-site coordinators for site installation and related activities. In addition they will be responsible for inspecting and signing off on the contractor's installations.
- Mobile radio installation in Stage 4 will be performed by Radio Maintenance. The quality of this activity will be ensured by close coordination with the radio contractor, specifically through their delivery of technical training to the radio technicians, before the start of installation.
- Final acceptance in Stage 5 will follow the performance requirements that are documented in the contract.

A 2006 budget proviso required this project to engage the services of a Quality Assurance contractor for the life of the project. As of February, 2006, proposals for this work had been solicited from the IT Master Consulting contract roster. Two proposals were received and are being evaluated for a final selection in March, 2006.

Under the terms of the contract, King County will issue a "Notice of Apparent Completion" upon the successful completion of each major stage of work. These major milestones are proposed as possible QA checkpoints upon which the QA consultant could issue a summary report.

Proposed Major QA Checkpoints	Completion Milestone
Stage 1, System Design, including the contractor's QA Plan	June 19, 2007
Stage 2, Factory Acceptance Testing and Microwave Installation	March 5, 2008
Stage 3, Installation of Radio System Infrastructure	July 29, 2008
Stage 4, Fleet Installation and Testing	July 4, 2009
Stage 5, Final Acceptance	November 25, 2009

7.2.3 Quality Control Roles and Responsibilities

The following project team members have been assigned specific responsibilities for quality control during this project:

Name	Quality Role	Responsibilities for Quality
Hai Phung, Project Manager	Manage and Review	• Ensure quality of contractor deliverables • Administer contract
Walt Miller, Technical Coordinator	Review	• Review and evaluate contractor deliverables and provide technical assessments on system design and implementation issues. • Evaluate Radio Maintenance's organizational impacts and requirements for implementation and ongoing support.
Radio Technicians	Inspect & monitor testing Install equipment Monitor system	• Provide on-site coordination and inspection support during the installation of radio system infrastructure and system testing. • Install mobile radio equipment following established procedures provided by the contractor. • Maintain installed system following contractor-provided training, using established procedures, tools and processes.
Macro Corporation	Review	• Review contractor submittals; provide technical assessments and engineering assistance as required.
Quality Assurance contractor (TBD)	Monitor & Report	• Provide QA oversight and reporting
IT Management Team	Review and manage	• Provide management direction to project team, review work products, evaluate risk, and provide assistance to project team

8. Change Management Plan

8.0 Summary

The project will use standard change management processes to identify, evaluate, track, control and communicate project changes as they occur throughout the life of the project. Potential changes will be evaluated for their potential impacts on scope, schedule and budget, and will be communicated to the project stakeholders and steering committee before a change is implemented.

The Communication Center System (CCS) portion of this project, which is budgeted under Radio/AVL Replacement, is managed in combination with the On-Board Systems project. Change management for CCS implementation is addressed in the OBS/CCS Project Plan.

8.1 Change Control Process

8.1.1 Definitions/Standards

Change: A change can be a request for additional scope, a difference in the existing scope, a new or revised requirement, or an enhancement to an existing feature or requirement. A change can also be a request that has the potential to have an effect upon the approved scope of the project including, but not limited to, requests made to project team members for work external to the project.

8.1.2 Requested Changes

The following process will be used to request, analyze, authorize, and document changes to the project's scope, schedule or budget:

- Requested changes will be tracked in a Change Control Form maintained by the Project Manager.
- All proposed changes will be evaluated for their potential impact on scope, schedule and budget. These impacts will be documented in change logs and forms.
- Changes will be evaluated for their potential cross-project impact, specifically with regard to its potential impacts on OBS/CCS design, testing, installation and implementation.
- Following analysis and documentation, changes will be carried forward for steering committee consideration and possible approval.
- The Radio contract includes specific requirements for managing changes to the vendor contract.

8.1.3 Emergency Changes

Emergency changes will be documented in the same form as other proposed changes, but the timing for their approval or execution may need to be accelerated, under some circumstances. Special meetings of the steering committee may be organized to expedite emergency changes, or approvals may be requested via e-mail ballot or personal briefings, if schedules do not accommodate a meeting.

8.1.4 Communicating Project Changes

The project manager will convey information on approved changes, to project stakeholders, steering committee members and the contractor. Project documents and files will be updated as appropriate.

9. Implementation Plan

9.0 Testing plan

The radio contract calls for an extensive testing program both at the factory and in the field, following system design. Detailed requirements and the criteria for successful test completion for each round of testing are included in the contract.

During Stage 1, the design phase, Motorola is required to submit the following documents for Project Manager review approval:

- Digital Loop Microwave Factory Acceptance Test Plan
- Digital Loop Microwave System Field Test Plan
- Digital Loop Microwave System Field Acceptance Test Plan
- RF Base Station Functional and Operational Test Plan
- RF Coverage Acceptance Test Plan
- Factory Acceptance Test Plans
- Subscriber Test Plan
- Radio System Availability Test Plan
- CCS Control Center Integration Test Plan
- OBS/CCS Integration Field Test Plan
- DSTT Field Integration Test Plan
- KCRS Field Integration Test Plan
- Location-specific Voice System Test Plan
- Voice System Coverage Test Plan
- Mobile Unit Installation Test Plan
- Operational System Test Plan
- Full System Acceptance Test Plan

9.1 Training plan

Training is an essential element of the project, for radio users and Radio Maintenance staff. The contractor is required to provide the following training plans during Stage 1, for Project Manager review and approval:

- Maintenance Training Plan and List of Maintenance Equipment
- User Training Plan

During system installation in Stage 3, the contractor is required to complete the following tasks:

- Train Installation Personnel
- Train Maintenance Personnel
- Deliver System Documentation
- Train Users (Dispatchers, Field Users and Trainers)
- Deliver User Manuals

9.2 Documentation plan

As documented in the sections above, the contract has extensive documentation requirements specific to Testing and Training. In addition to those already mentioned, Motorola is required to provide the following documents Project Manager review and approval:

- Detailed Project Schedule
- Quality Assurance and Control Plan
- Microwave Path Survey
- Completed Microwave License Applications
- Completed 700 MHz License Applications
- Completed 800 MHz License Applications
- Final Design of Digital Loop Microwave System
- Installation Inspection Plan
- System Deployment Plan
- Voice Group Mapping
- Base Station Equipment and Field Equipment Installation Inspection Results
- Preventive Maintenance Plan
- Interface Specifications for OBS/CCS
- Table of Intellectual Property in TRS
- Final TRS Design
- Factory Acceptance Test Results and Resolutions
- Integration Test Results and Resolutions
- Installation Documentation, including Trouble Reports and Resolutions
- Field Test Results and Resolutions
- Final Acceptance Test Results and Resolutions
- Final As-Built Drawings and Software Documentation

9.3 System deployment plan

Motorola is required to deliver a System Deployment Plan that addresses the transition and migration of existing radio users to the new system. Minimizing the disruption to users of the existing system is a key requirement of the system deployment plan.

The plan will include information on the deployment of all major project elements, including:

- Trunked radio system installation
  - Fixed radio infrastructure
  - Mobile radios
  - Portable radios
- System integration
- Communications Center equipment
- Digital loop microwave system

- Network management system
- System software

The Radio Project Manager will be working closely with the OBS/CCS project managers to ensure that deployment plans and schedules are coordinated. The detailed planning for the final deployment of the fully integrated system requires the participation of the OBS/CCS contractor.

Both contractors, Radio and OBS/CCS, are contractually required to participate in a cross-project coordination process called the Technical Interface Committee. This process will be managed by KCM Project Managers and will provide a mechanism for tracking cross-project coordination issues and activities. A key work product of this effort will be a more detailed installation and deployment plan. Motorola's initial plan will address the deployment of the radio system as a system, and will be expanded with additional detail when the OBS/CCS contract has been awarded and detailed discussions with that contractor can take place.

10. Staffing Plan

10.0 Project staffing needs

The project is being managed within the Information Technology (IT) section of the Metro Transit division, reporting to Larry Calter. Dan Overgaard, supervisor of the Systems Management and Analysis group, provides daily supervision for this project and leads the project management office that also oversees the Regional Fare Coordination and On-Board Systems / Communication Center System project.

Hai Phung is the Project Manager, responsible for contract administration and management. A Quality Assurance contractor, to be selected by April 2006, will provide ongoing QA and reporting to the Executive and the County Council as required by a 2006 project budget proviso. In addition to the project management team identified above, the project receives technical assistance from Walt Miller, who represents the Radio Maintenance group that will maintain the system following final acceptance. Hai is assisted by Randy Boshart, PPM II, and Susan Weisberg, PPM I, to complete the Radio Project Management (PM) team.

During system installation and testing, the project is also budgeted to provide two radio technicians to assist in the coordination and inspection. Since KCM will be responsible for performing mobile radio installation of 1400 revenue buses and 400 non-revenue vehicles, the project is also budgeted for four additional technicians to cover this task.

The Radio and OBS/CCS Projects are evaluating a possible combined installation of OBS and Radio equipment. Under this scenario, Radio Technicians will work as part of a multi-disciplinary team that includes staff from the Vehicle Maintenance such as Electronic Technicians, Mechanics, and Sheet Metal Workers. Additional detail on this OBS & TRS "concurrent project" is available separately in a summary project plan.

10.1 Required skill sets

In addition to standard IT project management skills, the project manager for this project must have experience in the design, testing, installation and maintenance of two-way radio systems.

Radio Maintenance, as the workgroup that will maintain the system, requires basic radio and electronic maintenance skills, FCC certification, and general maintenance skills.

10.2 Approach to obtain required skill sets

The approach used to obtain the required project manager skills identified above was to advertise for, and hire, an experience radio system manager. Hai Phung, the selected project manager, has over 15 years of experience with the deployment and management of radio systems as radio system manager with the Alaska pipeline and Valdez terminal.

The maintenance skills identified above are already resident in the Radio Maintenance workgroup that maintains the current system. For this project, specialized training in the trouble-shooting, repair and maintenance of Motorola's system and its subsystems – such as microwave – will be provided by Motorola and its microwave subcontractor, Harris, as a contract deliverable.

10.3 Resource assignments

Resources for the project are included in the project budget. Resource assignments within the IT section will be made by Larry Calter, Manager of IT, and Dan Overgaard, Supervisor of Systems Management & Analysis. Resource assignments within Radio Maintenance will be made by Corey Traylor, Supervisor of Power Distribution.

10.4 Team training plans

No additional team training beyond the contractually required system training to be provided by Motorola is planned.

11. Architecture Plan

11.0 Applications Architecture

11.0.1 Major applications technology

The 700 MHz transit radio system (TRS) is a integrated digital voice and data P25 Compliant wide-area simulcast trunking system consisting of next-generation infrastructure and subscriber equipment. The TRS uses Time Division Multiple Access (TDMA) protocol as well as Frequency Division Multiple Access (FDMA) protocol. The TRS can operate in both trunked and conventional modes in the 700MHz/800MHz frequency range. The mobile and portable radios can operate in both analog/digital trunking mode and analog/digital conventional mode, thus providing interoperability with King County regional trunked radio system (analog trunked) and satisfying 700 MHz interoperability requirement (digital conventional).

The radio system infrastructure is a IP-based network using standard routers and switches as described in excerpts from Motorola's proposal in sections below.

11.0.2 Integration of major applications technology approach

System integration is required at two key points between the TRS and the OBS/CCS, to support the full deployment of voice and data communications for Transit's revenue fleet. In essence, Motorola is providing a communications network to connect the Communications Center with on-board voice and data systems.

On board the vehicle, there is an interface between the mobile radio unit provided by Motorola and the Vehicle Logic Unit to be provided by the On-Board Systems / Communication Center System contractor. The interface to be used on-board is Motorola's proprietary SBC9600 interface, which provides voice and data communications and the control functions needed to operate the mobile radio.

In the Communication Center, there will be an Ethernet interface between the radio system and the Communication Center System provided by the OBS/CCS contractor. This Application Programming Interface (API) is defined by Motorola. provides a proprietary to interface between the radio infrastructure and the servers of the Communication Center System software to be provided by the OBS/CCS contractor.

The radio system will include a proprietary network management system managed by Transit staff and maintained under a maintenance contract with the vendor. The databases and applications supporting On-Board Systems and the Communication Center System functionality will be provided by the OBS/CCS Contractor.

11.0.3 Interface technology

Note: The information provided in this section is excerpted from Motorola's Proposal.

The various interfaces used throughout the Motorola design are captured in the preceding discussion, but are summarized here for ease of reference.

- **CCS** – the Motorola provided interfaces include a P25 trunking CADI interface, console API, and a distributed LAN to permit CCS access between console position and CCS server(s).

  The CCS host connection to the CADI portion of P25 trunking system is at a 10BaseT / 100BaseT level to a Motorola provided ETHERNET switch at Central Atlantic Base. The OBS/CCS host vendor will be provided with a CADI API document to enable them to develop their applications.

  The console interface is at the application level using the Motorola provided API document to enable the OBS/CCS vendor to develop applications that access the Motorola console operation application.

- The interface to the distributed LAN is at a 10BaseT level.
- **OBS** – Motorola is providing subscriber radios with a Motorola mobile SPC9600 software API to allow the OBS/CCS vendor to emulate the radio control functions normally provided by a radio control head. The physical interface is a bus architecture using leads that connect through a specialized Motorola radio connector. A special adaptor cable will need to be developed between the Motorola radio and the selected OBS/CCS vendor device.
- **DSTT** – Motorola is providing a single Simulcast Remote site to service the DSTT tunnels. The interface to the Motorola equipment will be at a RF combiner level using fiber-optic devices to extend the connection from the RF site location to the tunnel distribution entry point provided under a separate contract by Sound Transit. The control stations are interfaced together in a common RF combiner and use a low profile antenna. The stations are envisioned to be located within the tunnel itself.
- **SMUT** – The Network Management Client Terminals (SMUT) are provided at the locations specified in the RFP. Their interface to the P25 trunked network is via a 10BaseT connection to a Motorola provided ETHERNET switch.
- **Microwave** – Motorola is proposing a microwave system that will make available connectivity at a T1 (DS1) level.
- **KCRS** – As described in the interoperability description near the beginning of this document, Motorola is providing Control Stations that can be connected to the Metro Transit consoles to provide an infrastructure interface to the KCRS system, as well as subscriber radios that can operate directly on the KCRS system. Direct console-to-console approaches are technically also available, but as explained in various Compliance Matrix responses Motorola does not believe the KCRS system has the capacity to add any additional console hardware to support a direct connection at this time.

11.0.4 Conversion technology

Not applicable.

11.1 Database Architecture

Note: The information provided in this section is excerpted from Motorola's Proposal.

Motorola's new generation Network Management System is based on the client/server LAN networking model. The NMS utilizes the widely deployed Microsoft Windows® operating system for running the client Personal Computer (PC) workstation applications.

In the equipment room, the application and database servers run unattended on industrial-class computers based on the CompactPCI standard. The server applications run over Sun Microsystems' Solaris™ 7 Operating Environment, a leading UNIX® operating system (OS) supported by industry standard network management applications and vendors of embedded software solutions. Solaris is a mature OS known for its high availability and security.
The following applications are available to be accessed from the PC client workstations:

System Level:

- System Profile
- User Configuration Manager
- Software Download
- Historical Reports

Zone-level applications:

- Zone Profile
- Zone Configuration Manager
- ZoneWatch
- Affiliation Display
- Dynamic Reports
- Historical Reports (Zone-level)
- Fault Manager using FullVision Integrated Network Manager (INM)
- FullVision Administration
- FullVision Web Browser
- Radio Control Manager (RCM)
- Radio Control Manager Reports

11.2 Platform Architecture

Note: The information provided in this section is excerpted from Motorola's Proposal.

The Motorola system integrates IP based data services with the voice networks providing a cost effective solution by utilizing a common infrastructure for both voice and data. The data channels will operate using 12.5 kHz bandwidth C4FM modulation providing 9.6 kbps data performance. The fixed end of the data network includes a Gateway GPRS Service Node (GGSN) and a Packet Data Gateway (PDG). The

Gateway Service Note provides for the inter-networking between the selected OBS/CCS vendor's network and Motorola's P25 system allowing for independent management of IP addresses across networks. The GGSN also handles the IP routing services in support of end-to-end IP data messaging. These services include Static and Dynamic IP addressing, IP fragmentation and ICMP error reporting messaging useful for diagnostics and troubleshooting.
Another element of Motorola's data fixed end is the Packet Data Gateway (PDG) designed to link the wireline IP data network to Motorola's P25 radio frequency (RF) network. The PDG manages IP message traffic to and from the wireless network supporting wide area roaming. With wide area roaming, the data subscribers can roam seamlessly throughout the coverage area of the ASTRO 25 network without the need to manually select a different channel or have any specific knowledge of the RF network.

The PDG supports SNMP-based network management by providing detailed statistics and alarm information to monitor system activity and performance. These statistics and alarms provide the ability to monitor system operation and loading to support audit, diagnostic, and optimization activities using SNMP-based standard. The information can be viewed directly via the PDG local console or through the Network Management System.

The PDG is based on a Compact PCI design providing flexibility and ease of migration to configure the gateway to meet specific system requirements. The PDG combines the radio network controller and the gateway services. These two functionalities are served by utilizing both the Linux and LynxOS operating systems within the PDG.

11.3 Network Architecture

Note: The information provided in this section is excerpted from Motorola's Proposal.

Motorola's Metro Transit system design is engineered to meet the performance requirements of a real time system transporting voice, call control, network management, and ancillary network services. The P25 trunking Master site located at Central / Atlantic Base connects the RF sites and dispatch locations together through a Motorola IP LAN network infrastructure (see picture below). The Master site controls voice and data communications, network management, and dispatch operations. The Central / Atlantic Base Master Site includes zone control equipment, zone network transport equipment, and zone network management equipment.

The Local Area Network (LAN) Switch or Enterprise Ethernet Switches are used to aggregate all the Ethernet interfaces for all servers, clients, and routers. Rack mountable, stackable, 10/100 base-TX port switches comprise the LAN. The LAN switches function using standardized trunking LAN protocols. The Core Routers, which have two network interfaces, will be physically connected to different Layer 2 ports in the LAN switch. The Ethernet switch has a Network Management system to provide proactive fault management.

The Core Routers perform the following functionality:

- Routing- control, audio, data, and network management traffic in and out of the Zone.
- Replicating packets while still maintaining the short delays required by real-time voice systems.

Each router has two Ethernet ports that are connected one port to each of the two LAN Switches. The number of core routers required depends on the number of sites and the level of site availability. The WAN ports on the core routers provide the WAN connectivity to the remotes or to the DACs. Fewer sites linked to each core router increases the amount of the total system still available should a core router fail. The Core Router uses Frame Relay to talk to the sites via the LAN Switch. The Core Router used with its Network Management system provides a proactive fault management system reporting on the health of the routers.

Redundant Gateway Routers are used for devices that are multicasting beyond their local LAN. Gateway routers provide several benefits:

- Single access point or gateway for each host's NIC to access the Core Routers.
- Isolate multicast traffic from the various hosts they are servicing
- Redundant connections for hosts with redundant interfaces (i.e. Zone Controller) or load balancing devices.

The Gateway routers use VRRP virtual redundant router protocol and VLAN tagging that makes it possible for one router to perform all of the gateway functions for the Zone Controller and Data Packet Router. If the active router should fail the other router will automatically step in and become the prime router. The Gateway Router when used with the Network Management system provides a proactive management system and sends alarms if there is an equipment malfunction. A Digital Cross-Connect switch will be used to interface remote dispatch sites into the Master site.The Zone Core will use two types of synchronization. The first type of synchronization is the synchronization of the LAN network to a common clock source. The other type of synchronization used at the Zone Core will be Network Time Synchronization (Network Time Protocol (NTP)). NTP will synchronize the clocks of all devices on network. The clock source for both types of synchronization will be a Stratum 1 source. The Stratum 1 source will be derived from the Global Positioning Satellite (GPS) system. This will require a GPS receiver to be located at the zone core. For synchronization of the WAN network, the GPS receiver will contain a framed T1/E1 output. This framed T1 will be connected to the Digital Cross-connect Switch (DCS) through the synchronization input.

The Motorola Zone Controller is a redundant processor that provides trunking call processing for wide area radio communications systems for P25 system operation. The Zone Controller forms the heart of a wide area radio system by providing the central processor for the zone with the necessary hardware and software capabilities to provide call processing and mobility management. The Motorola Zone Controller incorporates CompactPCI hardware, which provides adaptability to technology enhancements and provides for improved planning of future communication needs and migration.

11.4 Description of New Technologies

The 700 MHz transit radio system provided by Motorola is an integrated digital voice and data P25 Compliant wide-area simulcast trunking system consisting of next-generation infrastructure and subscriber equipment. The primary new technology in the system is the combined use of the Time Division Multiple Access (TDMA) protocol as well as Frequency Division Multiple Access (FDMA) protocol to achieve the spectrum efficiency required by the FCC's regulations for the 700 MHz band. Each of these technologies has been widely deployed and supported for several years; however their combination into a single product, the Astro 25 radio system, is a new development. The TRS can operate in both trunked and conventional modes in the 700MHz/800MHz frequency range.

ID	Task Name	Start	Finish	Duration
3	**RFCS Project**	5/23/05	5/23/08	786 days?
31	PRB Reviews	5/23/05	5/23/08	786 days
104	OBS Integration Subproject	2/1/06	8/6/07	394 days?
105	Full Integration Mode (FIM) Change Order	2/1/06	9/28/06	171 days
108	Third Party Application Certification	6/1/06	8/6/07	307 days?
141	Financial Processes Subproject	9/26/05	4/28/06	155 days?
151	Network Subproject	9/26/05	5/7/07	421 days?
214	On-Board Equipment Subproject	9/26/05	7/24/07	477 days?
218	RCU/DDU Integration	11/7/05	2/10/06	70 days
223	Beta Vehicle Install	12/14/05	3/22/06	70 days
238	Phase II Vehicle Install	3/23/06	7/6/07	337 days
256	Operations Training Subproject	9/26/05	8/3/07	485 days?
302	**OBS/CCS ALTERNATIVES ANALYSIS (Phase 002)**	4/28/03	10/2/06	892 days?
303	RFP and Proposal Preparation	4/28/03	11/18/04	409 days?
306	Proposal Evaluation & Selection Process	11/19/04	10/2/06	483 days?
342	**OBS/CCS LEVEL 1: OBS (Subject to vendor schedule & TR**	10/3/06	11/4/09	807 days?
343	OBS/CCS Pre-design	10/3/06	11/13/06	30 days
344	Level 1 Design & Development Phase	11/14/06	10/4/07	233 days
349	Level 1 Pilot Phase	10/5/07	9/8/08	242 days
355	Level 1 Implementation Phase	6/19/08	9/29/09	334 days
379	WLAN/Network Design Concurrent Project	11/14/06	8/14/07	196 days?
386	DDU Application Concurrent Project	11/14/06	8/6/07	190 days?
393	VLU Data Update Concurrent Project	11/14/06	10/1/07	230 days
406	Level 1 Operations Training Concurrent Project	7/3/07	11/4/09	612 days
412	Base Installation Concurrent Project	8/15/07	9/25/09	553 days?
418	On-Board Installation Concurrent Project	10/2/07	7/6/09	460 days?
424	**OBS/CCS LEVEL 2: CCS (Subject to vendor schedule & TR**	7/10/06	7/1/11	1300 days?
425	Level 2 Design & Development Phase (Coordinated w/TRS)	10/3/06	2/4/08	350 days?
432	Level 2 Installation & Test Phase	2/5/08	11/24/08	210 days
437	Level 2 Implementation Phase	11/25/08	12/31/09	288 days
443	CCS Migration Conccurent Project	7/10/06	2/10/10	938 days
464	Level 2 Operations Training Concurrent Project	11/14/06	11/12/09	783 days
470	Level 2 Testing	11/14/06	8/16/10	980 days
474	DDU Application Concurrent Project (OBS & CCS)	11/14/06	3/17/08	350 days
479	CCS Installation Concurrent Project	7/10/07	9/1/08	300 days
484	Level 2 Reporting Concurrent Project	11/14/06	2/15/10	850 days
490	OBS/CCS Full System Acceptance	1/1/10	7/2/10	131 days
493	**TRS System Schedule**	2/7/06	11/25/10	1253 days
494	Notice to Proceed	5/1/06	5/1/06	1 day
495	Stage One (Complete Final Design Deliverables & License Applications)	2/7/06	6/19/07	356 days
766	Stage Two (Complete Installation and Testing Of Digital Loop Microwave System &	8/14/07	3/5/08	147 days
799	Stage Three (Install/Test Base Station Equipment - All Sites)	12/3/07	8/29/08	195 days
860	Stage Four (Installation of mobile Equipment)	9/1/08	8/4/09	242 days
892	Stage Five Finalize TRS Implementation	8/5/09	11/25/10	342 days
899	TRS Architecture & Engineering	3/13/06	8/30/07	384 days

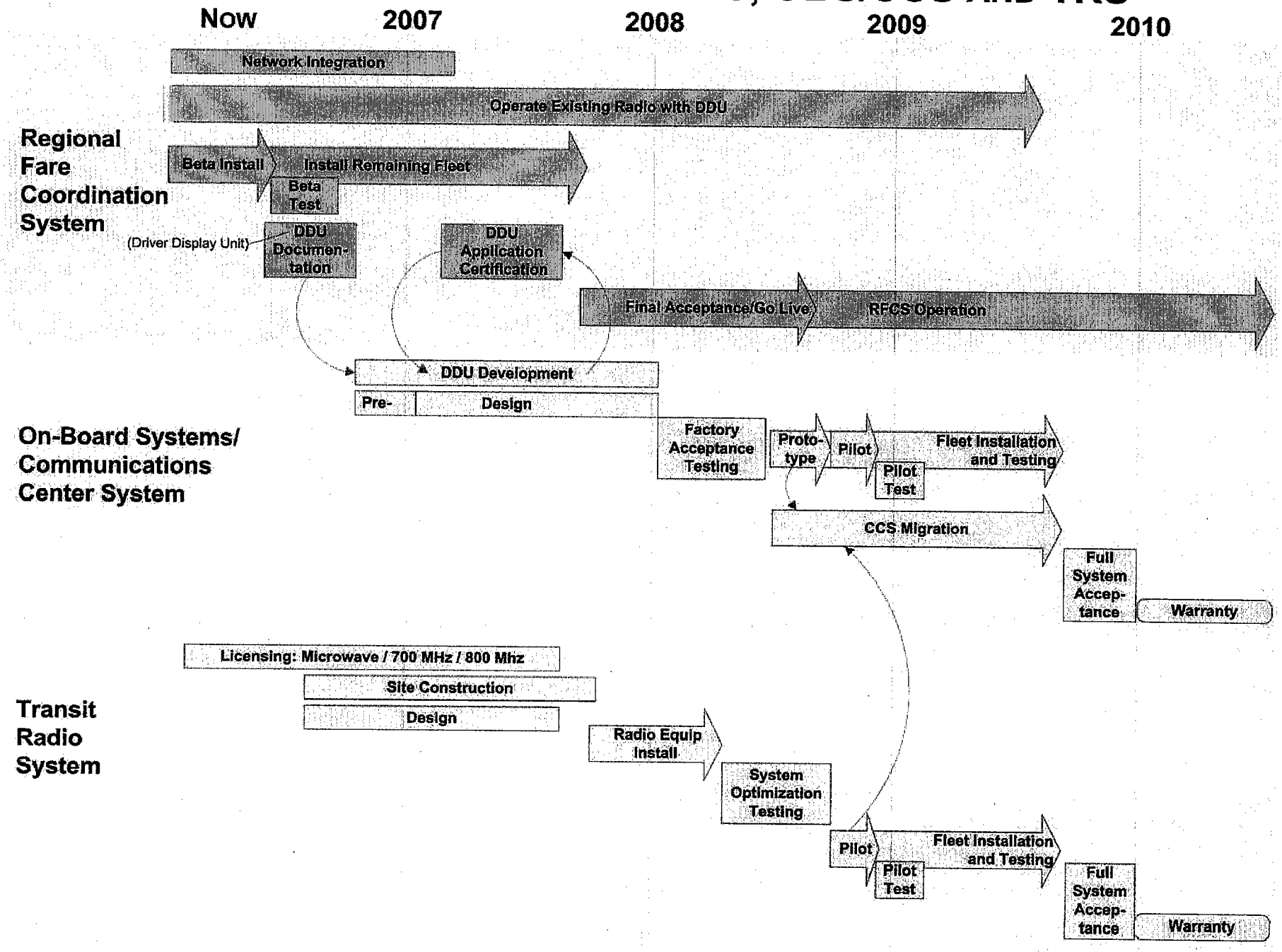
Transit Program Overview

Schedule Overview

Critical Path Overview

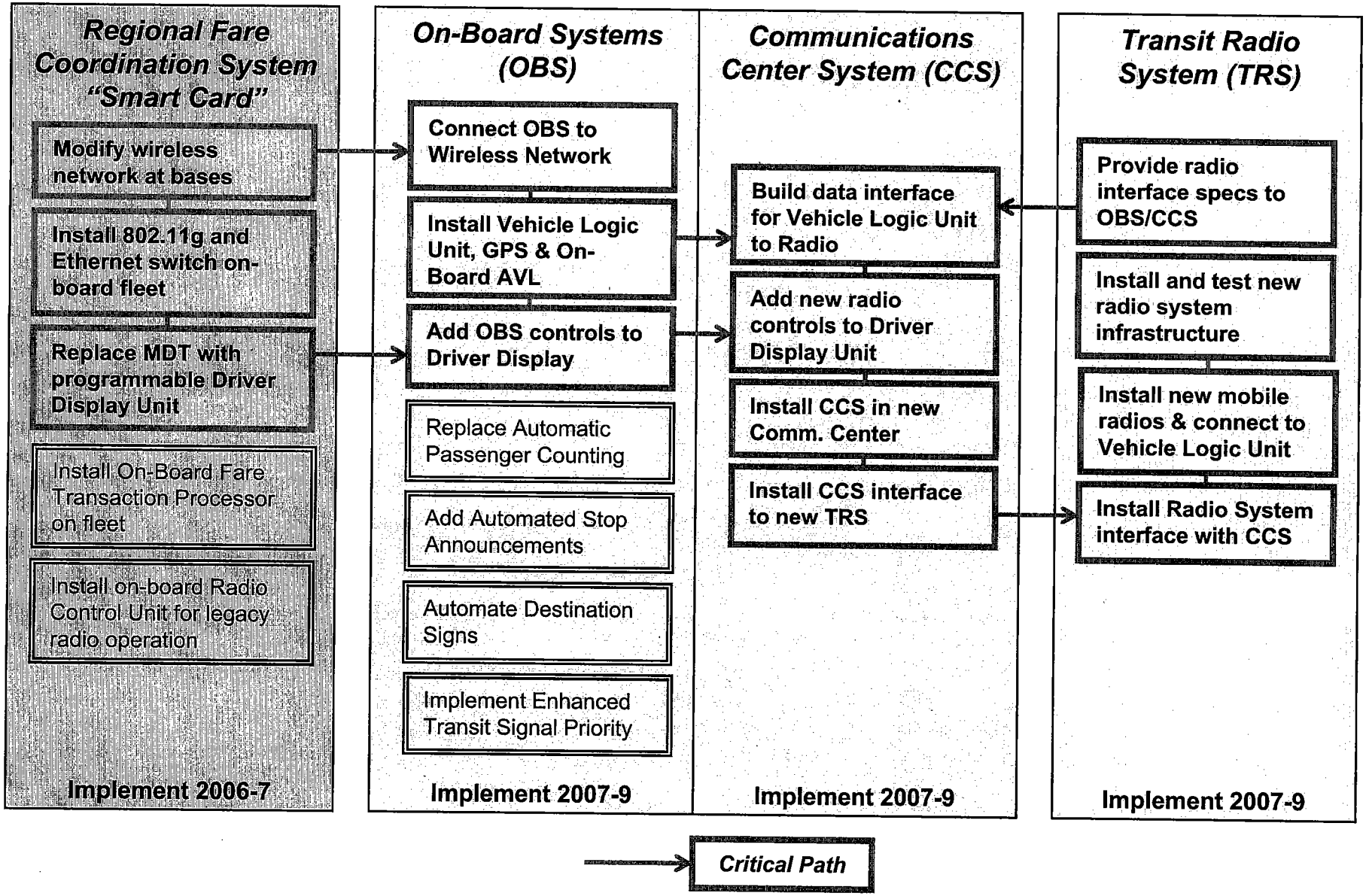
Radio and OBS/CCS Integration

SCHEDULE OVERVIEW FOR RFCS, OBS/CCS AND TRS



Critical Path Overview

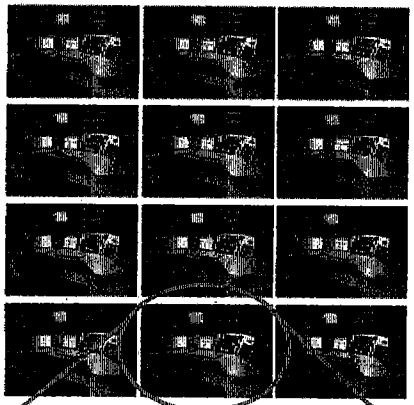
for Smart Card, OBS/CCS and Transit Radio System



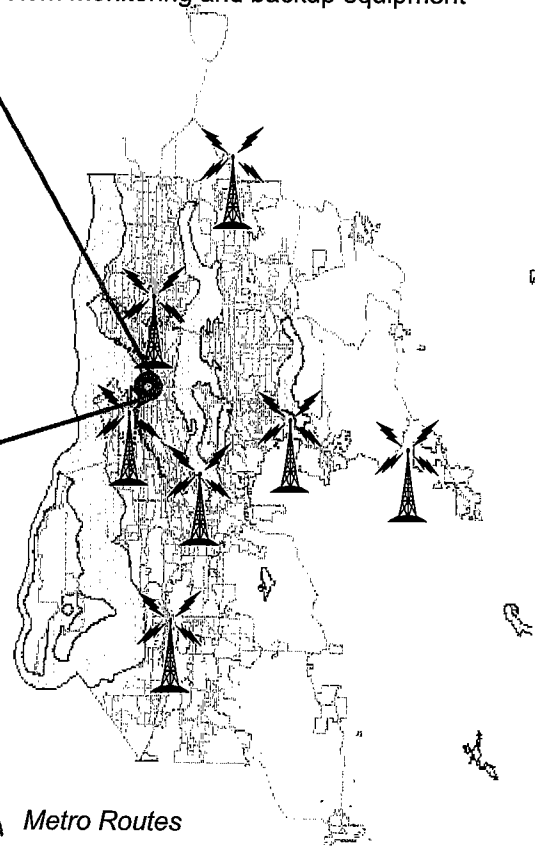
Radio and OBS/CCS Integration

Radio Project Scope

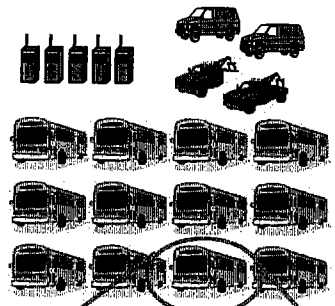
Communications Center
- Network Management System
- Master Site Equipment & Controls
- Console Equipment
- Interface to CCS



Fixed Equipment & Microwave Loop
- Radio tower sites, structures and equipment
- Microwave loop connecting sites to Comm Center
- System monitoring and backup equipment



Field Equipment
- Vehicle and handheld radios
- Interface to On-Board Systems

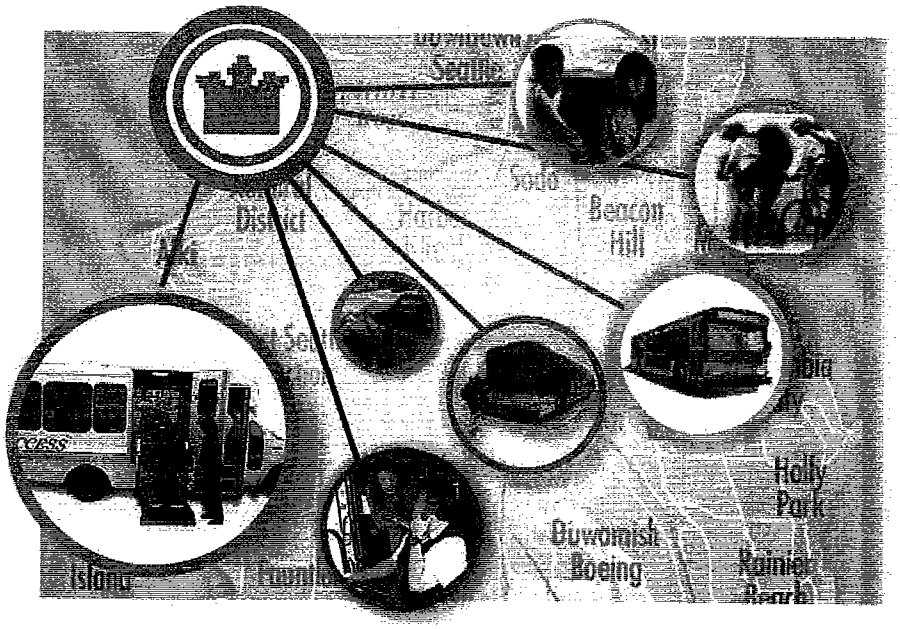


Communication Center System (CCS) Scope
- New dispatching and AVL displays
- Develop interface to the Radio System
- Add new radio functions to DDU
- Provide system reporting tools
- Provide new functions including:
  - Text messaging
  - Off-route vehicle tracking
  - Monitor on-board microphone

Note: *CCS is funded by Radio, but procured and managed together with On-Board Systems*

On-Board Systems (OBS) Scope
- Provide Vehicle Logic Unit
- Upgrade AVL processing with GPS
- Modify Driver Display Unit for OBS
- New automatic passenger counters (15%)
- Automated stop announcements
- Automated destination sign control
- Improve Transit Signal Priority
- Upload & download data via wireless LAN
- Options:
  - Additional APC units
  - Interior LED signs
  - Wireless Transit Signal Priority
  - Automatic Vehicle Monitoring

King County
Department of Transportation
Metro Transit Division



Transit Radio System
Project Assessment

MACRO Corporation
A KEMA Company

Final Report
March 2006

King County Metro
Transit Radio System Project Assessment

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Section 1

INTRODUCTION

In January of this year, The Metro Transit Division of The King County Department of Transportation (KCM) engaged Macro Corporation (Macro) to conduct an assessment of the Transit Radio Replacement and related transit ITS projects currently in various stages of procurement and development. This report presents the findings of this assessment and recommendations where appropriate to ensure project success.

For the purpose of this report, we have used the term "Transit Communications System" to represent the generic integrated group of subsystems that include radio communications, voice and data messaging, computer aided dispatch (CAD), automatic vehicle location (AVL), and smart bus technologies. Smart bus technologies include subsystems for fare collection, passenger announcements, passenger counting, customer information, reporting, traffic signal coordination, and the like.

1.1 Overview of Target Projects

While the County and Metro have numerous projects underway, this assessment is focused on three major projects, which together, result in a new, state-of-the-art transit communications system that is fully compliant with the County's present and future needs, and includes integration with the Regional Fare Collection initiative. These three projects are the Regional Fare Coordination System (RFCS), the Transit Radio System (TRS) and the On-Board Systems/Communications Center System (OBS/CCS).

1.1.1 Project Vision

It is KCM's goal and vision that these projects provide reliable wireless communication throughout KCM's service area, while providing a common, on-board vehicle infrastructure for the Bus Operator's interface and all the associated on-board devices. Further, single devices will be utilized wherever possible to eliminate the need for duplication of equipment and functions. In particular, the Operator's interface (DDU) will be a single device that serves all the on-board subsystems, and data for all on-board system will be transferred to and from the bus over a single wireless LAN infrastructure. These goals are consistent with the direction of the transit industry and have been expressed by other transit agencies. Barriers to achieving these goals in the past have not been technical, but have been associated with the desire of individual vendors to retain control of its system and issues of intellectual property rights (trade secrets).

1.1.2 Regional Fare Coordination System Project

The RFCS project includes the development and implementation of a coordinated fare collection system for the transit properties in the Central Puget Sound region, of which King County KCM is one participating agency. While KCM is a major participant in this project, it is not the only participant, and the project must meet the needs of all the partners. The RFCS is being developed and implemented by ERG Transit Systems (ERG), who has been under contract to provide the system since April 2003. Beta testing of portions of the RFCS is expected to start in the third quarter of this year. The RFCS includes both on-board equipment for transit vehicles and fixed-site equipment, which provide fare collection and regional clearinghouse functions. Communications between the vehicles and the fixed-site subsystems will be via wireless LAN technology.

The portion of the RFCS project that is of principal interest to the KCM radio project is limited to the Driver Display Unit (DDU) being developed by ERG. While this device will be the Operator's interface with the fare collection system for all participating agencies, for KCM it will also serve as the Operator's interface for communications and other on-board systems. Vehicle installation of the initial DDUs will occur before installation of TRS and OBS equipment. Since the DDUs will replace the existing Operator interface equipment, it will be necessary for them to control radio communications. To meet this requirement, a temporary Radio Control Unit (RCU) has also been designed for the interface between the DDU and the existing vehicle radios.

1.1.3 Transit Radio System Project

The TRS project includes replacement of KCM's microwave and RF communications infrastructure with a new, expanded capacity, communications system that utilizes new 700 MHz radio frequencies, new radio site locations, and the latest technology. The enhanced communications infrastructure provides for increased capacity and coverage for the entire KCM service area. In addition to providing both voice and data communications with KCM's revenue and non-revenue transit vehicles, the TRS will also have expansion capability to provide voice communications for ACCESS vehicles.

The entire TRS project is of interest to this Radio Project Assessment, because it is the conduit through which all communications with transit vehicles will take place. Accordingly, it is important that the TRS meets the requirements of the procurement specifications, as negotiated with the selected supplier. It is equally important that the resulting supplier contract include the necessary project management and oversight tools (e.g., design reviews, tests, payment terms, schedule control, issue resolution, etc.) to ensure measurable compliance.

1.1.4 On-Board Systems/Communications Center System Project

The OBS/CCS project includes the on-board vehicle systems, "back office" base and KC WAN systems, and the Communications Center System (formerly part of the TRS project). These systems enable voice and data communications between the Communications Center (Dispatchers) and the transit vehicles (Operators), gather real-time vehicle information to aid in the management, security, and planning of transit services, provide information to the Operators and Dispatchers to assist them in performing their duties, and provide information to customers.

The OBS project is of interest to this Radio Assessment because it provides the on-board equipment and software to control communications and gather and process data. This project provides those elements to enable the new DDU (provided under the RFCS project) to control the new mobile radios (provided under the TRS project), essentially replacing the existing on-board systems with new technology equipment.

The CCS project will replace the existing Communications Center system with a new, updated system that includes advanced capabilities not included in the present system. This new system also includes the required communications with the TRS.

1.1.5 Project Status

The following items present a brief status of the three projects of interest to this assessment report at the time that this report was written:

- The **RFCS** project is presently in the design and implementation phase by ERG Transit Systems. The work was started in April 2003, and some initial vehicle installations of the DDU, RCU, and Fare Transaction Processor (FTP) are expected to begin in March 2006. With these initial installations, the DDU and RCU will be performing radio control. The FTP will not be loaded until RFCS Beta testing, which is scheduled to start in July 2006, following the installation on the first 100 vehicles.

- The **TRS** project is presently in the final stages of negotiation with the selected vendor. Development and implementation of this project is expected to start in the second quarter 2006.

- The **OBS/CCS** project (both Level 1 and Level 2) is in the final stages of vendor selection. Best and Final Offer (BAFO) proposals for Level 1 have been received and are presently being evaluated. BAFO proposals for Level 2 are due shortly. It is envisioned

that contracts will be executed and the development and implementation of these systems will start in the fourth quarter 2006.

1.2 Scope of the Assessment

The primary intent of this assessment is to focus on the elements of the three projects (RFCS, TRS, and OBS/CCS) that are relevant to achieving successful, reliable radio communications with the transit fleet. In conducting this assignment, Macro has placed specific emphasis on aspects of the projects that present both usual and unique risks to project success, and the plans in place to mitigate or eliminate the risks. While several technical aspects of the projects were reviewed during the investigation, a full technical evaluation was neither required nor conducted. The primary focus of the assessment included the following subjects:

- Technical specifications and interface documentation requirements for interfaces between equipment and software being supplied by different vendors.
- Concerns raised by vendors in proposal material and questions associated with interfaces and integration responsibilities
- Integration requirements and responsibilities between the systems/projects.
- Revised radio communications coverage predictions by the selected TRS vendor
- Vendor cooperation requirements and processes between the projects, including commercial commitments.
- Schedule requirements and coordination among the proposed individual project schedules
- Testing and acceptance requirements
- Project management approach to implementation
- Hardware and software development risk
- Evaluation of TRS proposal pricing related to the final, negotiated pricing

Investigations and resulting assessments were primarily directed toward the TRS and its interfaces with the other two systems. This involved the OBS/CCS and the DDU portion of the RFCS. There are many other technical aspects to these projects that are intended to meet the needs of KCM.

These are not the subject of this investigation, and appear to be well handled by the KCM project team through the development of comprehensive specifications, detailed proposal evaluation, and vendor negotiation processes.

1.3 Methodology

In conducting this project assessment, it was important to first obtain a comprehensive understanding of the individual projects, their status, goals, and methods being used to procure and integrate the various technologies. With Macro's direct experience with the TRS project, much of the required information was already available. However, for the RCFS and OBS/CCS projects, substantial study and investigation was required. The following identifies the methodology employed in obtaining the required information and reaching assessment conclusions and recommendations:

- Obtain relevant documentation for all three projects. This included final negotiation material for the TRS project (specifications, terms and conditions, pricing, schedules, and negotiated changes to these documents), specifications, proposals, and schedules associated with the OBS/CCS project, and ERG's DDU development documentation associated with the RFCS project.

- Review all documentation to obtain required understanding of the projects and their interrelationships, and identify questions and discussion items to further clarify understandings and concerns.

- Meet with the KCM project team to discuss the projects in detail and resolve questions and issues not thoroughly represented by the initial documentation. Also discuss preliminary findings to gauge the validity of our project understanding.

- Develop this Assessment Report and issue a draft for initial review and discussion.

- Issue this final Assessment Report.

1.4 Macro Background

Macro Corporation is a widely recognized leader for providing public transit and public safety agencies a full-range of value added engineering consulting and project management services for intelligent transportation systems and advanced communications.

Over the past 14 years, Macro has performed planning, specification, proposal evaluation, and contract oversight/project management services to over 30 transit agencies procuring transit communications, scheduling, and trip planning technologies. These projects have included smaller systems supporting less than 100 vehicles (e.g., Intercity Transit) to large systems supporting in excess of 1000 vehicles (e.g., New York City Transit). Additionally, these systems, most of which are in full operation, are serving both fixed-route and paratransit operations. Accordingly, Macro has been through all phases of procurement, including final implementation, installation, and cutover to revenue operations. In addition to radio communication experience supporting transit communications systems, Macro has similar long-term experience providing consulting services to public safety agencies, involving over 90 projects. In addition to radio communications consulting services for KCM's TRS project, Macro is presently providing transit communications system consulting services to Pierce Transit and Intercity Transit.

Macro's breadth of experience in all aspects of system procurement and implementation directly related to the key KCM projects provides a knowledgeable, yet independent view of the work that has been performed and plans for the work to be performed as the projects move forward. In our experience it is clear that for a number of reasons, agencies do things in different ways to achieve their goals. The important element in achieving success is not necessarily the way an agency chooses to achieve its goals, but is the application of thorough planning, clear descriptions of the work to be accomplished (i.e., specifications), comprehensive project oversight (i.e., project management), and dedicated staff support. It is from this viewpoint that this assessment has been conducted and the results developed.

1.5 Report Structure

This assessment report includes the following six sections and two Appendices:

- Section 1 contains introductory remarks, a brief overview of the projects, the scope of the assessment, the methodology employed, and background information about Macro Corporation.
- Section 2 provided the assessment of the TRS project.
- Section 3 provides the assessment of applicable portions of the RFCS project.
- Section 4 provides the assessment of applicable portions of the OBS/CCS project.

- Section 5 addresses implementation support infrastructure issues common to all the projects under this study.

- Section 6 provides recommendations.

- Appendix A provides clarification questions and responses arising from the review of the Draft Assessment Report.

- Appendix B provides a list of issues raised by the TRS evaluation team and describes the final resolution of these issues in the TRS Contract.

Section 2

TRS PROJECT

The Transit Radio System (TRS) project establishes the voice and data communications between the transit vehicles (OBS) and the fixed-site systems (CCS). It is essentially the medium through which all elements of the overall transit communications system function. Under the scope of the TRS project, the entire, existing radio communications infrastructure will be replaced with a new system, utilizing the latest technology, new frequencies, new radio site locations, and providing expanded capacity.

2.1 Technical Assessment

The following sections focus on the assessment of technical issues that could present risks to the TRS project, and ultimately the success of the overall transit communications system. Several issues of concern were identified during the vendor proposal evaluation process (refer to Appendix B). These issues have been resolved through specific wording changes to Part B (Commercial Terms) and Part C (Technical Specification) of the TRS procurement documents, which will result in a conformed specification that will become the guiding document for the implementation work. There are no remaining, significant issues of a technical nature.

2.1.1 Radio Communications Issues

2.1.1.1 System Availability

Macro believes that Motorola's proposed design provides the reliability required to support the OBS/CCS and voice communications needs of KCM. The current contract defines a specific system reliability (or availability) target for the TRS overall, the vehicular radio equipment, and for individual devices within the TRS. It also defines what constitutes a failure for each component. The overall availability of the TRS is measured in a straightforward manner by defining the number of minutes the system must be on-line and available for use on an annual basis. Short-term availability will be verified during a mandatory 720-hour test period, where the TRS will be placed in operation, serving a full compliment of revenue and non-revenue vehicles. The annual availability requirements apply during the warranty period, and over the life of the contract (10-years). The current availability agreement negotiated with Motorola is much improved over Motorola's initial proposal, which failed to

contractually commit to a specific system reliability target or numeric threshold, or define what constitutes a failure. The negotiated agreement presently meets KCM's requirements.

2.1.1.2 System Capacity

Our capacity analysis shows that the Motorola system should be able to accommodate KCM's voice and data traffic expected though the year 2012. Additionally, this analysis has been based on a 1% Grade of Service (GOS), which is an acceptable value, if not conservative. The lower the GOS numerical value the better the service. Motorola's system design makes very efficient use of the available frequencies, and there appears to be sufficient capacity to expand at a later time to support the ACCESS voice communications requirements. As noted below, the simulcast design provides significant voice capacity over a wide area and higher reliability, from an equipment perspective, throughout its coverage area when compared to other approaches.

Macro also considered the proposed TRS's ability to be expanded with respect to coverage and/or capacity should some unforeseen passenger service changes occur during the useful life of the TRS. Increasing the capacity of a simulcast-type system can be costly and complex, and often requires vendor engineering assistance. Such changes could also require expansion of the central TRS controller, and/or require additional 700 MHz radio channels. However, the proposed design is based on growth projections through year 2012, so it is unlikely that future capacity or coverage enhancement would become necessary. Should such growth occur, Macro has verified that the proposed controller is an expandable "zone type" controller, which provides significant flexibility and scalability. Additionally, Motorola's proposed simulcast TDMA solution required fewer 700 MHz channels than other approaches, leaving several unused channels for expansion, at least in the near term.

2.1.1.3 System Coverage

Macro's prior concern when reviewing Motorola's initial proposal was its selection and number of tower sites, as well as their coverage verification and testing plan. From past experience with radio propagation in the King County region, we were concerned whether the proposed sites could provide adequate coverage along many of the northwest and southeast routes, to a reasonable level of reliability. Even though Motorola's coverage prediction maps indicated reasonably good coverage in these areas, we felt the maps were a bit too liberal (e.g., showed better coverage then we would have expected). Additionally, the Coverage Acceptance Test Plan (CATP) Motorola proposed, which defines how coverage is to be verified, was much too weak to ensure a representative test. Among other things, we were concerned that the areas predicted to have marginal coverage, which included areas and routes in the northwest and southeast, would not in fact be tested.

Subsequently, KCM's negotiation with Motorola has been successful in attaining a comprehensive CATP that addresses the concerns that were originally raised and provides for the verification of the committed coverage. The current contract requires 95% of KCM's routes (and 90% of areas between them) to meet a certain signal quality level. This is a reasonably stringent requirement that is consistent with current industry standards for general government and public safety radio systems. Additionally, Motorola is required to add equipment at its cost if required to meet the committed coverage.

2.1.1.4 Microwave Path Design

The TRS includes a digital loop microwave system, initially interconnecting eight sites. Microwave paths were confirmed via computer modeling; however, field surveys of the microwave path designs have not yet been conducted, which raised some concern that there could be undetected path blockages caused by foliage or buildings. Such blockages would have to be resolved with alternate paths and/or microwave repeaters and could require additional costs.

KCM has addressed this concern in two ways. First, by including the physical path analysis early in the TRS schedule, providing early information concerning the need for additional design and possibly equipment. Second, a 20% contingency for microwave has been included in the budget to cover the potential additional cost resulting from additional design and equipment. Additionally, a contingency plan has already been considered for the path from the Capitol Hill site to the new Communications Center, because of a potential blockage. Macro feels that these actions are appropriate at this time to mitigate the potential for microwave routing issues that could arise when physical field surveys are completed during the Stage 1 Design.

2.1.1.5 Radio Frequency Licenses

Obtaining FCC licenses for the required radio frequency licenses is critical to the success of the TRS project and ultimately the Transit communications System. While plans are well established to acquire the required licenses, it is imperative that all work associated with licensing be given a high priority, and that King County carefully monitor the regulatory process summarized below to ensure its timely resolution.

The timing for license applications is dependent on a regulatory process established by the FCC and the Regional Planning Committee (RPC) that manages the process within Washington State. The RPC has completed its 700 MHz Plan, and has submitted it to the FCC on February 7, 2006. The FCC has committed to a 120-day turnaround on their review of regional plans. Following FCC approval of the plan, the RPC will announce a regional filing window for frequency requests, which will be closed within six months of Plan approval. Within 45 days of the closure of the filing window, the RPC will

approve frequency requests, at which point the actual license applications can be filed with the FCC. Typically, the FCC will approve licenses within 90 days of submittal. Based on the current schedule, it is expected that licenses will be granted during Stage 2 of the project, during Factory Acceptance Testing. The contract calls for licenses to be in hand before Motorola is given approval to proceed with Stage 3, which involves installing and testing the system infrastructure. While this process is fairly lengthy, it should be noted that the Regional 700 MHz Plan does include a preliminary allocation of spectrum to KCM, so the risk of not obtaining frequencies appears low. The primary risk is that granting of the required licenses could be delayed. There is time in the schedule to absorb some delay before project progress is affected. Based on the TRS Contract schedule, the licensing process is projected to be complete approximately six months prior to the start of Stage 3. Furthermore, if the FCC does fail to issue the licenses in time for the start of Stage 3, the TRS Contract states that neither KCM nor Motorola will be liable for any costs or other impacts arising from the delay.

2.1.1.6 Radio Site Preparation

Obtaining leases and resolving issues related to site building space, tower space, power, access, and other basic site needs for all radio communication sites is a critical requirement for the timely installation of the TRS equipment. Macro has found that the resolution of site issues can require substantial time and are a frequent cause of delays. Accordingly, this activity requires close and dedicated attention. The responsibility for this work has not been assigned to Motorola, but presently resides with the KCM staff.

Of the seven radio communication sites, KCM has lease options executed, or nearly executed for five sites. These leases include agreements related to the required space, power and other site issues. Work is continuing to obtain adequate leases for the two remaining sites. The West Seattle site lease is held-up pending resolution of terms and conditions issues, which are reported to be close to resolution.

The Norway Hill site lease is held-up because the City of Bothell is considering a tower replacement or upgrade, and a senior management turnover at the City has delayed a timely resolution of this issue. There could be some delays at this site while waiting for the tower issue to play out, but since it is a critical location, KCM will continue to pursue an appropriate lease.

The primary issue at Norway Hill is limited tower capacity for KCM's microwave dishes. There is sufficient tower space for the much smaller whip antennas that provide 700 MHz radio coverage, and there is sufficient physical space for the system infrastructure. KCM is pursuing a strategy of negotiating a lease agreement that allows the project to go forward in such a way that KCM will be an incumbent on the site when the tower is replaced or upgraded. In the interim, if necessary, this site could be temporarily served by leased telco circuits or by smaller microwave dishes that use a short hop to some other site in the area, such as Clearview in Snohomish County or Ring Hill (owned by King County).

This work is critical to achieving the TRS implementation schedule, and while KCM has taken the appropriate action to date, Macro recommends that this work continue to be given priority attention to ensure that all seven sites are ready for site work at the required time.

2.1.2 Motorola Development

Radio networks, such as the proposed TRS, consist of both wireless and non-wireless components. The wireless portion of the network provides connectivity between a tower site and a moving vehicle. The non-wireless (or fixed) portion of the network connects each of the tower sites to one another and to the dispatch center consoles. This fixed portion includes some wireless elements like microwave radio linkages, and provides management of the communication channels through the TRS central control system.

The fixed portion of the network, including the majority of the TRS hardware and software, is a combination of Motorola's latest version of its traditional offerings, as well as some standard off-the-shelf networking products and backup power systems. Major portions of the fixed network appear to be compliant with current digital equipment standards that were developed for public-safety grade communications systems. This design, which was not a stated or critical requirement for KCM, may provide more flexibility in the future if the system requires interfacing to equipment of other manufacturers, or if modifications are required.

The wireless portion of the network uses Motorola's latest repeater stations and vehicular radio hardware models. The radio repeater model proposed (STR3000) is already in use by other government agencies (e.g., Phoenix AZ, Houston TX), although these installations are operating on 800 MHz frequencies. Models capable of operation on the 700 MHz frequencies available to KCM should be operationally identical. We are unaware of any Transit agencies currently using the proposed vehicular radio (model XTL2500), but there are at least three Public Safety agencies now using this radio. We do note that the XTL2500 has been proposed to other transit agencies (e.g., San Diego Transit Corporation and North County Transit District). In these particular cases, due to production delays with the proposed XTL2500, Motorola chose to supply the more feature-rich radio from the same family (XTL5000). These radios are presently in full operation at these transit agencies. Motorola's previous radio model (Spectra), which has been produced for over eight years, is being phased out. The XTL2500, which Motorola has confirmed is presently shipping, is a logical replacement radio model, and is compatible with many more types of radio systems than the Spectra, including systems operating on 700 MHz and 800 MHz bands.

The most significant aspect of the proposed wireless component is the wireless protocol that has been proposed, which describes the special set of rules required for the devices to communicate. Motorola has proposed simulcast Time Division Multiple Access (TDMA) technology, presumably to provide greater system capacity over a larger area than previously possible. While TDMA is a mature

technology that has been used for many years in many public cellular telephone networks, its use in domestic municipal government systems is relatively new. However, TDMA has been selected by public-safety and government technology groups as the best technology to meet mandatory FCC spectrum-efficiency standards. Macro is unaware of other properties using the proposed simulcast TDMA product, although we believe Motorola began proposing this technology late in 2004. TDMA operation is determined by firmware or software in the radio repeater stations and in the vehicular and portable radios, as it primarily affects the operation of the "over-the-air" link. Thus, this software may still be in development or under initial testing at this time. Some software problems can cause service interruptions and disrupt internal operations to a certain degree. However, Motorola expects their TDMA technology will be ready for KCM's formal factory acceptance test program, which will allow KCM to verify its operation to a significant degree prior to shipment to KCM. Motorola has committed in the Contract to report monthly on the status of its internal development. KCM advised us that if the TDMA software package were not ready in time for factory acceptance tests, KCM would delay these tests, within reason, to ensure that adequate testing can be performed. This is an important risk mitigation action that should be followed in the event that Motorola development is delayed. Even with this testing, as with most new software releases, Macro expects that Motorola will have to perform some software modifications and/or updates following factory acceptance tests, and possibly after system installation as typical software-related anomalies become apparent. This is not overly unusual, as most all radio systems require some type of optimization once they are activated and placed in operation.

We must also note that the benefits of the proposed simulcast TDMA are significant. TDMA effectively doubles the voice channel capacity of the system, while the simulcast approach provides this capacity benefit over the entire coverage area of the system. This was in contrast to the competing M/A-Com proposal (also TDMA) that lacked simulcast, limiting its effective capacity. Macro also notes that Federal Communications Commission (FCC) rules require that 700 MHz radio systems meet certain minimum spectrum efficiency requirements by the year 2016, which would be before the end of the system's useful life. Therefore, the use of other technology could put KCM at risk of having to replace or significantly retrofit the system prematurely. For these reasons, Macro feels that the benefits of the proposed technology offset the development risks that may be associated with the simulcast TDMA product.

2.1.3 OBS/CCS Interface

There are two areas where Motorola is providing an interface for the On-Board Systems (OBS) /Communications Center System (CCS) vendor to interface to the TRS. The first is a fixed-end interface to Motorola's radio dispatch consoles system and trunked radio system, while the second is an interface to the on-board vehicle logic unit.

The fixed-end console interface uses an application program interface (API), which is proprietary to Motorola. The wireless communications industry has no current interface standard for these systems, although one is currently under development. While this is a proprietary interface, the API should provide all that is needed for a fully functional interface. The physical interface is based on the well-known Ethernet standard. This interface provides the various functions for Dispatcher control of the TRS.

Another element of the fixed-end interface is the interface to the trunked radio system that allows the CCS to transmit and receive data messages over the TRS. It is known as their CADI (Computer Aided Dispatch Interface) API. As above, this interface is also proprietary to Motorola. However, a similar, if not identical API has been available to outside vendors to send digital information and signaling over a trunked radio network. However, this API only defines some of the required parameters of this interconnection. Since OBS-equipped vehicles will be roaming among many different tower sites, maintaining a connection with each vehicle requires additional call processing and routing. Motorola has proposed using two "gateway" devices to provide these remaining functions. The primary Gateway device is based on the General Packet Radio Service (GPRS) standard, which is already in use by many domestic and international cellular companies. This device uses a standard Ethernet interface. The other device is referred to as a Packet Data Gateway (PDG). Again, similar PDGs are in use with GPRS equipment around the world. Macro sees no obvious risk associated with this interface, although we have not considered this equipment to significant depth.

For the on-board interface, Motorola will be supplying an API (SBC9600) that permits the OBS vendor to interface its equipment with the Motorola vehicular radios. Macro is aware that this interface has been used by at least one OBS vendor with other transit properties, but with a different vehicular radio model. We note that while the SBC9600 is a proprietary interface, the API should provide all that is needed for a fully functional interface. The physical connector (similar to a "plug") that is required to interface the OBS to the radio is included in the Motorola contract. Motorola indicates that the SBC9600 interface will "allow the OBS/CCS vendor to emulate the radio control functions normally provided by a radio control head" (such as radio speaker volume, and other typical radio controls).

2.2 Project Implementation

Macro assessed the project implementation requirements of the Motorola contract, focusing on integration issues, documentation, training, and the project schedule. Macro also reviewed the Terms and Conditions from a technical perspective. Macro's assessments of these project implementation issues are provided in the following sections.

2.2.1 TRS Integration with OBS/CCS

The TRS contract clearly defines Motorola's responsibilities to cooperate and coordinate with the OBS/CCS Contractor in the development of interfaces between the TRS and OBS/CCS and related integration activities. As a formal commercial commitment, Motorola, (along with the OBS/CCS Proposers) signed a certification of cooperation that will require Motorola and the selected OBS/CCS Contractor to work together to ensure the success of this integration. Furthermore, Motorola, KCM, and the OBS/CCS contractor have committed to work together in the Technical Interface Committee to accomplish these integration objectives. This committee was established to serve as a forum for inter-project communications, integration design, and problem solving associated with the interfaces between the equipment provided by the two projects.

The TRS Contract identifies specific areas of the TRS design that require integration design and coordination with the OBS/CCS Contractor. These areas include:

- Group calls
- Private calls
- Fleet calls
- Emergency alarm functionality and backup
- Vehicle speaker volume control
- Voice and data call setups
- Registration and de-registration of mobile radio status
- Interface between the OBS Vehicle Logic Unit (VLU) and the TRS mobile radio
- Interface between the CCS and TRS fixed-end equipment
- Fall-back modes
- System time
- Transmitter time-outs
- Correlation of radio and vehicle Ids

In addition to coordination with the OBS/CCS Contractor on design issues, Motorola is required to participate with the OBS/CCS Contractor in multiple levels of integration testing, including:

- *CCS Control Center Integration Test* – test of TRS/CCS interface functionality using a simulation of the mobile fleet

- *OBS/CCS Integration Field Test* – test of TRS and OBS/CCS interface functionality in the field, using the installed TRS and a small group of vehicles in simulated revenue service

- *OBS/CCS Integration Pilot Test* – test of the TRS and OBS/CCS interface functionality with 236 vehicles operating under actual revenue service conditions.

2.2.2 Documentation

The TRS contract defines the documentation requirements in detail. Documentation deliverables are tied to progress payments and KCM has full review and approval rights over the documentation submittals. KCM will issue a Notice of Apparent Completion when a deliverable is satisfactorily completed. The documentation requirements are comprehensive and include the following documentation:

- Project Management documents, including schedule and monthly status reports
- Design documentation for the microwave and land mobile radio systems
- Dispatch design document
- Microwave path survey report
- License application documentation
- Coverage maps
- Site readiness inspection report
- Deployment and Phase-Over Plan
- Mobile radio configuration templates
- Equipment inventory
- Interface Control and API Documents for interfaces to the OBS, CCS, and tunnel systems
- Site Installation Documentation
- User manuals
- Equipment manuals
- Quality Assurance plan
- Preventative Maintenance Plan
- Test plans, test results, and trouble reports for each test
- Training documentation
- Talk group plan
- As-built documentation
- Maintenance records

The TRS Contract identifies the responsibilities for each document. KCM has responsibility for a few additional project documents not listed above, such as the security manual and vehicle installation design. The document requirements will provide KCM with the appropriate level of visibility into, and control over the design, and are appropriate for the long-term maintenance and support of the system.

2.2.3 Testing

The TRS Contract specifies a multi-stage testing program. Motorola must produce a test plan and test results documentation for each test. Test plans are subject to KCM approval and must be completed during Stage 1 of the TRS project. The specified test program includes the following tests:

- Factory Acceptance Test, including testing of the Microwave and Mobile radio infrastructures, mobile radios, and end-to-end testing of TRS functionality
- Microwave System Field Test
- Radio Coverage Acceptance Test
- Field Operational Test
- OBS/CCS Integration Testing (refer to 2.2.1 above)
- DSTT Field Integration Test
- KCRS Field Integration Test
- A 720-hour TRS Availability and Final Acceptance Test

The testing program is comprehensive. Significant detail has already been agreed upon on the content of the testing, including the critical radio coverage and system availability tests. The test program strongly reinforces Motorola's obligation to cooperate with the OBS/CCS Contractor in the interface design by tying major payment milestones to the successful completion of multiple integration tests.

2.2.4 Schedule

KCM has stipulated that diligent and expeditious progress and completion of the Work is required of the Contractor. Careful, adequate, accurate and complete planning and scheduling of the Work by the Contractor, both prior to the start of, and throughout development is vital to the success of this project for both the Contractor and the KCM.

The Contract states that purposes of the Project Schedule include:

- Ensuring adequate planning and execution of the Work by the Contractor;
- Assisting KCM in monitoring the Contract, reviewing the Work and planning for installation and other County activities;
- Assessing the impact of any actual, potential or proposed schedule or scope change, including, but not limited to, the financial impact resulting from schedule changes and changes to the scope of Work; and
- Avoiding additional costs or expenses to KCM.

While KCM has placed these demands upon the Contractor, it has also placed reciprocal demands upon its self by committing to actively managing the project. KCM has also agreed to what appear to be fair Terms and Conditions to keep the project on schedule, establish constraints that induce timeliness and quality, and provide means to encourage fruitful interaction among all project participants.

Other aspects of the Terms and Conditions, including language about products, deliveries, payments, and contractor/owner interactions, are consistent in all documents that were reviewed. Together these provide a forum for achieving these desired TRS objectives.

2.2.5 Commercial

Macro's review of the Contract Terms and Conditions was non-legal and limited to an interpretation of the types of changes that have occurred throughout the negotiations between KCM and Motorola. In other words, does the commercial language support, frame, and properly address the various aspects of the TRS project, like products, deliveries, payments, contractor/owner interactions and other pertinent relationships?

Earlier versions of the document supplied to Macro had incorporated accepted changes and did not yield much data as the genealogy of the changes. However, the comparison showed that the negotiated items had a clarifying effect as details are learned, discussed, resolved, and accepted. In the more recent version, the types of changes observed include:

- Narrowed and increased Contractor accountability of TRS security, while removing some of the more onerous and not easily controlled subjective descriptions
- More amicable language for dealing with the approval (or disapproval) of key personnel to be provided by the Contractor and Subcontractors
- Improved traceability of transfers of deliverables with time constraints that benefit both parties
- Inclusion of Consultation with the Contractor before certain actions can be taken by KCM
- Definition of process and rates to compensate KCM for dealing with Pre- acceptance deficiencies

In summary, the documents that were reviewed have clarity and detail specific to the TRS project that were absent in earlier versions. Ambiguity has been eliminated and relevant process is being articulated for the protection of KCM and the Contractor. The Contract includes mechanisms that

describe how variations will be handled within the project. Finally it defines the project phases and deliverables, along with a payment strategy that rewards the Contractor at each Phase acceptance while remaining favorable to KCM.

Section 3

RFCS PROJECT

The Regional Fare Coordination System (RFCS) project will provide a single, common fare-collection system for bus, rail, ferry, and vanpool travel in the Central Puget Sound region. The project was awarded to ERG Transit Systems, Inc. in April 2003. The RFCS project includes smart cards, customer service terminals, retail revalue network, fare transaction processors, data acquisition systems, a clearinghouse system, and other back office systems. While the RFCS project, in general, is not relevant to this assessment of the TRS project, one device that will be supplied under that contract, the Driver Display Unit (or DDU), is a necessary component to the successful implementation of real-time voice and data communications with a vehicle.

Reliance on the DDU for a subset of voice and data communication functions introduces two areas of risk for the ultimate success of achieving radio communications with the fleet:

- This version of the DDU is a newly developed product for ERG. As such it carries all the risk typically associated with new hardware and software development.

- A new application must be developed for the DDU by the OBS Contractor, which will provide operator controls for OBS and future radio functions, and provide communications between the DDU and the OBS Contractor's on-board computer, commonly called the Vehicle Logic Unit (VLU). ERG will provide integration guidelines, a software development kit, a production unit, and training for the OBS/CCS contractor to develop this application. ERG and the OBS/CCS Contractor will share responsibility for development of this interface. The roles and responsibilities of each Contractor are well defined; however, since this application development has not yet occurred, and neither party has total control over all the technical variables associated with this development, there is some risk that issues could arise, or cooperation could breakdown and jeopardize the successful implementation of this new application.

The following sections provide an assessment of these two areas of risk.

3.1 Driver Display Unit (DDU) Development

The DDU will be the Bus Operator's interface for CAD/AVL and Smart Card functions. The DDU is a Mobile Data Terminal. It consists of a display area surrounded by programmable pushbuttons. The function of each pushbutton can be redefined based on the functions provided by the display that are

currently on view. The DDU is designed for mobile environments. It will be mounted on the vehicle's dashboard in a location within normal reach of the Operator and where it can be viewed in all lighting conditions.

The DDU has an important interim role in fleet communications prior to its ultimate integration with the OBS on-board equipment. The DDU will initially replace the legacy Mobile Data Terminal that is currently in use in the fleet. The DDU will interface to the Radio Controller Unit, another new product developed by ERG, which will then interface to the existing MDU and mobile radio. ERG will develop the Operator functions to control radio communications with the existing CAD/AVL system. Essentially, this design supports a smooth transition for the onboard equipment associated with real-time voice and data communications.

The DDU proposed for the RFCS project is an evolution of ERG's existing DDU and the RFCS project has had substantial delays. It appears that these delays are now mostly behind ERG. ERG has conducted functional and hardware factory acceptance tests of the DDU and RCU and KCM now has units on site for KCM to conduct further testing. The first quantity shipment (35 units) of DDUs have arrived, with more scheduled for delivery in March. The System Integration test for the legacy radio functions is scheduled to occur in February, with vehicle installations to immediately follow upon completion of the test. Beta testing of the Smart Card functions is not scheduled to occur until late summer, but the use of the DDU for legacy radio control functions is not dependent on the integration of these Smart Card functions.

The interim role of replacing the legacy Operator interface and radio control is important. It will provide an opportunity to extensively test the unit in a real world environment for at least a year and a half before OBS prototype installations begin. It will also validate the device's use as an Operator interface for radio communications (albeit with the legacy system).

3.2 DDU Interface to OBS

The OBS/CCS Contractor is required to interface to the DDU and to develop all the necessary applications and Operator screens necessary to implement the Operator interface for voice and data communications over the new TRS radio system. The DDU will also be used for the exchange of a minimum set of data between the ERG-supplied onboard Fare Transaction Processor and the OBS/CCS Contractor's Vehicle Logic Unit.

In the risk analysis documentation reviewed by Macro, the DDU interface is fully recognized as an area of risk by the KCM project team. The risk comes from two sources: (1) the interface requires software development, which by its nature is always a risk, and (2) successful implementation of the

interface requires the cooperation and collaboration of two separate Contractors; a single party is not responsible for the interface and does not have control over all the variables that affect success.

The following are characteristics of the DDU, and steps taken by KCM to help reduce the risk of developing this interface:

a. Use of industry standards lowers the risk of implementing the interface. The DDU utilizes the following industry standards that are relevant to this interface.

   - The interface will use standard Ethernet for the physical interface and lower layers of the interface protocol.
   - The DDU utilizes Microsoft's CE.net operating system. This is a widely used standard for mobile devices.

b. ERG, in response to its obligations under the RFCS contract, will provide the following services and material:

   - Documented directions on how to develop applications for the DDU. A draft of this document, "Guidelines for Third Party Integrators" has been supplied to KCM.
   - A software toolkit for use by the OBS/CCS Contractor and other third parties to develop applications for the DDU.
   - A class to train the OBS/CCS Contractor in how to develop applications for the DDU.
   - A development test bed for use by the OBS/CCS Contractor in the development process
   - A certification process, whereby the OBS/CCS Contractor will submit its applications to ERG and ERG will certify compliance with developer guidelines and compatibility with ERG's applications.

c. The OBS/CCS Proposers have certified in writing that they will comply with KCM's integration requirements and work collaboratively with ERG on the implementation of the DDU interface.

d. The OBS/CCS Proposers have been provided copies of ERG's "Guidelines for Third Party Integrators". The Proposers have commented on the document and ERG expanded and updated the document in response to the comments.

No formal direct communications have occurred between ERG and the OBS/CCS Proposers, but ERG is willing to have such discussions with the selected Proposer at the appropriate time. Because of the intellectual property rights associated with ERG's products, it is understandable that ERG would want to limit its exposure to the selected OBS/CCS supplier. Macro recommends that KCM insist on such direct discussions at the appropriate time, prior to going to contract with the selected OBS/CCS supplier; KCM should participate in these discussions and document the issues that arise. Such discussions will enable the OBS/CCS supplier to work out additional details on the interface design and all parties will gain earlier recognition of potential problems. The selected OBS/CCS supplier will then enter into contract with KCM having had maximum disclosure of the details of this interface and documentation of any issues discovered, thus lowering the possibility of change requests under the contract. KCM's direct knowledge of potential problems will enable KCM to incorporate these issues in its risk management program, and keep these issues as priority topics with both Contractors until the issues are resolved.

To Macro's knowledge, none of the OBS/CCS Proposers identified any technical reason why the DDU interface cannot be successfully implemented. There were no fatal technical flaws to the interface approach that were evident to Macro in the documentation Macro reviewed. As discussed in Section 3.1 above, the interim role of the DDU in interfacing to the legacy onboard equipment and radio system will provide a good indication that the DDU can be successfully deployed in the role of an Operator interface for real-time voice and data radio communications. Undoubtedly there will be technical difficulties to overcome as there are in all interfaces; KCM should, therefore, remain focused on this interface as an area of risk.

Macro does have a few non-technical areas of concern related to this interface. These are not fatal flaws, but will need to be properly managed during the projects:

- As discussed in Section 3.1 above, ERG has had difficulties meeting its schedule obligations on the RFCS project. ERG also has many high-profile milestones on the RFCS Project that are scheduled to occur over the next year. Support for development of a new third-party DDU application will be one of several high priority obligations competing for resources within ERG. Given this project history, additional delays may occur that could delay the DDU application development. According to the current schedule, ERG should complete its development tools prior to the start of the OBS/CCS project. However, it would still be prudent for KCM and the OBS/CCS Contractor develop a work schedule that includes several months of float time for the development and certification of the new DDU application in order to minimize the impact of any delays that could affect this element of the project, should they occur, and that KCM should develop contingencies for even longer delays.

- ERG and the selected OBS/CCS supplier may be competitors in certain markets, or may view each other as potential competition in the future. ERG has already shown its concern over exposing its intellectual property to potential competitors and has designed the DDU interface, application toolkit, and application certification process to minimize such exposure. KCM will need to remain closely engaged with both contractors to ensure the cooperation necessary to successfully implement the interface. One possible mitigation strategy to consider would be for KCM, or the OBS/CCS Contractor, to subcontract the DDU application development directly to ERG. ERG has already demonstrated its ability to develop similar applications in the work it has done for the interim interface to the legacy radio system. By taking full responsibility for the application development, ERG's trade secrets regarding the inner workings of its DDU can be mostly shielded from the OBS/CCS contractor while still providing KCM the information and tools necessary to manage and migrate the DDU functionality as needed in the future without being dependent on one vendor. This strategy could also be employed if ERG's third party application development toolkit is delayed, or has significant shortcomings or bugs.

Section 4

OBS/CCS PROJECT

The OBS/CCS (On-Board Systems and Communications Center System) will replace and upgrade legacy systems to provide smart bus technology on the KCM fixed-route bus fleet and a fixed-end infrastructure for operational management of the fixed-route fleet. The OBS/CCS will provide the interfaces required to fully utilize the TRS radio infrastructure for real-time voice and data communications on-board the vehicles and in the communications center.

4.1 Technical Assessment

Macro focused its assessment of the OBS/CCS project on those elements of the project critical to real-time communications with the fleet and focused in detail on those elements that require interfaces or integration with equipment supplied under other Contracts. In addition to the technical assessment of interfaces and integration issues, Macro assessed the general project implementation environment that is established by the RFP. This project implementation assessment was necessarily broader than the technical assessment, as the project implementation requirements are more general in nature, and therefore apply to all aspects of the project, not just the specific interface and integration issues that are the focus of this assessment.

The OBS/CCS project is structured into two Levels:

- Level 1 will provide an on-board smart bus infrastructure, functions, and equipment; modifications to the wireless LAN; and a fixed-end system for the batch exchange of service and performance data with the vehicles at each base. The legacy 450MHz radio system will continue to operate in Level 1 or until combined Level 1 and TRS installations occur.

- Level 2 will modify the Level 1 smart bus infrastructure to add a connection to the new radio to manage real-time voice and data communications over the TRS infrastructure. When the TRS project installs a new mobile radio, the DDU and its radio-related interface will be relocated to the Vehicle Logic Unit and the old radio system equipment will be removed. Level 2 will also include the replacement or upgrade of the legacy CAD/AVL with a new Communications Center System and associated dispatch functions.

4.1.1 OBS Functions

The OBS will provide a modern integrated infrastructure on KCM's bus fleet. Under Level 1, the basic on-board equipment and interconnecting infrastructure will be established. Short-range wireless communications between the bus and fixed-end infrastructure will be via the wireless LAN at each base. These communications will not be in real-time. Service data will be downloaded to the vehicles prior to pullout, and performance data will be off-loaded from the vehicle each evening after pull-in. Level 1 will include wireless LAN servers at each base and back-end servers to collect and disperse the data. On-board equipment and functions provided by the OBS/CCS Contractor under Level 1 will include:

- Vehicle Logic Unit (VLU) – the on-board computer
- Vehicle location equipment, including GPS receiver
- Automatic Vehicle Location
- Schedule and Route Adherence
- Automatic Passenger Counting (for a percentage of the fleet)
- Vehicle Area Network
- Audio annunciation. Visual annunciation (i.e., next stop on-board signs) are an option.
- Interface to KCM's Transit Enterprise Database (TED)
- Historical Data
- Interfaces to existing on-board equipment supplied by others, including:
  - Digital Video Recording System (DVRS)
  - Fare transaction processor
  - Driver Display Unit (DDU)
  - Destination sign
  - Engine controllers
  - Vehicle sensors (e.g., doors, lift activation, engine alarms)
  - Traffic signal priority (TSP) equipment.

Level 1 will not include an interface to the mobile radio. This capability will be added under Level 2 in concert with the deployment of the new CCS and TRS. Under Level 2, the DDU, which initially supports mobile radio communication via the legacy radio system, will be modified to operate via the VLU to the new TRS mobile radios and infrastructure. The successful integration of the DDU, the OBS/CCS VLU, and the TRS mobile radio and related infrastructure is critical to real-time fleet communications. This integration is discussed in Section 4.1.3 below.

A detailed assessment of most of the on-board devices and interfaces was outside the scope of Macro's assessment. Macro focused on the small subset of the onboard equipment that is necessary to support real-time radio communications. Macro's primary interest in reviewing these broader OBS equipment requirements was to determine if there were other areas of risk that could impact the successful

implementation of real-time radio communications due to a cumulative risk effect. Based on this general review of the OBS/CCS RFP, Macro found that the specified OBS on-board equipment and functions are typical of the range of capabilities available from transit communications system suppliers. A similar set of equipment and functions, or a subset of these, is included in most modern transit communication system projects. If not included in the initial procurement, the typical transit communication system project will include the ability to add these capabilities in the future. Depending on the selected OBS/CCS supplier's unique experience, some specific interfaces may need to be developed, as that vendor may not have implemented an interface to that specific equipment in the past. However, OBS suppliers are used to developing some type of new on-board interface on almost every project, and their Vehicle Logic Units are designed to provide maximum flexibility for implementing such interfaces. KCM's use of standard vehicle network technology (i.e., Ethernet and J1708) for the physical interfaces and lower level protocols will simplify any development that is required.

KCM's OBS design will accomplish a level of integration in the following two areas that will be new to the industry, but are consistent with the direction the industry is going.

- Use of a single operator interface, the DDU, for the operator interaction with all on-board equipment. Most transit communication systems utilize multiple display units as provided by each equipment supplier. It is not unusual to have separate operator interface units for the transit communications system, the destination sign, and the fare collection system.

- Use of a single wireless LAN point of interface on-board the vehicles, coupled with a single wireless LAN network at each base, for the shared use by all equipment onboard the vehicles for bulk transfer of its data with its corresponding fixed-end servers. The common approach is for each on-board device that must communicate with a fixed-end system to have its own wireless LAN radio and antenna, and sometimes its own dedicated wireless LAN at each base.

Both of these points of integration will require development and require the cooperation of two or more vendors for successful implementation; hence they both represent a level of risk to the project. The wireless LAN integration is not directly related to mobile radio communications and therefore was not assessed by Macro to any detailed degree. This is an area of risk that is fully recognized by KCM and multiple mitigation strategies have been developed and documented. Macro's assessment of the DDU interface is detailed in Sections 3.2 and 4.1.3 of this report.

4.1.2 CCS Functions

The CCS will be implemented on a secure, modern, network-based computing platform. Redundancy will be provided for critical components to achieve the target availability of 99.999%. The CCS will include the following functions:

- Computer Aided Dispatch (CAD) including management of voice radio communications
- Automatic Vehicle Location (AVL)
- Schedule and Route Adherence
- Incident Reports (Coordinator Service Records)
- Playback
- Work Distribution
- Text Messaging
- Historical Data

Almost all of these functions are either directly related to real-time communications with the fleet, or are indirectly related, by virtue of the fact that the function processes the real-time data acquired via the TRS infrastructure.

It was beyond Macro's scope in this assessment to critically examine the internal functionality of the CCS. Proposals for the OBS/CCS are currently under evaluation, and therefore CCS functionality will not be finalized until that evaluation is complete. However, a general review of these functions was conducted from the perspective of potential areas of risk that could affect the successful implementation of real-time communications with the fleet.

In general, Macro found the CCS functionality to be relatively standard and compatible with the suite of transit communication system functions available as standard products from most CAD/AVL vendors. KCM does have some very agency-specific requirements for Customer Service Records and reports, but these are typical areas of customization in most transit communications system projects, and do not represent significant risk. The major areas of CCS development and risk are related to interfaces. The interfaces critical to radio communications are discussed in Section 4.1.3 below. Other interfaces include:

- An interface is required to KCM's Transit Enterprise Database (TED) for the receipt of map and service data and to provide performance and historical data for greater accessibility to the agency for planning and other purposes. This interface will be implemented first under Level 1 (OBS) and expanded under Level 2. KCM will share in the responsibility for the design of this interface and will be responsible for any required modifications to the TED. This type of interface is required for all transit communication

system projects. As discussed further in Section 5.1, often the exchange of this data requires interfaces with multiple agency systems and always requires some degree of customization. The integration of this data in a single source database (i.e., the TED), to some extent, simplifies the implementation of the interface for the OBS/CCS Contractor. It does, however, represent a major obligation for KCM under the Contract and will require that appropriate and sufficient KCM resources be applied to the task in a timely manner. This commitment has been fully recognized by KCM in its Project Plan.

- An interface is required to provide real-time bus location data to the "My Bus" and "Bus View" web-based customer information applications. Macro does not consider these difficult interfaces; furthermore, any delays in implementing these interfaces would not affect the effectiveness of the CCS for real-time management of fleet operations.

The offering of specific Proposers may contain additional areas of risk unique to their offer or product line. The OBS/CCS also allows for an alternative approach whereby the OBS/CCS Contractor could upgrade the CCS rather than to supply a complete replacement. The upgrade approach would present a different risk profile than the complete replacement alternative. Any such Proposer-unique risk issues will need to be carefully considered by KCM in the final evaluation of OBS/CCS proposals.

4.1.3 OBS/CCS Interfaces Critical to Radio Communications

Real-time voice and data radio communications between Dispatchers and vehicle Operators will require the integration of elements being supplied by the TRS, RFCS, and OBS/CCS Contractors. Integration is required both on the bus, and among fixed-end equipment as follows:

- On board the bus, the OBS/CCS Contractor's Vehicle Logic Unit (VLU) will interface to both the TRS Contractor's mobile radio, and the RFCS Contractor's Driver Display Unit (DDU). The overall interaction can be summarized as follows: The mobile radio will normally reside on the data channel, passing data and status information from the bus to the CCS (e.g., location reports, requests to talk, emergency alarms, text messages, time point crossings, schedule and route adherence status) and receiving data from the CCS (e.g., poll requests, text messages, differential GPS updates). The VLU will control all data from the bus end. When an Operator desires to communicate via voice, the Operator pushes a Request to Talk button on the DDU. This request is transferred to the VLU, which then sends the request over the data channel where it ultimately appears on the Dispatcher's screen. When the Dispatcher is ready to respond, the call setup at the mobile end is accomplished via a command sent over the data channel. The IVLU switches the mobile radio to the designated voice talk group and routes the audio to the onboard microphone and speakers as directed by the data exchange. In a similar manner, text

messages can be sent between the Dispatcher and the vehicle Operator. On board, the DDU is used by the Operator to manage the initiation and review of text messages. All text transmissions are controlled by the VLU.

- At the communications center, there will likely be two interfaces between the CCS and the TRS radio system. One interface will be for data. The TRS infrastructure will act as the communications medium for data. On the fixed-end, data will routed to the tower sites, converted to Motorola's over-the-air protocol, and reconverted when the data reaches the mobile radio. A similar process will occur in the reverse direction. A multi-site approach will be used, whereby all radio sites can receive data from the vehicle, and data is transmitted from the site where the receive signal was at its strongest. Motorola's over the air protocol will add some error-detection and correction capabilities to the OBS/CCS Contractor's data channel protocol, but overall control of polling, efficient packing of data, end-to-end error detection, and confirmation of message delivery will be controlled by the OBS/CCS Contractor's protocol and its CCS and OBS applications.

- The second fixed-end interface will be used for the purpose of setting up voice communications. The CCS will interface to Motorola's central electronics to identify the desired talk group for voice communications. The central electronics will then set up the talk group and console audio equipment as requested for the voice call.

4.1.3.1 DDU Interface

The interface on-board the bus between the OBS/CCS VLU and the RFCS DDU will be a custom development. Physically, the interface will utilize the widely-used Ethernet standard. The OBS/CCS Contractor will be required to develop the DDU applications necessary to support the Operator interface for OBS/CCS applications. The RFCS Contractor, ERG, is responsible for supplying documented guidelines for this development, an application software development toolkit, a development platform, training, and certification of the final application. Both Contractors will be required, by Contract, to cooperate as necessary, and as directed by KCM's project manager, to achieve a successful integration. Please refer to Section 3.2 of this report for additional detail on all these aspects of the DDU interface and Macro's assessment of the associated risk.

4.1.3.2 TRS Interface

The OBS/CCS must interface to the TRS at both the communications center and on board the vehicle. As discussed in Section 2, some elements of the TRS and the TRS interface are under development by Motorola. Therefore, no transit communications system vendor will have a standard interface to this radio. At least portions of the interface will have to be developed by any of the OBS/CCS Proposers. Thus there is development risk associated with this interface, and because of the development

content within the TRS itself, there is also some schedule risk that development delays at Motorola could affect the OBS/CCS project. These are real risks that KCM will need to manage throughout the projects. Because of the following mitigation factors, Macro believes these risks are not fatal and can be managed:

- Motorola is intimately familiar with the mobile radio needs of transit communication systems having acted in the roles of both Prime- and sub-contractors on several transit communications system projects.

- Transit communication system suppliers are well experienced in interfacing their systems to many different mobile radio systems from Motorola and other private and public mobile radio system suppliers.

- When questioned on this topic, none of the OBS/CCS Proposers expressed any concern over being able to get the interface to the Motorola system to work.

- Motorola and the OBS/CCS Proposers have signed a certification of cooperation that will require Motorola and the selected OBS/CCS Contractor to work together to ensure the success of the interface.

- Motorola and the OBS/CCS Proposers, along with KCM, have committed to participate in the Technical Interface Committee. This committee was specifically established to serve as a venue to overcome technical and non-technical hurdles in the successful implementation of the TRS and other interfaces.

- KCM has established strong payment and project progress motivations for Motorola to develop an Interface Control Document (ICD) in Stage 1 of the TRS project. In addition to the ICD being one of the criteria for a milestone payment, failure to complete this effort as a Stage 1 task could jeopardize or delay Motorola's ability to move on to the subsequent stages of the project. Similarly, as a major component of all of the Level 2 Design Review and Testing milestones, incentives for the OBS/CCS Contractor to meet its obligations in the development of this interface will be built into the OBS/CCS contract.

KCM fully recognizes the risk of the interfaces between the OBS/CCS and TRS and has documented the risks and mitigation strategies in its risk management document. Numerous technical and project implementation requirements have been established in both contracts to ensure technical compatibility and cooperation between the Contractors.

The reality of the interface between the OBS/CCS and TRS is that the OBS/CCS Contractor will likely have the majority of the burden of making the interface work. Motorola is building its product

to serve not only transit, but other industries, such as Public Safety, as well. It is in all parties' interests that the Motorola products, as implemented at KCM, be standard to the maximum extent possible. This will provide a better environment for long-term support from Motorola and increase the likelihood of KCM being able to take advantage of competition for some elements of the TRS in future procurements of expansion and replacement parts. It will also be in the best interest of the OBS/CCS contractor as, once developed, the interface will be re-usable on other future transit communication systems that utilize this Motorola radio system. Macro does not anticipate that this role will be a problem for the OBS/CCS Contractor, as transit communication system suppliers are used to being the more flexible party in implementing radio system interfaces.

4.2 Project Implementation

Macro conducted a broad assessment of the Project Implementation environment established by the OBS/CCS RFP as most of the requirements in this area are general and apply to all aspects of the project, including the integration and interface issues that were the specific focus of Macro's assessment. The discussion that follows provides that broader context. Where applicable, it also addresses provisions that KCM established specifically to manage the inter-project interfaces and integration.

KCM has specified a comprehensive set of requirements for services and other Contractor responsibilities for the management and implementation of the project. These requirements are necessary to ensure product quality, system maintainability, and Contractor compliance with the requirements of the Contract. They are essential to a successful project. Macro found these requirements to be thorough, logically structured, and complete. They are comparable to the requirements Macro specifies on its transit communication system projects. Although a few recommendations and suggestions are provided, Macro has no significant concerns or recommendations for improvement. An overview of some of the more significant requirements is provided in the following sections. These overviews are intended to illustrate the comprehensive nature of the RFP's implementation requirements.

Meeting many of the project implementation requirements can be resource intensive for the vendors, and may be resisted on that basis. However, the implementation requirements specified in the RFP are reasonable and prudent requirements; the project team has defined an appropriate set of processes, deliverables, and project controls.

There will often be project and external pressures to deviate from project implementation processes established in the RFP. The industry does not have a good record for schedule performance. Project delays of 6 –12 months and even higher are not uncommon. It is not unusual in later phases of a complex transit communications system project, as schedule and internal cost control pressures mount, for a vendor to try to short cut the required project implementation processes, or pay less attention to

documentation. Similarly, when schedule delays occur, it is not uncommon for customers to allow these short cuts to occur in order to "get the system into the field as soon as possible". Such strategies rarely have positive results. Typically, the user community is exposed to a far greater number and severity of problems. As a result, users lose confidence with the system, and it takes a long time to get that confidence back. Neither is this approach really in the best interest of the vendor, as it is far more expensive to fix a problem in the field, than in the factory. In the long run, the user experience and the project itself are better served by staying the course established in the contract, even if further delays are the result. It is important that all levels of management understand these trade-offs and support the project team in this approach.

4.2.1 Design Reviews

The requirement to conduct formal design reviews gives KCM control over the design process. It enables problems and misunderstandings to be identified early and necessary changes to be accommodated before the Contractor makes a significant investment in the design implementation. The Contractor will be required to present the system design at three checkpoints in the design process. Preliminary (PDR), Critical (CDR), and Final (FDR) Design Reviews are required, corresponding to a level of 50%, 75%, and 100% of design completion respectively. Inter-project planning and interface design are a focus throughout all three levels of design review.

The PDR for Level 1 and 2 functionality will be conducted concurrently. This will allow the complete direction of the design to be understood and approved by KCM at a system-wide level, prior to allowing the Contractor to proceed on the detailed design of each of the components. The subsequent CDR and FDR for Level 1 will occur independent of these design reviews for Level 2. The design basis is finalized upon successful completion of FDR. Any changes to the design that occur after FDR must be explicitly approved by KCM's Project Manager.

The RFP fully defines the documentation that is required to be produced for each design review. For the majority of required documents, the general approach is to require draft versions of almost all documents at each review, with the completion level of the document corresponding to the percentage of design completion. While this is a valid approach, it requires the Contractor to focus earlier in the project on some documents that might normally be produced later in the project, after the design is complete and implementation is underway. Documentation is resource intensive for the Contractor to produce, and KCM to review. Resource constraints for either party could unnecessarily delay project progress. Macro suggests that KCM, after selection is complete, discuss the documentation flow with the selected OBS/CCS Proposer and make adjustments to the Design Review documentation submittal requirements that are more in line with the Contractor's natural documentation flow, without sacrificing any visibility into the design process.

4.2.2 Documentation

The OBS/CCS RFP defines documentation requirements in detail, and specifies over 200 specific documentation deliverables. The OBS/CCS Contractor is required to maintain a project web site containing the latest version of all documents. The general documentation requirements apply to all facets of the project, including interface and integration issues, and include documentation for:

- Project Management, including schedule, status reports, and problem tracking reports
- Quality Assurance, System Security, Performance Monitoring, and Configuration Management plans
- Hardware, software, and user interface design documents
- User documentation
- Training documentation
- Test plans, procedures, readiness certifications, and reports
- Maintenance documentation, including detailed System Administration documentation
- Installation and cutover plans.

Documentation requirements more specifically targeted at inter-project dependencies and interface issues include:

- List of Project Issues and Mitigation Strategies. This is a pre-design submittal, to be provided within 60 days of the notice to proceed.

- Project Issues Report. This report includes mitigation strategies for real and potential integration issues. This document is initially to be provided for PDR and updated for each subsequent design reviews.

- Implementation Strategy for Integration and Installation. This document is to describe the Contractor's strategy for integration and cooperation with the RFCS and TRS Contractors.

- Interface Control Documents (ICDs). An ICD is required for each OBS/CCS interface, including interfaces to the TRS radio system, and RFCS on-board equipment. Appendix C of the RFP is devoted to defining, in detail, the information that must be contained in each ICD.

The documentation requirements are comprehensive and suitable for a project of this complexity. Tracking the versions and review status of such a large quantity of documents will be a challenge for KCM Project Management. Currently, documentation deliverables are included in the integrated project schedule. The detail necessary to add documentation submittals for the OBS/CCS and

TRS projects will not be available to enter into the integrated schedule until these Contracts are underway. Tracking documentation in a scheduling software package can add a large number of activities to the schedule, particularly when multiple releases of each document are planned (i.e., PDR, CDR, and FDR versions) and each release has an associated review period. With such a large number of documentation-related activities in the schedule, other information can be obscured. Macro has found that the use of a separate database to track documentation submittals works well, and is easier to maintain. The project schedule would then contain a condensed set of documentation milestones, with each milestone representing a group of related documents.

4.2.3 Testing

The required testing program follows a logical progression of test steps which gradually expose the OBS/CCS to real-life operating conditions and an expanding group of users. With this approach, all significant problems should be uncovered and resolved before the general user population begins using the system. Test plans and procedures must be provided by the Contractor for each test, and approved by KCM prior to the start of the respective test. The Contractor must formally certify its readiness for each test. Tests will be witnessed by KCM representatives. The specified testing program is comprehensive, as illustrated in the following overview descriptions of the required testing program.

a. Level 1 OBS Tests:

1. *Factory Acceptance Test*: - This testing will be conducted in the Contractor's factory, using simulations of field conditions, where necessary. In addition to the testing of functions and performance, the factory acceptance test will include environmental and electromagnetic interference testing, human factors acceptability testing, and testing of the system maintainability.

2. *Prototype Installation Testing* - Equipment will be installed on one representative vehicle of each vehicle type and fully tested. The test will also verify the acceptability of the installation design for each vehicle type.

3. *Prototype Field Testing* - Operational testing will be conducted with the prototype vehicles from each fleet.

4. *Pilot Test* - Approximately 100 vehicles, representative of all fleet types, will be tested in normal revenue operation.

5. *Base Test* - Testing will be conducted at each base as installation is completed at that base.

6. *Level 1 Conditional Acceptance* - This test will focus on availability, performance, and data accuracy.

b. Level 2 OBS/CCS Testing:

1. *Factory Acceptance Test* - System functions, performance, and usability will be verified. All DDU and TRS interface functions related to radio communications will be tested. Portions of the radio system may be simulated to accommodate the factory environment.

2. *CCS User Bench Testing* – Following factory test, the Contractor is required to provide a test environment that simulates OBS and radio-system data messages for further testing by KCM users of all CCS functions.

3. *Installation Test* - The factory test is expanded to include integration testing of live interfaces to the field. This will be the first formal testing of the complete integration of the OBS/CCS with the TRS radio system. All subsequent testing will utilize the TRS.

4. *Field Test* – Testing will be conducted on 10 vehicles in simulated revenue service.

5. *Pilot Test* – Testing will be conducted on 100 vehicles under actual revenue service conditions.

6. *Mid Implementation Test* – This test will be conducted when installation has been completed for 50% of the buses.

7. *Conditional Level 2 Test* - Conducted when vehicle installations are essentially complete.

8. *Full System Acceptance Test* – Full operation for 90 days after successful completion of the Level 1 and 2 Conditional Acceptance Tests.

Macro recommends that KCM carefully select the dispatchers and vehicle Operators that participate in the early phases of testing. These individuals should have a generally positive but realistic perspective of complex technology projects, understand the process of testing and debugging the system, and be willing to help the project team work through problems. It helps if they are also respected opinion leaders in their respective labor groups.

4.2.4 Quality Management

The OBS/CCS Contractor is required to submit a Quality Management Plan that is compliant with ISO 10006:2003, "Quality Management Systems – Guidelines for Quality Management in Projects". The Contractor is required to comply with this plan throughout the duration of the project. Macro has found that it is best for Project Quality Management plans to be consistent with the quality management processes already in use by the Contractor; rather than to enforce project specific processes. Use of processes that are already engrained in the Contractor's standard work flow are more likely to be adhered to. New processes should only be introduced when the existing processes are absent or significantly deficient.

4.2.5 Configuration Management

The OBS/CCS Contractor is required to submit a Configuration Management Plan that is compliant with ISO 10006:2003, "Quality Management Systems – Guidelines for Quality Management in Projects". Configuration management is critical to complex software projects. A frequent occurrence on projects that lose control of configuration management is that an older version of a software module gets inadvertently integrated with a new software release, resulting in a function that worked yesterday, no longer working today. Such occurrences can become a valid reason for loss of confidence in a system. Configuration management processes are most likely to be skipped or circumvented when schedule pressures are at their highest. KCM should make the priority of configuration management clear at the outset of the project, and make it a constant theme throughout the project. It should be clear to the Contractor that failure to follow the processes established in the Configuration Management Plan will not be tolerated.

4.2.6 Schedule

The OBS/CCS RFP provides detailed schedule requirements, requirements for the schedule format and content, and requirements for monthly updates and progress reporting. The RFP puts the Contractor on notice that he may be liable for delays that impact other projects.

The major external driver of the project schedule is the desire to have the CCS operational using the TRS radio infrastructure and radios in time for joint bus and rail tunnel operations. Revenue service in the tunnels is currently scheduled to become operational sometime between December 2008 and September 2009. This event is not specifically identified as a schedule requirement for the OBS/CCS Contractor. Depending on when the OBS/CCS Notice to Proceed occurs, achieving full operation, particularly for the earlier dates in this range, may not be achievable, even if the Contractor meets its schedule requirements. However, full CCS system operation, including completion of all vehicle installations, is not necessarily required to achieve the required radio communications capabilities in the

tunnel. KCM has developed contingency plans in case the CCS is not ready in time. KCM will also be able to discuss additional alternatives with the selected OBS/CCS Proposer once the evaluation is complete.

As indicated in Section 4.2, the transit communication system industry does not have a good schedule performance record. In the past, many of these delays could be attributed to large development efforts and vendors overextending themselves by trying to handle too many projects at one time. The trend is improving as vendors standardize their products and gain field experience. However, overextensions can still occur, product lines evolve (i.e., continued development), and project progress can be constrained by the availability of sufficient resources or the proper skill sets. It is therefore prudent to plan contingencies for up to a 6-12 month delay.

4.2.7 Commercial

Macro briefly reviewed the Terms & Conditions for the OBS/CCS contract to ensure that there were no commercial considerations that could undermine the project implementation requirements. Sometimes this can occur when an organization uses a standard boilerplate for all procurements. The Commercial requirements in the OBS/CCS RFP, however, are tailored to a procurement of a large system of this type and include clauses appropriate to software-intensive system procurements. Specialized clauses include spare parts, software licenses, software escrow, software warranty, progression of work, intellectual property, quality assurance, project schedule, payment milestones, and post warranty price escalation. The Contractor is also required to sign a certification of cooperation with the Contractors of the RFCS, TRS, and on-board Security Camera systems in order to satisfy the County's requirements to have fully integrated systems.

Section 5

COMMON PROJECT IMPLEMENTATION ISSUES

A transit communication system project places many demands on a transit agency. Significant agency resources will be required to manage the execution and technical quality of the projects and to meet the agency's obligations under the contract. A project management support infrastructure must be in place to support the agency's fulfillment of these responsibilities. The ability of KCM to meet these demands is an important consideration in the assessment of the TRS and related elements of the OBS/CCS and RFCS projects. In general, Macro has found that KCM's recognition of its project role, its competency to perform that role, and the quality and extent of the associated planning and preparation for that role are superior to what Macro has seen at other agencies. The following sections highlight Macro's observations in these areas.

5.1 KCM Project Team Experience and Capabilities

It is extremely important to the overall success of any transit communication system project for a transit agency to devote sufficient and knowledgeable staff to the project. This staff will be needed for the agency to meet its obligations under the contract, and to monitor the Contractor's design, testing, and implementation progress. For the TRS and OBS/CCS projects, key areas requiring the support of KCM resources include:

- Development of an interface for KCM's Transit Enterprise Database (TED) to exchange service, performance, and historical data with the OBS/CCS.
- Review of the Contractor's design, maintenance, user, test, and training documentation.
- Participation in design reviews
- Participation in formal factory and field tests
- Procurement of fixed-end computer and network infrastructure equipment (based on Contractor's specifications)
- Procurement and installation of any required wireless infrastructure upgrades at each base
- Installation of CCS hardware and Contractor-supplied software
- Installation of OBS equipment and TRS mobile radios on KCM vehicles.

Macro reviewed KCM's Project Plan for the OBS/CCS project to better understand its plans for staffing the projects. KCM appears to fully appreciate the importance of properly staffing the TRS and OBS/CCS projects. Dedicated staff have been assigned to key project management and lead technical roles. Macro met these key individuals during its onsite interviews and was favorably impressed with their experience and understanding of the technology. Most agencies are not able to dedicate staff to their transit communication system procurements. In these more typical situations, agency personnel, already with full-time responsibilities, are assigned to these key roles on the project on a part-time basis.

In addition to the full-time key project team members, the Project Plan includes the participation of other individuals from departments that will be affected by the project, and defines the responsibilities of each assignment. The level of staffing and the thoroughness of the associated staff planning are among the best of any property Macro has worked with on transit communication system projects. It also appears that if additional staff is required over and above the staffing identified in this plan, it will be made available by virtue of the fact that KCM has made the TRS and OBS/CCS projects it's highest priority internal projects. KCM has stated that, if necessary, lower priority projects will be postponed or delayed if additional staffing is required for the TRS and OBS/CCS projects.

When compared to other properties that Macro has assisted to procure and implement a transit communication system, the KCM Project Team is unique in its experience and capabilities. The TRS and OBS/CCS projects will be the second generation of a transit communication system deployed by KCM. Most other properties Macro has assisted were deploying their first system. The experience KCM gained from the deployment and maintenance of the existing system is invaluable in providing an understanding of the technology and the complexities of implementing a system of this type. It should be noted that soon after deployment of KCM's current system, the Contractor took a different direction with its product line and eventually withdrew from the market. KCM was forced to fully support the system in-house. KCM developed the skills to not only maintain the system, but also was able to significantly customize the system to better meet its needs. KCM has also upgraded portions of the system to keep pace with technology as computing platforms became obsolete, and has been able to effectively extend the service life of the system.

Although not directly related to TRS project assessment, a good illustration of the technical capabilities and foresight of KCM's technical staff is its development of the Transit Enterprise Database (TED) cited above. The TED consolidates data generated from multiple Transit support systems, such as scheduling and GIS systems, and will provide a single point of interface to the new OBS/CCS system for provision of this service data and receipt of performance data. Over time, the TED interface to these other Transit systems may need to be adapted as these systems evolve and are eventually replaced; however, with this architecture, the TED interface to the OBS/CCS can remain unchanged as these other systems evolve. Without a consolidated database like KCM's TED, the implementation of a transit

communication system requires the development of multiple, often custom, system interfaces to accomplish the same level of data exchange. This multiple-interface approach is by far the most prevalent approach in the industry. In this more typical situation, the property must coordinate the upgrade or replacement of each system with associated modifications to the transit communication system interface. KCM's consolidation of data in its Transit Enterprise Database is a superior solution. This approach will simplify implementation of these interfaces in the current projects, and will be easier to maintain over the long run.

5.2 Risk Recognition and Mitigation

CAD/AVL and mobile radio projects are always technically complex and challenging to implement. Each project requires the project team to make hundreds of decisions ranging from how to set up a configurable behavior to evaluating the trade-offs of alternative design approaches to custom applications. Some degree of risk is always inherent in such complex system projects. In recent years, the inherent risk of deploying CAD/AVL/radio projects has been generally declining as vendors develop more standardized products and gain actual field experience with those products. But even as the industry matures and develops a foundation of "off the shelf" products, development of product lines continues in order to keep pace with technology and competitive pressures. When product lines are in transition, the risk profile changes. For example, while it may first appear a riskier approach to base a procurement on a product line undergoing major new development, in the long term, it may be riskier to proceed with existing "proven" product as vendor support for this product could wane before the product's intended service life is achieved. The bottom line is that risk cannot be totally averted in transit communication system projects. There will be risks associated with the uniqueness of each project, and there will be additional risks related to the unique characteristics of each potential Contractor.

Since risk cannot be avoided, it becomes vital to fully recognize the actual and potential risks inherent in the project itself as well as the unique risks presented by each Proposer. These risks must then be fully considered in the evaluation of proposals, and then actively managed once a Contractor has been selected. In the documentation reviewed by Macro, and from interviews with KCM project managers and technical leaders, it was apparent that the KCM project team has taken an active and deliberate approach to the identification and analysis of potential areas of risks. This analysis has been documented and includes the explicit identification of risk mitigation strategies. While agencies are always sensitive to understanding the risk associated with undertaking major projects such as transit communication system projects, the degree that risk assessment has been formalized and documented at KCM is not typical. It also appears that KCM plans to take further steps in formalizing the processes of identifying and tracking areas of risk, as well as issues that could affect risk, during the implementation phase of the TRS and OBS/CCS projects (refer to Section 5.3 below).

As discussed in Section 5.1 above, the KCM project team has developed a unique familiarity with the complexities of implementing a transit communication system through their experiences deploying, maintaining, and upgrading their existing system. This in-depth understanding of the internal intricacies of a transit communication system gives the team a unique perspective to recognize areas of risk in the new project, to realistically analyze that risk, and to develop practical mitigation strategies. Macro found that the areas of risk that KCM has identified and analyzed are a realistic representation of the major risks that must be managed on the TRS and OBS/CCS projects, particularly in the area of inter-project dependencies. Macro did not identify in its assessment any other major areas of risks that, when discussed with KCM, had not already been recognized. Other risks may yet be identified in the final OBS/CCS BAFO evaluation. The specific areas of risk and associated risk mitigation approaches identified by the team are discussed elsewhere in this report under the associated technical subjects.

5.3 Project Management Support Systems

KCM has set up, or is in the process of setting up, multiple project management support systems and processes that will be used during implementation of the TRS, OBS/CCS, and RFCS projects to assist the project teams in managing the projects and, in particular, the interfaces and dependencies among the projects. These systems and processes should provide the following benefits to the management of the projects:

- Monitor Contractor progress and assess the impact of delays and other schedule changes generated on one project on the other projects and KCM's resource plans
- Monitor Contractor compliance with the respective contract
- Identify potential problems earlier in the project when they are less difficult and costly to resolve and are less likely to impact other projects and resources
- Improve resource planning by identifying peaks and valleys in required resources necessary to support the projects activities
- Manage risk by requiring the formal recognition and documentation of risk and potential risk areas and requiring the development of risk mitigation strategies
- Minimize the chance of a requirement or issue "falling through the cracks"
- Establish clear project team responsibilities and lines of communication.

The project management support systems and processes follow good project management practices. They have been reviewed in greater depth as part of the Quality Management Review

conducted by MTG Management Consultants and were favorably rated. Adjustments are being made per the recommendations of that study. In Macro's experience, these systems and processes, the formalization of these systems and processes, and the apparent organizational support for these systems and processes, go beyond what is typically seen in the transit communication system projects that have been implemented by other transit agencies.

The support infrastructure for KCM management of the TRS, OBS/CCS, and RFCS projects is comprehensive and addresses project control and monitoring, risk management, quality management, communications, reporting, and decision-making components. Some of the more significant aspects of this project support infrastructure that are relevant to managing the interfaces between projects are described below:

a. Requirements Tracking: The OBS/CCS project has set up a software-based requirements tracking system to trace the thousands of system requirements (predominantly software) through all stages of development, testing, and final deployment. Software requirements tracking is particularly important on projects as complex as the OBS/CCS, because a requirement can be functionally related to other requirements, but for valid architecture reasons, could be implemented in a different module than the related requirements. Detailed tracking of requirements ensures that features do not "fall through the cracks". If a requirement is missed, or misinterpreted by the Contractor, the requirements tracking software will highlight this fact, and adjustments can be made early in the project, when the impact is minimized. KCM is using IBM RequisitePRO, a software product specifically designed for requirements tracking. KCM has also required the OBS/CCS Contractor to utilize a similar product on the project. The Contractor's requirements database will be a subset of the requirements and history that KCM is tracking. Although a different product may be used by the Contractor, there will likely be an ability to exchange information electronically.

b. Technical Interface Committee: The Technical Interface Committee was established as a forum to work through interface issues for interfaces affecting multiple projects. The TRS and OBS/CCS Contractors are required to have project management and technical participation on this Committee, along with KCM. The RFCS Contractor, while not contractually committed, will also be invited to participate in this Committee once the OBS/CCS project is underway. Meetings will be held monthly, or more often, as necessary.

c. Integrated Master Schedule: KCM is in the process of developing an Integrated Master Schedule that will include the RFCS, TRS, and OBS/CCS projects. The integrated schedule will be invaluable in understanding the inter-project dependencies and the

impact of schedule changes on the other projects and KCM's staffing plans. Currently the schedule has detailed activities for the RFCS and TRS projects, and a moderate level of detail for the OBS/CCS project. Additional detail for the OBS/CCS project will be available when the evaluation is concluded. On the advice of MTG Management Consultants, KCM plans to set up a process where task data is periodically exported from the scheduling program to Microsoft Access (a database product). In this form, it will be easier for KCM to develop reports to focus on specific project management issues, such as the interface points between projects, and the demands on KCM personnel.

d. Issue and Action Item Management Tracking System: KCM's Project Management Office is evaluating project tracking and reporting tools for general use on all KCM projects. This tool will include an issue and action item management tracking system. An issue is an item that could be detrimental to the project if left unresolved. Issues represent risk, or potential risk to the project. An appropriate mitigation strategy will be developed for each issue. Action items are tasks that must be performed as part of the normal execution of the project, and include responding to information requests from the Contractor. The issues and action item tracking system will enable project management to assign resources and priorities to each action item and issue. The tracking system will help ensure that KCM is responding to project demands in a timely and prioritized fashion, that items do not "fall through the cracks", and that potential risks are explicitly recognized, communicated, and addressed at the earliest opportunity.

e. Change Management System: It will be important to keep a relatively fixed target in front of each project Contractor throughout the execution of the project. Excessive changes to project requirements can decimate project budgets and give Contractors valid excuses for project delays. It is evident to Macro that considerable thought and detail went into KCM's definition of requirements for each of these projects. The thoroughness of the requirements development process and the resultant specifications make it unlikely that KCM will need to make many changes, and makes it difficult for Contractors to make change of scope claims. Nevertheless, some changes may be necessary or desirable to meet a dynamic operating environment. To manage change on these projects, KCM has set up a change control process and tracking system. Potential changes will be entered into the tracking system, along with an assessment of the impact of the change. A Change Control Board, consisting of various technical and business stakeholders, will be established to approve or reject proposed changes. Changes that impact scope, schedule, or cost must be approved by the Steering Committee. Any change that impacts system functionality must be approved by the client.

f. Steering Committee: The project Steering Committee will provide an important role of overall oversight and direction for the projects. The Steering Committee membership

includes managers from departments affected by the projects. The Steering Committee will assist the project team in managing risk; monitor project scope, schedule, and costs; and ensure that required staff resources are made available to the project.

Section 6

SUMMARY OF RECOMMENDATIONS

This report provided an assessment of technical and project implementation issues associated with KCM's program to implement real-time voice and data communications with KCM's fixed-route fleet. Along with TRS project, relevant elements of the RFCS and OBS/CCS projects were assessed, as these communications require the successful integration of elements from all three projects. In most areas investigated, Macro found little or no risk associated with KCM's approach or the selected technologies. In general, Macro found that KCM's procurement documents were thorough, complete, and will serve to provide a basis for very strong Contracts with the Contractors for each of these projects. However, as with any transit communications project, some technical and schedule risks were identified. Some of these risks are present to some degree in every transit communications system project. Others are unique to the approach taken by KCM, and/or the selected Contractors and Proposers. In general, Macro found that these risks were fully recognized by KCM and were already being focused upon in their risk management program. Macro did not identify any area of risk that could severely jeopardize the success of the project. There is a reasonable chance, however, that some of these risk areas could result in project delays, and has recommended that KCM plan accordingly.

The following is a summary of the major recommendations arising from Macro's assessment:

1. KCM should continue to aggressively pursue channel licenses, leases, and site preparation for tower sites. These issues are always troublesome and often cause delays on projects.

2. KCM should closely monitor Motorola's progress in areas of new development.

3. Once the OBS/CCS supplier is selected, and prior to contract, KCM should require the selected supplier to formally meet (but separately) with the TRS and RFCS Contractors to talk through the conceptual designs for the OBS/CCS interfaces to the radio system and DDU to gain early identification of potential problems. Any issues or potential problems should be documented.

4. KCM should actively participate in the interface designs (Technical Interface Committee) and facilitate agreements, as currently planned.

5. KCM needs to be flexible in its project plan. Delays of 6-12 months or more are common in the industry and could occur on one or more of the projects. KCM should obtain the necessary agreements for contingencies in case all systems are not in place in time for joint tunnel

operations. It would also be prudent for KCM to develop contingencies plans for extending the lifetime of existing equipment.

6. If project delays do occur, KCM should resist Contractor and other outside pressures to shortcut quality control, configuration management, and testing processes.

7. KCM should insist that the OBS/CCS Contractor maximize the float time in the Contractor's schedule for activities related to the DDU and TRS interfaces.

8. KCM should continue to place a high priority on assigning adequate staffing to the projects. Full-time project team personnel should be augmented with additional staffing as required for KCM to meet its obligations during peak periods of the project.

9. The OBS/CCS Contractor had not been selected at the time of this assessment. Differences may exist in the risk profile presented by each OBS/CCS Proposer that could impact this assessment. KCM should carefully consider any such Proposer-specific risk issues in the final evaluation of Best and Final Offers.

Appendix A

Clarification Questions and Responses

APPENDIX A

KING COUNTY METRO
TRANSIT RADIO SYSTEM PROJECT ASSESSMENT

Clarification Questions and Responses

The following are questions that were raised concerning the TRS Assessment Report findings, and the responses provided by Macro and the King County Metro project staff.

Review feedback from David Mendel:

1. Page 1-1 – Section 1.1 talks about how the TRS will meet today's and future needs of the County. Where are these future needs published?

   Macro Comment: Radio/AVL Replacement Project needs were established during planning activities conducted in 2001 and 2002, and were published in the "Radio User Requirements Report" (6/7/01) and the (Automatic Vehicle Location (AVL) User Requirements Report" (2/22/02). These initial needs have been updated during the course of the specification development activities, base on new developments and the availability of technologies.

   Provisions for unplanned growth are accommodated by the spare capacity and expandability requirements.

   KCM Comment: The RFP stated KCM's requirements for voice and data communications that included coverage, capacity, and the integration requirements needed to support future OBS/CCS deployment.

2. Page 2-2, section 2.1.1.2 – What is the definition of "Grade of Service?"

   Macro Comment: The "Grade of Service" (GOS) indicates the *maximum* percentage of calls or messages that could be blocked or delayed as result of a temporary overload condition, during the peak busiest hour of a given period of time; a 1% GOS indicates that no more than one out of a hundred calls would be delayed during the busiest hour. In a trunked radio system, delayed or blocked calls are placed in a queue. The queue is sorted by priority; the highest priority call will receive the next available resource.

   KCM Comment: The contract definition is as follows:

   System Capacity and Grade of Service

   A. The TRS (including ACCESS) shall provide channel capacity sufficient to meet Grade of Service below for both voice and data traffic during peak period through the year 2012 based upon the traffic data and projected fleet size provided in Appendix G, Fixed Route Radio Traffic Data and Fleet Size Projection; Appendix D, Subscriber Matrix and Appendix L, Voice Traffic Verification Analysis.

B. The TRS (including ACCESS) shall provide through the year of 2012 a Grade of Service of one percent (1%) (for every one hundred (100) calls, no more than one percent (1%) of the attempted calls shall be placed in queue). Forty-four percent (44%) of queued calls shall have access to a channel in one (1) second or less during the peak period.

3. **Page 2-2, section 2.1.1.2 – What are the growth projections for the system?**

   Macro Comment: Please see KCM comment.

   KCM Comment: The RFP, released in 2004, was based on the then-known projections through 2013, from KCM's adopted fleet plan. Macro's conceptual design in the RFP and Motorola's proposed design used these numbers. The RFP also included attachments with detailed, current traffic data from the existing system.

   Just recently, KCM management has been discussing possible fleet expansions that might occur as a result of a possible .01% sales tax increase, if approved by voters, as well as mitigation for major construction projects such as the replacement of the SR-99 and SR-520. It's our understanding that this fleet expansion could be around 200-230 coaches. No decisions on this issue are likely to be finalized until after contract signing. The project intends to address this expansion via change order, if required. Additional funding to pay for the added infrastructure would be requested as part of the fleet expansion program.

4. **Page 2-2, section 2.1.1.2 – A statement is made that the TDMA system leads to fewer channels which is true. Then it states that those channels will be used for expansion later. Does this mean the channel is built and unlicensed?**

   Macro Comment: Please see KCM comment. In addition, much of the common equipment in the TRS infrastructure is expandable to support additional talk paths but is not currently equipped.

   KCM Comment: We believe the point of this reference is that Motorola's proposed system does not use all of the nine 25-KHz channels that the Regional Planning Committee (RPC) has preliminarily allocated to KCM in the Regional Plan. As a result, the baseline system can be built within that allocation. It is our intention to file license applications for all nine channels in the allocation, build the system, and then return any unused channels into the pool.

   The fact that there may be "leftover channels," as it were, makes it more likely that we could return to the RPC later with a system expansion request, and still not exceed the original nine-channel allocation. The project would not propose to build any channels without a license. It would appear that the potential transit fleet expansion mentioned above could become a reality later this year if a ballot measure is passed. If so, the system expansion could be accommodated during the initial design and license application process.

5. **Page 2-3, section 2.1.1.5 – Same issue as the General concern above.**

   Macro Comment: In addition to the points stated by KCM below, the TRS commercial terms include provisions that state if the FCC fails to issue the applicable licenses by the "Start" dates specified in the Contract for Stage Two or Three, neither party shall be liable to the other for any added costs, expenses, compensation or other impacts arising from a Licensing Delay. While this clause does not eliminate all complications that could occur due to such delays, it does eliminate Motorola's right to make a claim for additional costs.

   KCM Comment: Section 2.1.1.5 is related to the timing of license applications. With the 700 MHz frequencies in particular, there are several steps to the process, which are summarized in Macro's report. Since the Region 43 700 MHz Plan was filed on February 7th, the project can now project the date of license approval with improved confidence, based on the known durations for each step which are established in the 700 regulatory process. Based on these durations, the licenses are likely to be approved by June 2007.

   The contract includes a requirement for 700 MHz licenses to be received before KCM will authorize Motorola to proceed with Stage 3, Install/Test Base Stations at All Sites. Stage 3 is scheduled to start in December 2007. Consequently there is a 5-6 month period of float between June 2007 when license approval is expected, and December, 2007, when licenses are required.

   It is true that the FCC or the Regional Planning Committee might not meet their stated target dates for completing each step of the process. The FCC could fail to meet their published commitment for a 120-day approval of Regional 700 MHz Plans, for example, or the Regional Planning Committee could fail to open the local filing window within 6 months of initial Plan approval, or fail to approve submitted applications within 45 days of the closure of the local filing window. Hai Phung, the KCM project manager, is a member of the RPC and will be monitoring each step of the process closely, in order to assess progress and potential impacts on the project schedule.

   In the event that a delay in license approval may start to affect the schedule, KCM may file a "Special Temporary Authority" application, which can provide temporary authorization for frequency use while the actual license is being processed. This is a standard waiver process under FCC rules. In addition to the above mitigation factors, King County has access to the services of a telecommunications legal firm in Washington DC, that may be able to intervene with the FCC and help mitigate any schedule delays. All of these processes will be used to monitor the progress of the licensing process and mitigation steps will be initiated as soon as the need is identified.

6. **Page 2-5, section 2.1.2 – First and second paragraphs both say fixed portion of the network, but seem to be talking about different things in contrary to the definition of a fixed network. The third paragraph says XTL 2500's aren't used by any agencies that Macro is aware of. RCS uses some, and I'm sure many other agencies use them both in a outside of public safety.**

   Macro Comment: With respect to the comment regarding the "fixed network", Macro understands that the term "fixed" may have created some confusion. In the first paragraph, we were trying to differentiate or separate the TRS into two discreet sub-systems - those that directly provide the wireless link to field equipment (e.g., wireless components), and those that support and integrate these wireless components (e.g.,

non-wireless components). Deletion or replacement of the term "fixed" with the term "non-wireless" may clarify these paragraphs."

With respect to the XTL 2500's, Macro is not aware of any other Transit Agency using the XTL 2500 radio, although it is aware of other Transit Agencies using other radios in the XTL series (i.e., the XTL 5000). We are now aware of at least three public safety agencies that are using the XTL 2500 radio. For purposes of the risk analysis, it is sufficient that we now know that development of this radio is complete and it is now being used in the field; it is not necessary that it be in use for a Transit Agency.

KCM Comment: That's interesting. Motorola providec some references for agencies that have started using the XTL 2500, and did not mention King County.

7. **Page 2-8, Section 2.2.1 – Are the CCS control Center Integration Test and OBS/CCS Integration Field Test defined in the individual OBS/CCS contract?**

   Macro Comment: Although the tests have different names, these tests align with the Field Installation and System Integration field testing specified in the OBS/CCS Specification. The names could be changed in the final OBS/CCS Contract to more clearly represent this correlation.

   KCM Comment: Yes, integration tests are defined in detail in the OBS/CCS RFP and neither proposal has taken exception to these requirements. The OBS/CCS contract is expected to be executed in late September of this year. It should be noted that the Transit Radio System will provide, essentially, the communications layer to connect the "On-Board System" with the "Communication Center System."

8. **Page 3-2, Section 3.1 – Since the DDU has to be compatible with two systems, I'm concerned about several things. 1.) Will the operators be able to adjust to the program differences? 2.) How will the programming be completed – is it one step or two?**

   Macro Comment: It is Macro's understanding that the general design approach for the DDU applications is to provide a unified Operator Interface such that the source system is transparent to the Operator. The Operator will interface to screens on the DDU; the underlying functionality and routing of Operator actions to the appropriate on-board system will not be apparent to the Operator. This approach should make it easier for the Operator to adapt to the new systems.

   KCM Comment: With regard to Question #1, we believe operators will be able to adjust with a minimum of disruption, especially given the lead time of DDU installation starting this year, and their extended use of the DDU with the existing radio system before OBS and Radio installation in 2008.

   With one exception, the addition of canned messaging, the radio functionality for operators will essentially be transparent as the DDU is reprogrammed. Starting with smart card deployment in 2006, the DDU will have dedicated keys for Request To Talk (RTT) and Priority Request To Talk (PRTT). (The Emergency Alarm is a foot-switch.) The RTT and PRTT keys are intended to stay in the same location on each screen throughout the transition as buses are migrated over to the new radio system. Detailed screen flows have been developed as part of Smart Card system design and are available for OIRM / PRB review if desired.

The use of canned data messages is the one new OBS/CCS function that will be enabled by the new radio system. These messages are envisioned in the OBS/CCS RFP as a fairly simple list of typical, frequently used messages that could be selected from a pick list and sent by pressing a few keys in sequence.

With regard to Question #2, ERG has already supplied what they call "the RCU (radio control unit) application" – their template for providing the RTT and PRTT functions, plus related message handling – as part of their 3rd Party Integration Documentation. This documentation has already been shared with both OBS/CCS proposers, with questions of clarification being routed back to ERG. Under the terms of our contract with ERG, the Intellectual Property for the RCU application is owned by KCM, and can be freely shared with other contractors. ERG is also required by contract to provide all software and hardware needed to allow third-party programming of the DDU and should deliver this to the selected OBS/CCS contractor early in the design process.

The selected OBS/CCS contractor is expected to engage in design discussions with ERG as soon as the contract is signed, and refine their proposed development plan for their DDU application, based on their early review of the 3rd Party Integration Documentation. Their DDU application will provide both OBS and Radio functionality. KCM believes, based on the most recent discussions with ERG, that the current RCU application will be incorporated into the future OBS application. The OBS/CCS contractor will need to develop a section of code that allows for a parameterized configuration switch that can be set depending on which hardware configuration, including radio system, is installed on the bus. When a new radio is installed, this software switch will be reset as part of the installation process and radio operation would be verified before the coach is put back in service.

KCM project staff continue to work with ERG to refine requirements for third-party programming of the DDU and identify potential integration or implementation issues. When an OBS/CCS contractor has been selected, KCM will facilitate technical discussions between the selected contractor and ERG to define specific requirements for DDU development, testing and deployment that are aligned with the needs of the OBS/CCS contractor. If this effort results in the need for additional work by ERG, KCM will negotiate a formal contract change with ERG to cover the added requirements.

9. **Page 3-3, Section 3.2 – Even though ERG is tied into the development of the DDU application and will be making a tool kit, are there going to be warranty issues or liabilities? Will the certification process mitigate this concern?**

   Macro Comment: Please see KCM's comment below.

   KCM Comment: Warranty issues and liabilities are addressed by general contract provisions that cover equipment performance and reliability requirements. The certification process is intended to verify, to all the parties' satisfaction, that the addition of any new functionality will not affect the operation of previously resident functionality. In other words, that new radio functionality, when added, does not cause any adverse impacts on the smart card fare collection system.

10. **Page 4-1, Section 4.1 – Level 1 and Level 2 don't seem to mention the reprogramming. Where does this occur?**

    Macro Comment: The programming of the DDU application is in Level 1.

    KCM Comment: The DDU programming will occur early in the Level 1 development phase. The OBS/CCS contractor will combine Level 1 and Level 2 DDU programming into a single development effort.

    The OBS/CCS RFP was originally structured into two Levels in order to allow for a possible phased implementation if necessitated by the TRS project schedule. If a phased implementation is required, then the new TRS features will be disabled until the radio system is implemented.

11. **Page 4-3, Section 4.I.1 - General Concern – DDU sounds like it is going to be very complicated. Are operators going to be driving and get distracted by the DDU and all the features? Is there a liability for accidents due to distracted drivers?**

    Macro Comment: The consolidation of the Operator Interface for all on-board systems into the DDU is an improved and simplified approach for the Operators than the alternative of requiring the Operator to deal with a unique interface for each on-board subsystem. It should not be necessary for the Operator to interact with the DDU while the bus is moving.

    KCM Comment: Minimizing driver distractions is a critical safety requirement for KCM, and always a key consideration. A single, integrated Driver Display Unit has long been envisioned as a preferable to having multiple driver displays or keypads requiring redundant data entry and continuous monitoring. The DDU is designed to present critical information to the operator at the time they need it, rather than everything at once. Fare collection functions occur when the bus is stopped and loading passengers. Many of the functions that are planned in the On-Board Systems project are automated functions that are intended to reduce the need for driver intervention with systems and allow for better concentration on safe vehicle operation. , i.e. automated "next stop" announcements.

    Mobile data terminals are in use by Transit agencies and others throughout North America and Europe without negative safety consequences.

12. **Page 4-12, Section 4.2.3 – In level 2 testing it looks like the CCS is only tested in the CCS User Bench Test. Is this the case?**

    Macro Comment: While the term "CCS" is only used in the title of one Level 2 test, in fact CCS functionality is tested during all of the tests listed in Section 4.2.3.b.

    KCM Comment: The CCS and its interfaces to the radio system will be tested in Factory Acceptance Testing, User Bench Testing, Installation Testing, Field Testing, Pilot Testing, Mid-Implementation Testing, Conditional Level 2 Testing and Full System Acceptance Testing.

Review feedback from Jim Keller:

13. There are many places in the assessment where they mention the schedule, such as first paragraph page 2-4 where they discuss the need to allow for a potential delay in the licensing, and there are not diagrams or lists show a summary of the schedule so the schedule comments are able to be understood in context.

    Macro Comment: The existing schedules may be too detailed for this purpose. If requested, Macro could generate a high-level diagram that illustrates the comments provided in the report.

    KCM Comment: Macro was provided with a copy of the integrated master schedule, and schedule issues were discussed at length in on-site meetings between Macro and the project managers. The proposed report outline did not call for any tables or graphical schedule summaries. However, if OIRM or the PRB would like this section of the report to be expanded, we can request that Macro spend some additional time on this.

14. Page 2-10 lists a "DSTT Field Integration Test"& "KCRS Field Integration Test". Can't tell what these are.

    Macro Comment: The Downtown Seattle Transit Tunnel Integration Test is a test of revenue vehicle functionality associated with radio communications in the tunnel. OBS/TRS integration is required for this functionality. In addition to testing portable and Mobile radio operation in the tunnel, the KCRS Field Integration Test tests Transit Police radio interoperability with a KCRS King County Police talk-group.

    KCM Comment: Both of these tests are related to radio system integration in the Downtown Seattle transit tunnel. The DSTT Field Integration Test is a test that verifies the connection between the new 700 MHz transit radio system and the tunnel antenna system that is being installed by Sound Transit as part of the tunnel retrofit, and will connect to the Regional 800 MHz Trunked Radio System. The KCRS Field Integration Test will verify that the control stations or talk groups that link the two radio systems together are functioning correctly.

15. Page 3-1 identifies dependencies between the OBS/CCS project, ERG project, and the Radio project including timing issues, with no diagram to put the functional or timing issues in context.

    Macro Comment: The existing schedules may be too detailed for this purpose. If requested, Macro could generate a high-level diagram that illustrates the comments provided in the report.

    KCM Comment: Macro was provided with a copy of the integrated master schedule, and schedule issues were discussed at length in on-site meetings between Macro and the project managers. The proposed report outline did not call for any tables or graphical schedule summaries. However, if OIRM or the PRB would like this section of the report to be expanded, we can request that Macro spend some additional time on this.

16. The review of the county's capabilities to manage the project is benchmarked by Macro against other transit agencies and according to Macro the county is doing much better than these other agencies. The question is, are they doing a good job as compared to what needs to happen to achieve success.

Macro Comment: Yes, Macro has provided consulting services to over 30 transit agencies procuring systems similar to KCM's TRS. This experience has shown that there are several key elements required for a successful project, and especially a project requiring the technology and development of the TRS. These include:

- **Staff capability** – the knowledge of the staff to understand the technology and make the critical decisions that will be required.
- **Staff experience** – the experience of having been involved in a complex development project in the past, and understanding the pitfalls and issues related to these projects.
- **Staff dedication and availability** – the quantity of staff with dedicated time available to monitor the work of contractors and provide the necessary data and review to keep the project moving on schedule.

Rarely, if ever in Macro's experience, has an agency had all three of these elements to the level that is present at KCM. Often times, support for a project is provided by staff that already has other assignments and is available only part-time. Additionally, these projects are frequently a first for the agency in scope and complexity.

Review feedback from Zlata Kauzlaric:

17. Page 1-4, Section 1.2. –

a) If the "*full technical evaluation was neither required nor conducted*" what is Macro's level of confidence – in percentage - that DOT Transit made a right choice in the "*selected vendor's technology and its ability to meet the transit division needs*"?

Macro Comment: Regarding the TRS and the selection of Motorola, a "full technical evaluation" was not required for the Transit Radio System Project Assessment, because a full technical evaluation had already been conducted (by both Macro and KCM) as part of the proposal evaluation process leading to a negotiated contract with Motorola. Accordingly, Macro has a 95% confidence level that vendor selection and technology is correct for KCM.

Regarding the OBS/CCS, vendor selection has not yet been completed; proposals are presently under technical evaluation by the KCM project team. For the TRS Project Assessment, Macro investigated the integration requirements and activities related to the interfaces between these systems and the TRS. The internal functions of the OBS/CCS project were not within the scope of this assessment.

b) What Macro did not evaluate that would constitute "*full technical evaluation*"? What is the level – in percentage – of the technical evaluation if full technical evaluation is 100%?

Macro Comment: See the response to Item a, above. Regarding the TRS, between the Macro team and the KCM team, a 100% technical evaluation was conducted.

Regarding the OBS/CCS project, the technical evaluation is still in progress by the KCM team.

18. **Page 2-4, first paragraph – regarding the schedule for obtaining licenses as a primary risk if delayed. There is a recommendation that the project schedule "should allow for this potential delay". Has Macro verified that the project plan/schedule and/or contract with Motorola includes/allows for such delay?**

    Macro Comment: Yes, the present schedule shows a six-month period from the earliest time that the licenses are expected to be approved by the FCC (June 2007) to the time that they are needed for radio system testing (December 2007).

    KCM Comment: This issue is discussed at length above, under David Mendel's question regarding Section 2.1.1.5

19. **Page 2-6, first paragraph in the middle regarding a potential risk of TDMA software not being ready in time for factory acceptance test ... and KCM advising Macro that in such case KCM would delay tests ... Has Macro verified that the project plan/schedule and/or contract with Motorola includes/allows for such delay?**

    Macro Comment: Macro has not verified that the schedule allows for such a delay, because verification would require detailed information related to Motorola's internal schedules, which are not available to Macro. However, KCM has addressed the need to closely monitor this activity by including monthly monitoring in the contract. This should provide early information regarding Motorola's schedule performance and allow schedule adjustments if necessary.

    KCM Comment: The contract terms applicable to this topic are excerpted below:

    10.4 In addition to the monthly Status Report provided by the Contractor under Section 11.5, the Parties agree to meet monthly to share information known to each of them about the status of the following:

    a. the FCC licensing processes, any problems that may be arising, the projected dates for issuance of the licenses and any actions that either or both Parties could take to expedite said issuance;

    b. the County's acquisition of rights to, and completion of all necessary facility improvements at, the sites where the Contractor will install Microwave Equipment;

    c. the performance of other County contracts which are providing equipment or software that will be integrated with TRS Equipment and Software

    d. the Contractor's development, testing and planned release date of its Software needed to operate the TRS in both FDMA and TDMA mode; and

e. any events or problems that could delay Contractor's ability to provide Contract deliverables on a timely basis.

20. **Page 2-11, first paragraph KCM "committing to actively managing the project" and "agreeing to ... keep the project on schedule, ...". Has Macro reviewed and assessed that the Project Plan and Integrated Schedule, developed by KCM, provide assurance that "Schedule Requirements and coordination among proposed individual project schedules" - as one of the elements in Macro's scope of assessment listed on page 1-4 – are appropriately addressed. What is Macro's assessment of those two documents?**

    Macro Comment: These documents are a "work in process" and continue to be adjusted as necessary to ensure project success, as is required for all complex projects of this nature. As such, we believe that appropriate attention is being given these important activities and expect that this level of attention will continue as the projects move forward into implementation activities.

21. **Page 2-12 – Although there is no final project schedule, "the Contract includes mechanisms that describe how variations will be handled within the project." What are those mechanisms?**

    Macro Comment: The Contract does include an initial detailed project schedule. Mechanisms for handling variations include:

    - Motorola's provision of a more refined and final version of the schedule early in Stage 1 of the project. This schedule will be subject to KCM approval.
    - The Clause 3.1 of the Contract acknowledges that "...preparation and delivery of various items, design documents, plans and specifications that, subject to their approval by the County, will serve as requirement for subsequent work to be performed by the contractor."
    - Anticipated variations caused by "...matters relative thereto, [that] are not sufficiently detailed or explained, or that are errors, omissions, ambiguities, discrepancies, inconsistencies, or other conflicts in the Contract Documents, the Contractor shall immediately contact the KC Project Manager to obtain explanation or clarification." This statement in Clause 3.2 is then followed by an order of Precedence of Contract Documents, outlining a method for resolving the variation(s).
    - King County has approval rights on all design and test documentation.
    - King County and Motorola have agreed to a staged payment and retention release methodology that further augments control of project milestone and deliverables contained in the Agreement.

    KCM Comment: There will be Project Schedule attached to the Contract as a baseline reference, with similar levels of detail to that provided in the integrated schedule submitted to the PRB. The contract also calls for Motorola to submit an even more detailed schedule during the initial phase of work.

Sections 10-15 of the contract terms and conditions cover these topics, and are appended at the bottom of this document.

22. Page 5-1 – first paragraph ... regarding KCM's project role ... Macro's assesses KCM " superior to what Macro has seen at other agencies." Please elaborate.

Macro Comment: See response to Jim Keller's fourth question.

Appendix B

Resolution Status of TRS Evaluation Issues

APPENDIX B

KING COUNTY METRO
TRANSIT RADIO SYSTEM PROJECT ASSESSMENT

Resolution Status of TRS Evaluation Issues

The following table was developed by the KCM staff to identify specific concerns raised by the evaluation team and consultants, regarding the Motorola TRS proposal, and the resolution status of each of the concerns. The table was updated during the course of contract negotiations to yield these final results.

	Issue	Status
Issues Raised by Evaluation Team		
1.	Motorola's system uses fewer sites than specified in the Conceptual Design in the RFP.	We have learned that Motorola has used a customized prediction model for their specific equipment, thus allowing them to make more accurate prediction of what needed to cover the required area. In addition, the coverage requirement has been reduced since the conceptual design was performed which was used as a basis for RFP requirement. The contract being negotiated would require the vendor to install additional equipment to meet coverage requirement at their own cost. **Contract reference:** Exhibit 13 – Section 2.3.2.C Contract Section 44.2.2
2.	Motorola does not guarantee the specified 99.9% annual availability measure. They claim to use "non-numeric methods" including redundancy and spares to ensure hardware reliability (there were multiple references to this issue).	Motorola and KCM have identified a numerical reliability parameter and the conditions that will apply to its calculation. **Contract reference:** Exhibit 13 – Section 2.3.2.2
3.	Motorola takes partial or full exception to almost every item in the Receiver Multicouplers section.	Further clarification with Motorola, it became clear that the proposed system is packaged differently than we have envisioned and that the exceptions are very minor, and it will meet KCM operational requirements. KCM accepted the changes. **Contract reference:** Exhibit 13 – Section 2.3.15

4.	Motorola does not offer a mobile radio with GPS that we could use for non-revenue vehicles. Installing a Vehicle Logic Unit in NRVs would be prohibitively expensive.	The GPS for mobile radio is an optional feature that we were exploring for future use in vehicle tracking and emergency alarm function, but since it is not available we no longer pursue that option. (In any case it was not a strong requirement from our stakeholders.) The non-revenue mobile radios in the current system do not have GPS or Vehicle Logic Unit. However, the proposed mobile and portable radios do have emergency alarm feature. **Contract reference:** Exhibit 13 – Section 2.3.3.6.2.C Exhibit 13 – Section 3.4.2.M
5.	Proposed portable radios lack user-configurable scan functionality. Service supervisors and P&F staff require more than 10 talk groups. May be a lower-tier model radio?	A radio model upgrade for those users may be appropriate The issue will be reassessed during system design when talk groups are finalized. **Contract reference:** N/A
6.	The data for some specified management reports are available in the system, but the reports will have to be developed by the OBS/CCS vendor.	System management reports were meant for radio maintenance staff and not for dispatch center staff. Motorola has confirmed that the reports are available in the TRS Management System (TRSMS) which is part of the system being proposed by the vendor. **Contract reference:** Exhibit 13 – Section 2.3.6.E
7.	Some alarms specified in the Power section (7.7) are not provided as standard features of the console system.	Similar to the above. The system power alarms was meant for radio maintenance and Motorola has confirmed that they are available in the TRSMS. **Contract reference:** Exhibit 13 – Section 6.5.C
8.	The Motorola's dispatch console does not include a VU display.	The rationale for not having a VU display was explained by the Motorola and accepted by KCM. **Contract reference:** Exhibit 13 – Section 6.9.G
9.	The proposal did not include data communications for Access	The 9600 baud data rate provided by this system is much slower than what Access is receiving from GPRS. Access staff feel that commercial data services are a better solution for their MDT requirements. **Contract reference:** N/A
10.	References did not include much information on other transit projects.	Motorola has provided a reference list that included transit agencies, and KCM has received good feedback on reference checks. **Contract reference:** N/A

11.	The specific mix of technologies (FDMA for data and TDMA for voice) is something of a hybrid. The Motorola hasn't deployed this configuration previously, and as a result we may face some early life-cycle issues with this system (multiple similar comments).	Motorola has clarified that they have implemented hundreds of FDMA and TDMA systems worldwide and the base stations have been shipped since early 2004 and portables/mobiles have been shipped since 2003. The proposed radio system combines both technologies. Both FDMA and TDMA will be tested at the Factory Acceptance Test. **Contract reference:** Contract Section 35.2
12.	Division of roles and responsibilities between the proposed Project Director and Program Manager are unclear.	Motorola has further clarified the roles and responsibilities of the proposed Project Director and Program Manager. **Contract reference:** N/A
13.	Proposal summary didn't include a statement of understanding of the County's needs, or the Motorola's understanding of the project goals and objectives.	In subsequent revised submittals and drafts of contract language, it is clear that Motorola does understand the County's needs, as well as the project goals and objectives. **Contract reference:** N/A
14.	Roles for Day Wireless, installation subcontractor, seemed unclear.	Roles for Day Wireless have been clarified. They will be responsible for installation, testing and tuning of the remote sites and radio infrastructure, under Motorola's engineering oversight. **Contract reference:** N/A
15.	Motorola takes significant exceptions to Terms & Conditions, primarily: • Warranty • Intellectual Property • Repeating Defects • Post-Warranty Maintenance • Schedule	These issues were negotiated to resolution, to the satisfaction of both parties. **Contract reference:** • Warranty - Sec. 30.0 of the main Contract • Intellectual Property - Sec. 35 of the main Contract • Repeating Defects - Sec. 32.4 of the main Contract • Post-Warranty Maintenance - Sec. 33 of the main Contract • Schedule – Sec
16.	The initial proposal missed the mark on Transit's coverage needs. The revised proposal is better but there are still some issues related to testing and verification that need to be resolved.	The specific testing and coverage issues are addressed below under "Issues Raised by Engineering Consultants." They have been addressed and resolved in subsequent discussions. **Contract reference(s):** See items #20-26 below.
17.	Motorola takes exception to the progression of work section of Terms & Conditions.	The Progression of Work section was modified during negotiations to the mutual satisfaction of both parties. **Contract reference:** • Sec.10-12 of the main Contract and Exhibit 4

18.	A one-day turnaround for KCM review and comment on contractor submittals is not possible.	The Motorola has agreed to a more reasonable scheduled for KCM review and comment. **Contract reference:** KCM review times are shown in the Schedule that is attached to the Contract. An initial review period of 15 business days (3 weeks) is provided.
19.	Proposal did not address option of integrating with existing tunnel RF distribution system.	KCM has decided not to pursue this option further. KCM has elected to join Sound Transit's RF Distribution System. **Contract reference:** Exhibit 13- Section 2.3.8.2
Issues Raised by Engineering Consultants		
20.	Proposed design is based on portable talk-in from head-level as opposed to belt-level.	RFP coverage requirement is based on outbound (base-to-portable) signal with portable radio mounted at the user's waist level (belt-level). Motorola has confirmed that outbound signal will be tested with portable radio at waist level. **Contract reference:** Exhibit 13 – Section 2.3.2.C.2 Exhibit 13 – Section 10.4.3.4.C
21.	Proposed coverage test verification is not stringent enough to ensure that the radio system meets coverage requirements.	Motorola has confirmed that the entire service area will be tested under full foliage conditions and that both objective (signal measurement) and subjective (listening) tests will be conducted to verify coverage. **Contract reference:** Exhibit 13 – Section 10.4.3
22.	The technology being proposed does not allow configuration changes to be made remotely (over the air).	Motorola has confirmed that a system enhancement for over-the-air programming of subscriber radios will be available at the time of system installation. KCM has requested pricing for this enhancement. **Contract reference:** Contract Section 35.2
23.	The entire service area is not being proposed to be tested.	Motorola has confirmed that they will test the entire service area in accordance with TSB88-A. Motorola will provide all grid test maps for Metro approval before conducting the tests. **Contract reference:** Exhibit 13 – Section 10.4.3

24.	Coverage verification testing is only being proposed for on revenue bus routes and a few selected areas and not areas between routes.	Motorola has confirmed that they will test revenue routes, route terminals, transit bases, and the area between routes. **Contract reference:** Exhibit 13 – Section 10.4.3
25.	Coverage verification testing is only being proposed for the grids that the vendor show on their maps as having coverage and that locations having less than the required performance is not included in the verification test calculations.	Motorola has confirmed that locations having less than the required performance will be included in the calculations. Inaccessible grids will be excluded from the calculations. **Contract reference:** Exhibit 13 – Section 10.4.3.6
26.	Recommend coverage testing using the Bounded Area Percent Coverage approach specified in TSB88-B to be followed.	The TSB88-B coverage standard will be followed. **Contract reference:** Exhibit 13 – Section 10.4.3
27.	System reliability parameters need to be defined.	Motorola and KCM have identified a numerical reliability parameter and the conditions that will apply to its calculation. **Contract reference:** Exhibit 13- Section 2.3.2.2
28.	The use of UDP on the data channels do not provide for an acknowledgment that does not seem reliable for emergency messages.	Emergency messages will also be sent on control channel. Motorola has confirmed that the control channel does provide an acknowledgment. **Contract reference:** Exhibit 13 – Section 2.3.3.6.1.H
29.	Proposed system capacity might be designed around averaged calls and not peak hour values.	Motorola has confirmed that their design capacity is based on peak hour values. **Contract reference:** Exhibit 13 – Section 2.2.1.2