

Model Systems Engineering Documents for Closed Circuit Television (CCTV) Systems

Version 1.0

May 2018



U.S. Department of Transportation
Federal Highway Administration

FHWA-HOP-18-060

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document. This report does not constitute a standard, specification, or regulation. The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

QUALITY ASSURANCE STATEMENT

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Technical Report Documentation Page

1. Report No. FHWA-HOP-18-060	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Model Systems Engineering Documents for Closed Circuit Television (CCTV) Systems		5. Report Date May 2018	
		6. Performing Organization Code	
7. Authors Iteris, Inc.: Jeffrey Brummond, Dwight Shank R. C. Ice and Associates: Ron Ice Federal Highway Administration: Richard Denney		8. Performing Organization Report No.	
9. Performing Organization Name and Address Iteris, Inc. 11781 Lee Jackson Memorial Hwy, Suite 625, Fairfax VA 22033 R. C. Ice and Associates 27155 Big Horn Mountain Way, Yorba Linda, CA 92887		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No. DTFH61-12-D-00043	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Highway Administration 1200 New Jersey Avenue, SE. Washington, DC 20590		13. Type of Report and Period Covered Project Report, September 2015 – May 2018	
		14. Sponsoring Agency Code FHWA - HOP	
15. Supplementary Notes Richard Denney, FHWA National Resource Center Kingsley Azubike, FHWA Office of Transportation Management			
16. Abstract <i>Model Systems Engineering Documents for Closed Circuit Television (CCTV) Systems</i> is intended to provide guidance for professionals involved in developing systems engineering documents covering the evaluation, selection and implementation of CCTV systems.			
17. Key Words systems engineering, closed circuit television, CCTV, concept of use, concept of operations, system requirements, verification, validation, intelligent transportation system		18. Distribution Statement No restrictions.	
19. Security Classif. (this report) Unclassified	20. Security Classif. (this page) Unclassified	21. No of Pages 218	22. Price N/A

TABLE OF CONTENTS

EXECUTIVE SUMMARY	11
PLANNING PHASE.....	11
PROJECT PHASE	11
CHAPTER 1. CONCEPT OF USE	13
PURPOSE.....	13
PROCESS	13
CONCEPT OF OPERATIONS	14
REQUIREMENTS DOCUMENT.....	15
VERIFICATION PLAN	16
VALIDATION PLAN	16
PROCUREMENT	17
ASSEMBLING YOUR DOCUMENTS	17
SUMMARY	18
CHAPTER 2. CONCEPT OF OPERATIONS GUIDANCE.....	19
SCOPE (CHAPTER 1 OF THE CONOPS DOCUMENT).....	20
<i>Document Purpose and Scope</i>	<i>20</i>
<i>Project Purpose and Scope.....</i>	<i>21</i>
<i>Procurement.....</i>	<i>21</i>
REFERENCED DOCUMENTS (CHAPTER 2 OF THE CONOPS DOCUMENT)	21
USER-ORIENTED OPERATIONAL DESCRIPTION (CHAPTER 3 OF THE CONOPS DOCUMENT)	21
<i>General Actors</i>	<i>22</i>
<i>Use Cases.....</i>	<i>22</i>
OPERATIONAL NEEDS (CHAPTER 4 OF THE CONOPS DOCUMENT).....	22
ENVISIONED CCTV SYSTEM OVERVIEW (CHAPTER 5 OF THE CONOPS DOCUMENT)	22
CCTV SYSTEM OPERATIONAL ENVIRONMENT (CHAPTER 6 OF THE CONOPS DOCUMENT).....	24
<i>Operational Environment</i>	<i>24</i>
<i>Physical Environment</i>	<i>25</i>
CCTV SYSTEM SUPPORT ENVIRONMENT (CHAPTER 7 OF THE CONOPS DOCUMENT)	25
PROPOSED OPERATIONAL SCENARIOS USING A CCTV SYSTEM (CHAPTER 8 OF THE CONOPS DOCUMENT)	26
CHAPTER 3. SYSTEM REQUIREMENTS GUIDANCE.....	27

SCOPE OF SYSTEM OR SUB-SYSTEM (CHAPTER 1 OF THE REQUIREMENTS DOCUMENT)	29
REFERENCES (CHAPTER 2 OF THE REQUIREMENTS DOCUMENT)	29
REQUIREMENTS (CHAPTER 3 OF THE REQUIREMENTS DOCUMENT).....	29
VERIFICATION METHODS (CHAPTER 4 OF THE REQUIREMENTS DOCUMENT)	29
SUPPORTING DOCUMENTATION (CHAPTER 5 OF THE REQUIREMENTS DOCUMENT).....	30
TRACEABILITY MATRIX (CHAPTER 6 OF THE REQUIREMENTS DOCUMENT)	30
GLOSSARY (CHAPTER 7 OF THE REQUIREMENTS DOCUMENT)	30
CHAPTER 4. VERIFICATION PLAN GUIDANCE	31
PURPOSE OF THE DOCUMENT (CHAPTER 1 OF THE VERIFICATION PLAN DOCUMENT)	32
SCOPE OF PROJECT (CHAPTER 2 OF THE VERIFICATION PLAN DOCUMENT).....	32
REFERENCED DOCUMENTS (CHAPTER 3 OF THE VERIFICATION PLAN DOCUMENT)	32
CONDUCTING VERIFICATION (CHAPTER 4 OF THE VERIFICATION PLAN DOCUMENT)	33
VERIFICATION IDENTIFICATION (CHAPTER 5 OF THE VERIFICATION PLAN DOCUMENT)	33
CHAPTER 5. VALIDATION PLAN GUIDANCE	35
PURPOSE OF THE DOCUMENT (CHAPTER 1 OF THE VALIDATION PLAN DOCUMENT)	36
SCOPE OF PROJECT (CHAPTER 2 OF THE VALIDATION PLAN DOCUMENT)	36
REFERENCED DOCUMENTS (CHAPTER 3 OF THE VALIDATION PLAN DOCUMENT).....	36
CONDUCTING VALIDATION (CHAPTER 4 OF THE VALIDATION PLAN DOCUMENT)	37
VALIDATION IDENTIFICATION (CHAPTER 5 OF THE VALIDATION PLAN DOCUMENT)	37
CHAPTER 6. PURCHASING A SYSTEM USING SYSTEMS ENGINEERING DOCUMENTS.....	39
TRADITIONAL APPROACHES ARE RISKY FOR TECHNOLOGY PROJECTS	39
REDUCING RISK USING REQUIREMENTS	40
REDUCING RISK FURTHER BY USING REQUIREMENTS FOR SELECTION.....	41
SOLE-SOURCE ACQUISITIONS	42
SERVICES AND INFRASTRUCTURE	42
VERIFICATION PLAN	44
PROCUREMENT AND VERIFICATION REFERENCES	44
APPENDIX A: CONCEPT OF OPERATIONS TABLE OF SAMPLE STATEMENTS....	47
APPENDIX B: SYSTEM REQUIREMENTS TABLE OF SAMPLE STATEMENTS	119
APPENDIX C: SUGGESTED REQUIREMENTS VERIFICATION METHODS.....	173
APPENDIX D: VERIFICATION PLAN SAMPLE CASES	191
APPENDIX E: VALIDATION PLAN SAMPLE CASES	197
APPENDIX F: STANDARDIZED COMMUNICATIONS PROTOCOL STACK INTERFACE DIAGRAMS.....	203
APPENDIX G: ACKNOWLEDGMENTS	215

LIST OF FIGURES

Figure 1: Concept of Use Process for SE Model Documents	14
Figure 2: High-Level Representative CCTV System Project Architecture Diagram	23
Figure 3: Sample Communications Protocol Standards for the NTCIP-SNMP Triple of External System → video surveillance control → External System Cameras based on the CCTV System Project Architecture Diagram.....	24
Figure 4: “Consumer Reports” acquisition approach	40
Figure 5: Low-bid process supported by requirements.....	40
Figure 6: RFP-based technical selection acquisition process	41
Figure 7: Complex project with both system services and infrastructure, and both pilot and full implementation phases	43
Figure 8: Communications Protocol Standards for the NTCIP-SNMP Triple of CCTV Cameras → traffic images → CCTV System based on the CCTV System Project Architecture Diagram.....	203
Figure 9: Communications Protocol Standards for the NTCIP-SMTP Triple of CCTV Cameras → traffic images → CCTV System based on the CCTV System Project Architecture Diagram.....	204
Figure 10: Communications Protocol Standards for the NTCIP-SNMP Triple of External System Cameras → traffic images → External System based on the CCTV System Project Architecture Diagram.....	205
Figure 11: Communications Protocol Standards for the NTCIP-SMTP Triple of External System Cameras → traffic images → External System based on the CCTV System Project Architecture Diagram.....	206
Figure 12: Communications Protocol Standards for the NTCIP-SNMP Triple of CCTV System → video surveillance control → CCTV Cameras based on the CCTV System Project Architecture Diagram.....	207
Figure 13: Communications Protocol Standards for the NTCIP-SMTP Triple of CCTV System → video surveillance control → CCTV Cameras based on the CCTV System Project Architecture Diagram.....	208
Figure 14: Communications Protocol Standards for the NTCIP-SNMP Triple of External System → video surveillance control → External System Cameras based on the CCTV System Project Architecture Diagram.....	209

Figure 15: Communications Protocol Standards for the NTCIP-SMTP Triple of External System → video surveillance control → External System Cameras based on the CCTV System Project Architecture Diagram.....	210
Figure 16: Communications Protocol Standards for the XML Triple of External System → device control request → CCTV System based on the CCTV System Project Architecture Diagram.....	211
Figure 17: Communications Protocol Standards for the NTCIP-DATEX-ASN Triple of External System → device control request → CCTV System based on the CCTV System Project Architecture Diagram.....	212
Figure 18: Communications Protocol Standards for the XML Triple of External System → traffic images → CCTV System based on the CCTV System Project Architecture Diagram	213
Figure 19: Communications Protocol Standards for the NTCIP-DATEX-ASN Triple of External System → traffic images → CCTV System based on the CCTV System Project Architecture Diagram.....	214

GLOSSARY

Closed Circuit Television (CCTV) System	The system that manages CCTV cameras to monitor transportation operations. The software communicates with the CCTV cameras in the field from a central location such as a TMC.
CFR	Code of Federal Regulations
COTS	Commercially available Off-The-Shelf. This is an FAR term defining a non-developmental item of supply that is both commercial and sold in substantial quantities in the commercial marketplace, and that can be procured or utilized under government contract in precisely the same form as available to the general public.
FAR	Federal Acquisition Regulation
ITS	Intelligent Transportation System
Low-bid	Contract awarded to the “lowest responsible bidder”. Bid is based on a complete set of plans and specifications that precisely defines the facilities to be built.
PIF	Public Interest Finding
Real-time	Activity that occurs simultaneously with or very soon after an event. For example, real-time control involves taking action based on measurements immediately after the measurement is completed.
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Qualifications
TMC	Transportation or Traffic Management Center
TOC	Transportation or Traffic Operations Center

EXECUTIVE SUMMARY

This guidance document for procuring Closed-Circuit Television (CCTV) Systems is the second in a series of Model Systems Engineering Documents. The first published set of Model Systems Engineering Documents was for Adaptive Signal Control Technology (ASCT) Systems, published in 2012 by the Federal Highway Administration (FHWA). Over 100 adaptive systems have been implemented in the U.S. since 2010, a significant number of these procurements have utilized the model systems engineering document process. The model systems engineering documents provide a framework for agencies to clearly articulate their needs, and specify succinct and comprehensive system requirements to guide the procurement and implementation of Intelligent Transportation Systems (ITS).

This guidance expands the concept to cover CCTV systems. This framework will support the alignment of an agency's over-arching objectives with their system operations strategies to guide the procurement of a system that best suits their needs within stated constraints. It will reduce the level of unmet expectations by stakeholders, improve the confidence of vendors that they will be able to verify compliance with stated requirements, and reduce the incidence of biased specifications.

These model documents will provide valuable support to agencies at two distinctly different stages of project development, the planning phase and the project phase.

PLANNING PHASE

During the planning phase, a feasibility analysis will clarify the agency's and other stakeholders' needs for a CCTV system. The analysis will explore how a CCTV system could enhance the ability of a CCTV System User to effectively monitor transportation conditions. This will provide sufficient information to clearly define a project with an appropriate schedule and budget.

PROJECT PHASE

During the project phase, a Concept of Operations will support documentation of system requirements to a level of detail that is sufficient to successfully procure a CCTV system. Verification and Validation will confirm the system meets the requirements and successfully meets the agency's overall objectives.

This guidance will support documentation of operations objectives and system needs and constraints by leading the reader through a series of questions that help extract this information from the stakeholder. Sample statements are provided to facilitate a response to each of the stakeholder questions. The sample responses should be tailored to address specific situations. The outcome of selecting and tailoring the sample responses will be a set of clear and concise statements to formulate the required systems engineering documentation. By following this guidance, an agency should be positioned to conduct an alternatives and procurement analysis and can expect to produce the following documents:

- Concept of Operation.
- System Requirements.
- Verification Plan.
- Validation Plan.

It is strongly recommended that CCTV systems not be procured using traditional low-bid process. The CCTV recommends that systems not be procured using traditional low-bid process. Many studies and experiences have proven that Intelligent Transportation Systems, including CCTV systems, are complex and require sufficient integration and customization that are difficult to anticipate and manage effectively within a low-bid process.

When Federal funds are involved in a project, the systems engineering documents are subject to review by the relevant FHWA Division Office, and should be submitted according to relevant State procedures. The systems engineering documents must be approved prior to commencing the procurement process.

CHAPTER 1. CONCEPT OF USE

PURPOSE

The primary objective of this CCTV Systems Concept of Use (COU) is to describe how the Systems Engineering (SE) Model Documents can guide the deployment of a CCTV system ensuring the procured and deployed CCTV system is successfully meeting the user needs of the stakeholders who will be using the CCTV system to monitor transportation conditions. The purpose of the SE Model Documents is to guide the user through the process of developing systems engineering documents for definition and procurement of a CCTV system. The CCTV system may be a brand-new deployment or an expansion of an existing system.

The Model Systems Engineering Documents for CCTV Systems are intended for projects with the following characteristics:

- Relatively small, such that the project budget cannot be reasonably expected to fund systems engineering document development from scratch.
- Constrained to existing products in the market. The model documents are not intended to provide the detail necessary to support new significant software development.
- Applications of CCTV are already well-defined in the transportation industry.

Agencies building large projects with custom software development or innovative applications will need to perform more detailed custom systems engineering, though these documents may provide an effective and timesaving starting point for that effort.

PROCESS

The target audience for this COU includes transportation agencies needing to procure relatively small-scale CCTV systems by following a standardized systems engineering process without the need to hire a consultant. The COU will help an agency align their processes, operations and needs with the CCTV System Engineering Model Documents, allowing the tailoring of the model document content.

This process will lead to a set of user needs, requirements, verification plan and validation plan to support a successful procurement of a CCTV system. A successful procurement results in a CCTV system that not only meets the agency's needs but also provides a basis for ensuring that the procured system meets its advertised capabilities.

The overall framework for the set of CCTV SE Model Documents is depicted in Figure 1 below.

The CCTV SE Model Documents begin with creating a Concept of Operations capturing typical representative *use cases*, and operational scenarios involving CCTV systems. Use cases capture the system *actors* and activities in order to accomplish a specific purpose. An actor defines a role, which may be filled by a person, a group of people, or an external system. The actors form the foundation for the definition of the users of the system and are critical to high-level use cases,

operational scenarios and user needs. Operational scenarios provide examples in narrative form of how those users, activities and systems work together in actual practice.

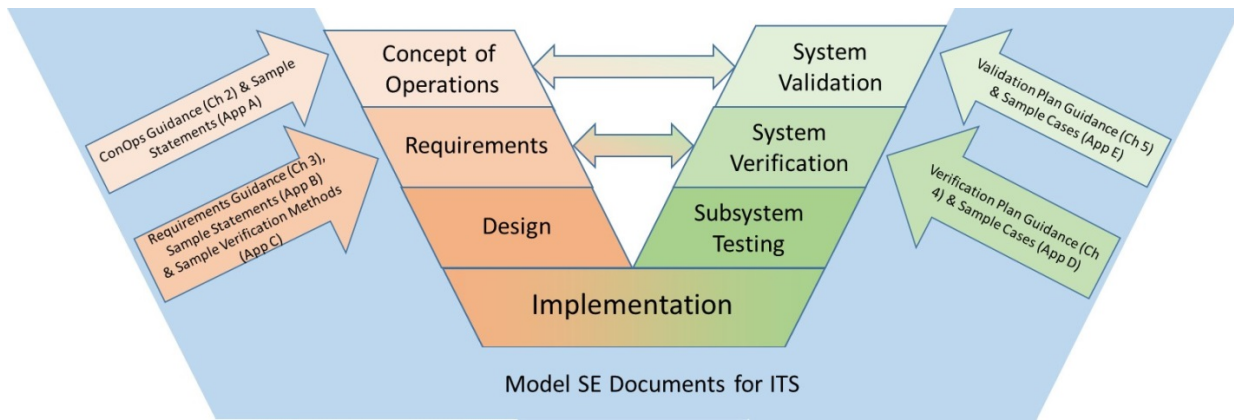


Figure 1: Concept of Use Process for SE Model Documents

The ensuing analysis of the use cases, and operational scenarios lead directly to draft user needs (all embodied in the *Concept of Operations*), and the beginning of system validation cases validating the user needs documented in the Validation Plan. The user needs drive the definition of the requirements and the requirements verification methods (residing in the Requirements document) and a requirements Verification Plan. These have been previously reviewed and validated by operational CCTV Subject Matter Experts (SMEs). The CCTV SE Model Documents walk the user through the process of selecting and tailoring the pertinent use cases and operational scenarios in order to arrive at a set of user needs. Since the systems engineering process is being used, there is forward and backward traceability between the resulting user needs and the requirements. The verification plan and the requirements verification methods are directly traceable back to the requirements being verified. Correspondingly, the validation plan is directly traceable back to the user needs being verified.

The CCTV Model Systems Engineering Documents will provide an agency with a means to describe their existing and planned CCTV system operations using substantive systems engineering products. In particular, the user will tailor the needs and requirements provided in the model. The process will provide meaningful systems engineering support for a CCTV procurement with far less effort than developing systems engineering documents from scratch. The user will still be expected to understand their processes in applying a CCTV system to solve their transportation management problems, but the model documents will provide guidance to the user to help them do so.

CONCEPT OF OPERATIONS

The first product of the application of the model documents will be a *Concept of Operations* for a CCTV system. The Concept of Operations (ConOps) is written from the perspective of the system user/operator, and it establishes the activities of the user in solving the transportation management problem at hand, using CCTV, as the basis for defining and defending requirements. The primary audience for the ConOps includes stakeholders who will participate

in the operation of the system or be directly affected by it. The ConOps is responsible for capturing the stakeholder needs and expectations in a manner that is easily understandable to the stakeholder community, so that the stakeholder community can be confident that it properly models what they will do.

The needs and expectations must be defined succinctly enough to determine what functions the proposed system must be capable of fulfilling. Stakeholders who may play a role in tailoring or reviewing the ConOps may include system users/operators, maintenance staff, system managers, administrators, decision-makers, elected officials, and other non-technical readers. Every element of the subsequent documents in the project, including the requirements, verification plan, designs, test procedures and processes and validation plan, must be able to be traced to statements of user need in the Concept of Operation. Ultimately, the ConOps describes how the agency will use the system, and in that manner, could be considered a prototype for an operating policy and procedure. It is the basis for validating (via the Validation Plan) the system when delivered to ensure that the system is acceptable, with “acceptable” being defined as fulfilling all the *user needs*. The guidance for the Concept of Operations can be found in Chapter 2 of this guidance document.

REQUIREMENTS DOCUMENT

After the ConOps is defined, corresponding system requirements are captured in the CCTV System Requirements Document. The requirements document targets technical staff, system users, system designers and vendors. The ConOps describes what the users will do, and the requirements define what the system must do. Each of the requirements listed in this document must be linked to a corresponding need described in the ConOps. Every need in the ConOps must be linked to one or more requirements in the Requirements Document. The forward and backward traceability between needs and requirements makes it possible to define needed requirements during procurement, and to defend requirements if they are challenged during procurement. The Requirements Document becomes the principle systems engineering document during the procurement process, providing the basis for selection, progress verification, (in some cases) payment, and system acceptance.

Once the user has selected and defined their user needs, the SE Model Documents provide system requirements that are linked to those user needs. The guidance in the model documents will assist agency users in tailoring the model needs and requirements as needed, including any needed iteration between needs and requirements. During tailoring, you will need to iterate between needs and requirements to ensure that they remain traceable and consistent. Traceability ensures that each need is fully represented in the requirements, and each requirement is fully driven by needs. Consistency ensures that the requirements will satisfy the user needs to which they are traced. Once all the needs and requirements are tailored to the specific project, and checked for traceability and consistency, both the ConOps and the requirements documents will be complete and correct.

The CCTV Systems Requirement Document does not define the design of the system, nor does it determine what technologies to use or how to implement them. This document sets the technical criteria that will be used to evaluate design and technology choices. It is the basis for verifying (via the Verification Plan) the system during design and when delivered to ensure that the system

is acceptable, with “acceptable” being defined as fulfilling all the requirements. The recommended approach is to have an Acceptance Test of the procured system based on the system requirements. The guidance for the Requirements Document can be found in Chapter 3 of this guidance document.

VERIFICATION PLAN

This leads to the third document that the user will develop using the Model Documents, the CCTV System Verification Plan. The Verification Plan is responsible for defining the verification testing that will demonstrate fulfillment of requirements. The target audience for this document is the same as for the Requirements document. Generally, the implementing contractor will be responsible to fulfill the requirements. The Verification Plan describes the general verification effort including verification cases with corresponding requirements being fulfilled, including the method by which that determination will be made. It is critical that all requirements are verified within the scope of the Verification Plan. This is best done by tracing each requirement into a verification case and eventually into appropriate steps in the verification procedures. The Model Documents provide a direct mapping of verification cases to the requirements. The user simply needs to extract and tailor the corresponding verification cases related to the chosen set of requirements.

The Verification Plan does *not* describe detailed procedures for testing the CCTV System. It is typical that the system developer/supplier/vendor will develop the verification test procedures that will map to the verification plan as part of the procurement process. The specific steps of a verification test procedure require a knowledge of the specific software and hardware technology that will be implemented. The guidance for the Verification Plan can be found in Chapter 4 of this guidance document.

VALIDATION PLAN

The fourth document that the user will develop using the Model Documents is the CCTV System Validation Plan. The Validation Plan is responsible for defining the validation testing that will demonstrate that the system meets the user needs. The target audience for this document is the same as for the Concept of Operations (ConOps) document. Generally, the implementing contractor will *not* be responsible for validation. The Validation Plan describes the general validation effort including validation cases with corresponding user needs being fulfilled. The Model Documents provide a direct mapping of validation cases to the user needs categories. The user simply needs to extract and tailor the corresponding validation cases related to the chosen set of user needs.

The Validation Plan does *not* describe detailed procedures for validation testing of the CCTV System. Typically, once the CCTV System has been accepted, the users of the system will validate if the system meets their user needs according to the Validation Plan and subsequent validation procedures. The guidance for the Validation Plan can be found in Chapter 5 of this guidance document.

PROCUREMENT

Finally, the guidance within the model documents includes a general discussion of procurement approaches, and how the products of the systems engineering process support various procurement processes. The guidance for procurement can be found in Chapter 6 of this guidance document.

ASSEMBLING YOUR DOCUMENTS

The finished product of your efforts will be several systems engineering documents. In order to successfully prepare these documents, you will need to take the following steps:

1. Read this document completely.
2. Begin to prepare the Concept of Operations. Establish chapters in accordance with the Concept of Operations template. While you are free to format the document to suit your needs, the template follows the outline suggested in ANSI standard G-043-1992. As an alternative, you may simply take the table of sample statements and check those statements you wish to include.
3. Following the instructions in this document, copy and edit relevant statements from the Table of Sample Statements for the Concept of Operations. Depending on how you answer each question in the guidance, select and edit each Concept of Operations statement.
4. Some sections of the Concept of Operations require you to write appropriate text in accordance with the instructions contained in this document.
5. Each statement in the Concept of Operations table has a unique identifier. The needs statements (Chapter 4) each refer to at least one relevant System Requirement that should be considered to support the need statement. Each Concept of Operations statement also contains a reference to the relevant section of this Guidance Document.
6. Begin to prepare the System Requirements. Establish chapters in accordance with the System Requirements template. As an alternative, you may choose to include the System Requirements as an appendix to the Concept of Operations. In this case, you may simply take the table of sample statements and check those statements you wish to include.
7. For each need statement used from the Concept of Operations table, identify the System Requirements that are linked. Copy and edit each relevant requirement into the System Requirements document. Note that whenever you pick a “child” requirement, you should also select its “parent” requirement.
8. If you describe needs in the Concept of Operations that are not covered by these sample statements, then you must either also create new requirements related to those needs, or take separate actions to support those needs if they do not lead to system requirement.
9. Prepare the Verification Plan. Establish chapters in accordance with the Verification Plan template. There is a suggested verification method for each System Requirement. Each high-level System Requirement also has an associated verification case name and description to get you started. Note that every System Requirement requires a verification test, which you will need to define to suit your situation.
10. Prepare the Validation Plan. Establish chapters in accordance with the Validation Plan template. Note that every need expressed in the Concept of Operations requires a corresponding validation test, which you will need to define to suit your situation. If you

define performance measurement in your requirements, some validation may be provided by the new system, while some may require separate off-line tests.

SUMMARY

In summary, the CCTV System Model Documents will provide documentation templates that will guide the user through the selection and insertion of applicable user needs, requirements, verification cases and validation cases that are consistent with each other. The Model Documents will provide guidance to the user on selecting operational CCTV system capabilities that fit within the use cases and operational scenarios. The focus of this guidance is to develop documents that will enable the agency to successfully procure a CCTV system that is currently available in the product market. It should be stressed that the responsibility for preparation of these CCTV Systems Engineering documents rests entirely with the procuring agency.

CHAPTER 2. CONCEPT OF OPERATIONS GUIDANCE

The Model Concept of Operations can be found in Appendix A. The chapters of the Model Concept of Operations, which are described in the sections below, follow a standard outline for concepts of operation established by the American National Standards Institute (ANSI/AIAA-G-043). There are competing standardized outlines for concepts of operations, but the ANSI outline was determined to be the most appropriate for infrastructure construction projects that established new capabilities.

While the layout of the Concept of Operations described in this guidance will provide a logical flow for the intended readers, it is generally not prepared in this sequence. As practical traffic engineers, it is generally preferable to describe at an early stage the operational scenarios envisioned by the system users/operators. After initially describing the limitations of the existing system, you should describe all the situations in which you expect the system to provide benefit, and how you expect the system to operate in each situation. After describing the operational scenarios, you will then be in a position to better describe the specific system and user needs, the alternative strategies considered and why they were discarded, and the envisioned system. Then you will be able to revise the operational scenarios so they are consistent with the statements of needs and provide clear examples of the expected operation.

The Concept of Operations will be organized in the following chapters, following the structure recommended in ANSI G-043-1992:

1. Scope.
2. Referenced documents.
3. User-Oriented operational description.
4. Operational needs.
5. System overview.
6. Operational environment.
7. Support environment.
8. Operational scenarios.

Once you have completed the Concept of Operation, use this checklist to confirm that all critical information has been included:

- Is the reason for developing or procuring the system clearly stated?
- Are all the stakeholders identified and their anticipated roles described? This should include anyone who will operate, maintain, build, manage, use, or otherwise be affected by the system.

- Are alternative operational approaches (such as maintaining the current system capabilities or no system, as appropriate to your situation) described and the selected approach justified?
- Is the external environment described? Does it include required interfaces to existing systems, both internal and external to your agency?
- Is the support environment described? Does it include maintenance?
- Is the operational environment described?
- Are there clear and complete descriptions of normal operational scenarios?
- Are there clear and complete descriptions of maintenance and failure scenarios?
- Do the scenarios include the viewpoints of all involved stakeholders? Do they make it clear who is doing what?
- Are all constraints on the system identified?

SCOPE (CHAPTER 1 OF THE CONOPS DOCUMENT)

The first product of the application of the model documents will be a Concept of Operations for a CCTV system. The Concept of Operations (ConOps) is written from the perspective of the system user/operator, and it establishes the activities of the user in solving the transportation management problem at hand, using CCTV, as the basis for defining and defending requirements. The primary audience for the ConOps includes stakeholders who will participate in the operation of the system or be directly affected by it. The ConOps is responsible for capturing the stakeholder needs and expectations in a manner that is easily understandable to the stakeholder community, so that the stakeholder community can be confident that it properly models what they will do.

The needs and expectations must be defined succinctly enough to determine what functions the proposed system must be capable of fulfilling. Stakeholders who may play a role in tailoring or reviewing the ConOps may include system users/operators, maintenance staff, system managers, administrators, decision-makers, elected officials, and other non-technical readers. Every element of the subsequent documents in the project, including the requirements, verification plan, designs, and test procedures and processes, must be able to be traced to statements of user need in the Concept of Operation. Ultimately, the ConOps describes how the agency will use the system, and in that manner, could be considered a prototype for an operating policy and procedure.

Document Purpose and Scope

The first part of this chapter is a short statement of the purpose and scope of this document. This will briefly describe contents, intention, and audience. Sample statements that may be used in this chapter are contained in the Concept of Operations sample statements table in Appendix A.

These statements should be customized to explicitly apply to your situation. One or two paragraphs will normally suffice.

Project Purpose and Scope

The second part of this chapter gives a brief overview of the purpose and scope of the system to be built. It includes a high-level description; describes what area will be covered by the project; and identifies which agencies will be involved, either directly or through interfaces. Sample statements that may be used in this chapter are contained in the Concept of Operations Sample Statements table. These statements should be customized to explicitly describe your project. One or two paragraphs will usually suffice. This section should be written late in the process, after the envisioned system has been described. It will be a brief summary to introduce the reader to the proposed system.

Procurement

The final section of this chapter will be a brief discussion of the proposed procurement process. The method of procurement should be determined early in this process, because it will have an impact on the format and content of the system requirements document. See Chapter 6 of this Model SE Document for Closed-Circuit Television (CCTV) Systems document for additional information.

REFERENCED DOCUMENTS (CHAPTER 2 OF THE CONOPS DOCUMENT)

This chapter is a place to list any supporting documentation and other resources that are useful in understanding the operations of the system. This could include any documentation of current operations and any strategic plans that drive the goals of the system under development. In particular, it should include documents that define the overall goals and objectives of your agency that will be supported by the CCTV System. This includes local and regional transportation program and policy documents and relevant inter-agency, management and labor agreements and memoranda of understanding. It should reference the applicable statewide and/or regional ITS Architecture(s) and include relevant codes and standards, such as ANSI, IEEE, NTCIP, CFR and NEC. It should also include references to detailed documentation of any required interfaces to other systems such as an Integrated Corridor Management (ICM) system. However, do not treat this as a bibliography. Only include documents that are referenced directly in the Concept of Operation. Sample statements that may be used in this section are contained in the Concept of Operations sample statements table (Appendix A).

USER-ORIENTED OPERATIONAL DESCRIPTION (CHAPTER 3 OF THE CONOPS DOCUMENT)

This chapter describes the operational problem to be solved and how a CCTV System helps the agency solve it. This is where we define the use cases related to application areas. When the use cases are selected in Chapter 3, it will guide you to which groups of user needs you need to select in Chapter 4, User Needs.

General Actors

The general actors represent the various roles and systems that interact with the CCTV System. Each actor represents a role, a user can have multiple roles and there can be multiple for the same type of actor. For example, a CCTV System Maintainer and a CCTV System User could be the same person or they could be different people.

Use Cases

Use cases capture the high-level typical interactions between an actor and a computer system. A use case needs to address a discrete goal of the actor/user. Besides the common use cases of system support (e.g., configuration, maintenance, etc.) the CCTV System use cases give the system user/operator the ability to better judge a transportation-related situation.

OPERATIONAL NEEDS (CHAPTER 4 OF THE CONOPS DOCUMENT)

In order to effectively manage the surface transportation system, users/operators need to be able to see the current conditions in order to detect problems, verify problems and ensure proper mitigation of the problems through various transportation management operations. A CCTV System provides the users/operators with visibility into the transportation network that they would not normally have. The key areas of the transportation network include: roadways, non-roadway transportation infrastructure, and verification of proper operation of non-CCTV field devices.

This chapter captures the stakeholder (including actual user/operator) needs and expectations answering the question “Why is a CCTV System Needed?” which sets the foundation for the system requirements. The stakeholder needs and expectations must be defined in a manner that is easily understandable to the stakeholder community, so that the stakeholder community can be confident that it properly models what they will do.

Each high-level grouping of user needs in Chapter Four of Appendix A includes the statement “Choose the user needs in this group if you chose [any on this list of use cases] in Chapter Three”. This is how the user needs relate back to the use cases. In most cases, the user needs were categorized specifically by their corresponding use case.

Some user needs and their corresponding system requirements will require additional specification and tailoring to the CCTV System environment. The user needs indicate where this is necessary by square brackets “[specify]”.

ENVISIONED CCTV SYSTEM OVERVIEW (CHAPTER 5 OF THE CONOPS DOCUMENT)

This chapter is an overview of the envisioned CCTV system. It is a high-level description that will describe the main features and capabilities, other systems with which it will be interfaced, and the scope of its coverage. You should describe its conceptual architecture at a block diagram level with a high-level data flow diagram. This should not show design details. This description should reflect the needs that are described in the previous chapter. It should illustrate, either graphically or in words, each of the following categories of needs that are relevant:

- Network characteristics.
- Type of CCTV System operations.
- Interfaces to other systems.

A good way of illustrating the system is to draw out the activities undertaken by stakeholders in a particular situation, and highlight those that are anticipated to be augmented with the operation of the CCTV System. An example of such a diagram, generated from RAD-IT, is illustrated in Figure 2.

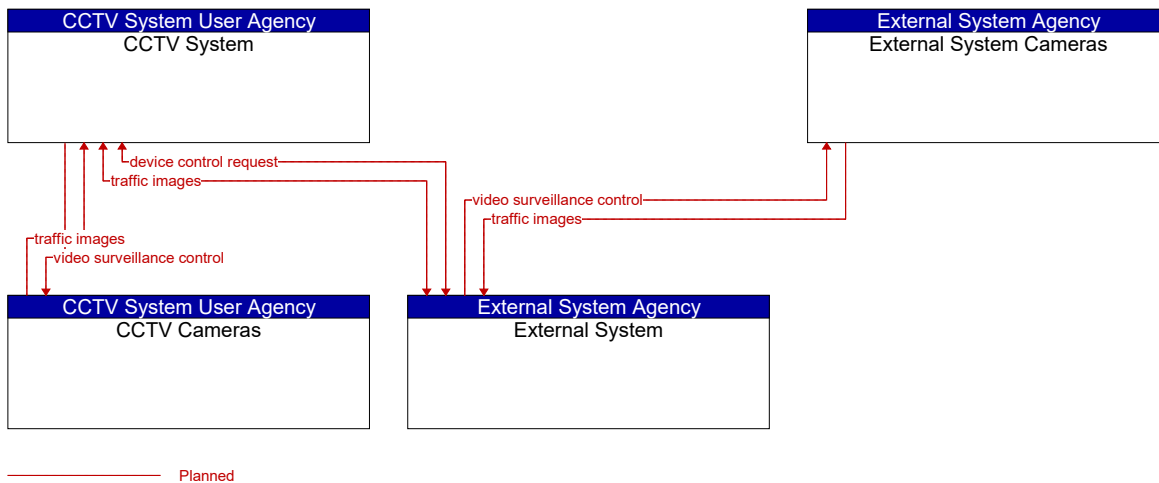


Figure 2: High-Level Representative CCTV System Project Architecture Diagram

Each interface between ITS elements in the architecture diagram can have multiple communications standards associated with it. Using the SET-IT tool and converting the CCTV System Project Architecture results in a set of standardized communication protocol stacks for each triple (source element, information flow and destination element). An example of one of these communication protocol stack diagrams is shown in Figure 3. The entire set of standardized communication protocol diagrams for each interface can be found in Appendix F.

NTCIP-SNMP		
video surveillance control		
External System		External System Cameras
ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS	Security Plane Undefined	ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS
Application Layer IETF SNMP		Application Layer IETF SNMP
Presentation Layer ISO ASN.1 BER		Presentation Layer ISO ASN.1 BER
Session Layer Undefined		Session Layer Undefined
Transport Layer NTCIP 2201-TCP / UDP / T2 NULL		Transport Layer NTCIP 2201-TCP / UDP / T2 NULL
Network Layer NTCIP 2202-IP		Network Layer NTCIP 2202-IP
Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet		Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet
Physical Layer Backhaul PHY		Physical Layer Backhaul PHY

* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 3: Sample Communications Protocol Standards for the NTCIP-SNMP Triple of External System → video surveillance control → External System Cameras based on the CCTV System Project Architecture Diagram

CCTV SYSTEM OPERATIONAL ENVIRONMENT (CHAPTER 6 OF THE CONOPS DOCUMENT)

This chapter describes both the operational environment and the physical environment within which the CCTV System will operate.

Operational Environment

Describe the stakeholders. These should include all existing stakeholders who have an influence on the operation of the proposed CCTV System. This will include Traffic Management Center

(TMC) operations staff, and staff of other agencies whose operation and duties may be affected by the envisioned CCTV System.

The activities related to the CCTV System operation should be described, such as configuration, CCTV camera characteristics, CCTV camera control and viewing, system performance monitoring, and inter-agency staff interactions.

The organizational structure should be described, highlighting any changes from the existing arrangements that are envisioned. An overview of the qualifications and experience of personnel should be presented along with a clear definition of any roles and responsibilities that would be undertaken by contractors, vendors, consultants and staff of other agencies.

Sample statements that may be used in this section are contained in the Concept of Operations sample statements table (Appendix A).

Physical Environment

This section describes the facilities within which equipment and personnel will be housed, additional furniture and equipment that will be required, new computing hardware and software that will be required, operational procedures for operating the system and any additional support that will be needed.

For example, describe whether the equipment will be located in a TMC, at City Hall, at the maintenance shop and/or in the field. Will field equipment need to be field hardened or located within an air-conditioned environment? Will existing power supplies be adequate or will additional service, UPS and battery backups be required?

Will the users/operators be on duty or available 24/7 or during limited hours? Describe their required experience, skills and additional training needs.

Sample statements that may be used in this section are contained in the Concept of Operations sample statements table (Appendix A).

CCTV SYSTEM SUPPORT ENVIRONMENT (CHAPTER 7 OF THE CONOPS DOCUMENT)

This chapter describes the current and planned physical support environment. Describe what support equipment, personnel, training and procedures currently existing, and explain those that need to be acquired or implemented.

Describe any additional test equipment and repair tools that will be needed to support CCTV System operation. Where will test equipment be located?

Describe additional staff or contractors who will not be involved in the day-to-day operations of the system, but will be needed to support the users/operators and maintenance staff. This should include staff from the system vendor and/or consultants, who will provide additional on-going training, periodically audit the system setup and performance and support expansion of the system in the future.

Where multiple agencies are involved, describe the support that will be provided by or to other agencies. This should include any existing or proposed memoranda of understanding or operations and maintenance agreements that will affect the CCTV System, or will need to be modified to include reference to the CCTV System. This may include modifying the policies and procedures of those agencies in addition to developing new policies and procedures within your agency.

Sample statements that may be used in this chapter are contained in the Concept of Operations sample statements table (Appendix A).

PROPOSED OPERATIONAL SCENARIOS USING A CCTV SYSTEM (CHAPTER 8 OF THE CONOPS DOCUMENT)

The purpose of this chapter of the Concept of Operations document is to provide examples that illustrate how the system will be expected to operate and interface with the users/operators in typical circumstances. It is not intended to comprehensively describe the operation under all conditions. It is intended to illustrate to vendors, managers and decision-makers alike how you see your objectives being met by the system. This description is practically oriented and takes into account the practical limitations of available systems. It should not be a description of how you would like some imagined system to operate with no regard for the practical limitation of candidate systems.

Each statement in a scenario should relate to a user need, although not all needs will be further described in a scenario. The statements in the description of each scenario do not directly generate requirements. Requirements are only generated from needs. The scenarios in the Concept of Operations sample statements table (Appendix A) simply provide examples of how the system meets some of the needs.

Once you have written the scenarios, if you are not satisfied that they describe an operation that will be adequate, you should then review your needs statements. If you wish to describe elements of the proposed operation that are not described by needs, then additional needs should be enunciated.

CHAPTER 3. SYSTEM REQUIREMENTS GUIDANCE

The model System Requirements can be found in Appendices B and C. Appendix B lists the requirements with backward traceability to the needs, and Appendix C shows the method by which each requirement can be verified. The sections below describe the typical outline of a *standard* requirements document, as described by the International Organization for Standardization (ISO) / Institute of Electrical and Electronics Engineers (IEEE) 29148:2011(E). For the projects targeted by these model documents, all of these sections may not be necessary, or are adequately covered in the Concept of Operations. We include them here for general information and context. The parts of the outline that are critical, however, include Chapters 3 and 4 of the IEEE outline, which include the requirements and verification methods. For this reason, the numbering for the functional requirements listed in Appendices B and C start with a “3.1”. This numbering approach is an artifact of the standardized numbering.

The chapters required for the System Requirements document are:

1. Scope of System or Sub-system
2. References
3. Requirements
4. Verification Methods
5. Supporting Documentation
6. Traceability Matrix
7. Glossary

This document sets the technical scope of the system to be built. It is the basis for verifying (via the Verification Plan) the system and sub-systems when delivered.

This document must be tailored to your project. All Closed-Circuit Television (CCTV) system projects need a set of requirements defining what will be provided by the vendor. You will need to decide how extensively to document these requirements. One convenient way to gauge how many requirements to write and/or how much detail to have in the requirements document is to start at the finish line. The following should be asked when starting at the top level of the system:

- What are all the functions needed in order to demonstrate to the agency that the system is doing what it is expected to do?
- How well does the system need to perform the required functions?
- Under what conditions does the system need to operate?

Each of these tests will need a set of requirements. This is done for the system and the sub-systems. For simple systems, one or two pages of requirements may be sufficient to fully define what the system is to do. In more complex systems, this could be 10 to 20 pages, or even more.

Another factor that drives the number of requirements and depth of detail that needs to be written is the extent to which commercially available products are used. These products have their own specifications. For many requirements, it may be sufficient to reference the existing product specifications after the requirements have been carefully reviewed. For example, the CCTV systems that are on the market have sufficient documentation to demonstrate that most requirements are fulfilled. The additional requirements would be for any modifications or enhancements needed. However, great care must be taken when referencing existing commercial product specifications to ensure the wording does not unnecessarily or unintentionally limit compliance to a single system when more than one is capable of fulfilling the requirements.

When choosing from available products, your requirements do not need to be as detailed as they would be when developing a new system. This document applies only to the former situation. If your needs lead you to decide that new software must be developed, the project will be of sufficient scope and risk to warrant a more detailed and customized system engineering process than is provided by these model documents.

Once the requirements document has been completed, use this checklist to confirm that all critical information has been included.

- Is there a definition of all the major system functions?
- With each function of the system, is there a set of requirements that describes: what the function does, and under what conditions (e.g., environmental, reliability, and availability)?
- Are all terms, definitions, and acronyms defined?
- Are all supporting documents such as standards, concept of operations, and others referenced?
- Does each requirement have a link (traceability) to a higher-level requirement of a user-specified need or scenario?
- Is each requirement concise, verifiable, clear, feasible, necessary, unambiguous, and technology (vendor) independent?
- Are all technology dependent requirements identified as constraints?
- Does each requirement have a method of verification defined?
- Does each requirement trace to a verification case?

SCOPE OF SYSTEM OR SUB-SYSTEM (CHAPTER 1 OF THE REQUIREMENTS DOCUMENT)

This chapter is a brief overview of the system and statement of the purpose of this document. Briefly describe the contents, intention and audience for this document. Summarize the history of system development, the proposed operation, and maintenance. Identify the project stakeholders, acquiring agency, users and support agencies. Identify current and planned operating sites.

REFERENCES (CHAPTER 2 OF THE REQUIREMENTS DOCUMENT)

This chapter identifies all standards, policies, laws, the Concept of Operations document, concept exploration documents and other reference material that are needed to support the requirements.

REQUIREMENTS (CHAPTER 3 OF THE REQUIREMENTS DOCUMENT)

This chapter lists all the requirements necessary to define the proposed CCTV System. Each requirement should be clear and concise, verifiable, feasible, necessary, unambiguous and technology independent. Each requirement should have a single statement. DO NOT use terms such as "and", "but", "except" and other modifiers that combine more than one thought into a single requirement.

In general, each of the sample requirements falls into one of the following categories, although they are not expected to be organized in this manner:

- Functional Requirements (What the system shall do).
- Constraints (e.g., Technology, design, tools, and/or standards).

Sample requirements that may be used in the Requirements document are included in the System Requirements samples table (Appendix B). Each of these is directly related to one or more statements of need in the Concept of Operation.

Some of the requirements and their corresponding user needs will require additional specification and tailoring to the CCTV System environment. The requirements indicate where this is necessary by square brackets “[specify]”.

VERIFICATION METHODS (CHAPTER 4 OF THE REQUIREMENTS DOCUMENT)

In this chapter, identify one of the following methods of verification for each requirement.

- Demonstration is used for a requirement that the system can demonstrate without external test equipment.
- Test is used for a requirement that requires some external piece of test equipment (such as logic analyzer or voltmeter).
- Analyze is used for a requirement that is met indirectly through a logical conclusion or mathematical analysis of a result. For example, algorithms for congestion: the designer

may need to show that the requirement is met through the analysis of count and occupancy calculations in software or firmware.

- Inspection is used for verification through a visual comparison. For example, quality of welding may be done through a visual comparison against an in-house standard.

Suggested verification methods that may be used in the Requirements document are included in the Suggested Requirements Verification Methods table (Appendix C). Do not describe how, when or where the verification will be performed. This is separately covered in the Verification Plan document.

SUPPORTING DOCUMENTATION (CHAPTER 5 OF THE REQUIREMENTS DOCUMENT)

This optional chapter is a catchall for anything that may add to the understanding of the Requirements and cannot be logically located elsewhere. Examples of supporting documents include: diagrams, analysis, memos, stakeholders contact list and published documents related to similar projects.

TRACEABILITY MATRIX (CHAPTER 6 OF THE REQUIREMENTS DOCUMENT)

This is a table that traces the requirements in this document to the needs expressed in the Concept of Operation. Every requirement *must* support *at least one* user need.

GLOSSARY (CHAPTER 7 OF THE REQUIREMENTS DOCUMENT)

This is a standard glossary of terms unique to the project.

CHAPTER 4. VERIFICATION PLAN GUIDANCE

The model Verification Plan can be found in Appendix D. The chapters required for the Verification Plan are:

1. Purpose of Document
2. Scope of Project
3. Referenced Documents
4. Conducting Verification
5. Verification Identification

This verification plan describes the activity of verifying that the system being built satisfies all the requirements set out in the requirements documents.

The verification documents will include:

- A plan to initially lay out the specific verification effort.
- The verification plan that defines the detailed mapping of the requirements to verification cases.
- A report on the results of the Verification activities.

To ensure that all requirements are verified by this activity, trace each requirement into a verification case, then trace this in turn into a step in the Verification procedure.

The Verification Plan does not need to include verification procedures. These may be prepared by the vendor, but must be reviewed by the agency to ensure each verification case will be tested and appropriate results recorded. In relatively simple cases, the vendor may prepare both the Verification Plan and the procedures. In this situation, the agency must ensure that each requirement is mapped to at least one verification case.

Preparation of a stand-alone verification plan is strongly advised if:

- The system is complex.
- There are several separate verification activities being performed on the system.
- Multiple deployment sites are involved.
- Multiple stakeholders have to be satisfied.

There is also the question of how comprehensive to make the verification effort. It is impossible to validate all possible combinations of actions under all possible operational situations. A good rule of thumb is: if it was important enough to write down as a requirement, then it should be verified, at least once. In-process¹ verification performed on the needs and requirements will help ensure that the correct requirements are being verified.

Once the verification plan is completed, use the following checklist to ensure all critical information has been included.

- Does the Verification Plan answer all the questions of who, what, where, and when?
- Does the Verification Plan make clear what needs to happen if a failure is encountered?
- Does the Verification Plan document the configuration of the hardware, software?
- Are all requirements traced to a verification case?

PURPOSE OF THE DOCUMENT (CHAPTER 1 OF THE VERIFICATION PLAN DOCUMENT)

This section identifies the type of verification activity to be performed within this Verification Plan. For instance, this activity may validate the entire system, a sub-system, the deployment at a site, a burn-in, or any other verification activity called for in the Verification Plan.

SCOPE OF PROJECT (CHAPTER 2 OF THE VERIFICATION PLAN DOCUMENT)

This section gives a brief description of the planned project and the purpose of the system to be built. This section also describes the environment in which the project operates. It identifies the organization structures that encompass all stakeholders. It also gives a brief description of the role to be played by each stakeholder. This includes ad hoc and existing management work groups and multi-disciplinary technical teams that should be formed to support the project.

REFERENCED DOCUMENTS (CHAPTER 3 OF THE VERIFICATION PLAN DOCUMENT)

This is a list of all documents used in the preparation of this Verification Plan. This usually includes the Project Plan, (if one was written), and the applicable Requirements Documents. Reference to other documents, such as descriptions of external systems, standards, a Concept of Operations, and manuals may also be included.

¹ In-process verification is reviewing the needs and requirements during the definition stage by the stakeholders to ensure that all the needs have been identified and traced to the appropriate requirements and have been reviewed for completeness for each of the needs.

CONDUCTING VERIFICATION (CHAPTER 4 OF THE VERIFICATION PLAN DOCUMENT)

This section provides details on how verification is accomplished. It defines: who does the verification; when and where it is to be done; the responsibilities of each participant before, during, and after verification; the deployed hardware and software configuration; and the documents to be prepared as a record of the verification activity.

This section also defines how anomalies are to be handled (that is, what to do when an unexpected situation or a failure occurs during verification).

In general, the following information should be included in this section:

- A description of the participating organizations and personnel and identification of their roles and responsibilities. This may include for example, a verification conductor, verification recorder, users/operators, and/or engineering support.
- Identification of the location of the verification effort, that is, the place, or places, where the verification must be observed.
- The deployed hardware and software configuration for all of the verification cases, including hardware and software under verification and any supporting equipment, software, or external systems. Several configurations may be necessary.
- Identification of the documents to be prepared to support the verification, including Verification Procedures, a Verification Report and descriptions of special equipment and software.
- Details of the actual conduct of verification, including:
 - Notification of participants.
 - Emphasis on the management role of the verification conductor.
 - Procedures for approving last minute changes to the procedures.
 - The processes for handling a failure, including recording of critical information, determination of whether to stop the verification, restart, or skip a procedure, resolution of the cause of a failure (e.g. fix the software, reset the system, and/or change the requirements), and determination of the re-verification activities necessary as a result of the failure.

VERIFICATION IDENTIFICATION (CHAPTER 5 OF THE VERIFICATION PLAN DOCUMENT)

This section identifies the specific verification cases to be performed. A verification case is a logical grouping of functions and performance criteria (all from the Requirements Document) that are to be verified together. For instance, a specific verification case may cover all the control

capabilities to be provided for control of the CCTV System. There may be several individual requirements that define this capability, and they all are verified in one case. The actual grouping of requirements into a verification case is arbitrary; however, the grouping is usually based on the grouping of functional requirements in the Requirements Document. They should be related and easily combined into a reasonable set of procedure actions. Suggested verification cases that may be used in the Verification Plan document are included in the Verification Plan Sample Cases table (Appendix D).

Each case should contain at least the following information:

- A description name and a reference number.
- A description of the objective of the verification case, usually taken from the wording of the requirement, to aid the reader understanding the scope of the case.
- A complete list of requirements to be verified or traceability to the requirements in the requirements document. Since each requirement has a unique number, they can be accurately and conveniently referenced without repetition.
- Any data to be recorded or noted during verification, such as expected results of a step. Other data, such as a recording of a digital message sent to an external system, may be required to validate the performance of the system.
- A statement of the pass/fail criteria. Often this is just a statement that the system operates per the requirement.
- A description of the verification configuration. That is a list of the hardware and software items needed for verification and how they should be connected (in most cases this is the deployed system configuration). Often, the same configuration is used for several verification cases.
- A list of any other important assumptions and constraints necessary to conduct the verification case.

Each verification case in Appendix D corresponds to the same name of a section of requirements in Section 3 of the Requirements model document. The details of each verification case will need to be added as the system is further defined.

CHAPTER 5. VALIDATION PLAN GUIDANCE

The model Validation Plan can be found in Appendix E. The chapters required for the Validation Plan document are:

1. Purpose of Document
2. Scope of Project
3. Referenced Documents
4. Conducting Validation
5. Validation Identification

This document describes the activity of validation that the system being built meets the user needs and scenarios developed in the concept of operations. The validation documents will generally include three levels of validation documents:

- A plan to initially lay out the specific validation effort.
- The user's/operator's manual and/or a validation plan that defines the detailed operational procedures.
- A report on the results of the validation activities.

To ensure user needs and scenarios are validated by this activity, trace each need and scenario into a validation case, then into appropriate steps in the validation procedure.

A separate Validation Plan and procedures may be minimal for the simplest projects, especially where the system is commercially available and does not involve any custom software development, and where the agency staff have a very clear understanding of the purpose of the system. Preparation of a validation plan is strongly advised if:

- The system is more complex.
- There are several separate validation activities.
- Multiple deployment sites are involved.
- Multiple stakeholders have to be satisfied.

There is also the question of how comprehensive to make the validation effort. It is impossible to validate all possible combinations of actions under all possible operational situations. A good rule of thumb is: if it was important enough to write down as a need or scenario, then it should be validated, at least once. This may not, for example, validate all possible failure mode conditions

or all possible incident scenarios. In-process² validation performed on the needs will help ensure that end-to-end validation of the system will meet the stakeholder needs.

Once the Validation Plan has been prepared, use this checklist to ensure all critical information has been included.

- Does the Validation Plan answer all the questions of who, what, where, and when?
- Does the Validation Plan make clear what needs to happen if an unexpected situation or a failure is encountered?
- Does the Validation Plan document the configuration of the hardware and software?
- Are all applicable needs and scenarios traced to a validation case?

PURPOSE OF THE DOCUMENT (CHAPTER 1 OF THE VALIDATION PLAN DOCUMENT)

This section identifies the type of validation activity to be performed within this Validation Plan. For instance, this activity may validate the entire system, a sub-system, the deployment at a site, a burn-in, or any other validation activity called for in the Program Plan or in the SEMP.

SCOPE OF PROJECT (CHAPTER 2 OF THE VALIDATION PLAN DOCUMENT)

This section gives a brief description of the planned project and the purpose of the system to be built. Special emphasis is placed on the project's user needs and issues that must be addressed and validated.

This section also describes the environment in which the project operates. It identifies the organization structures that encompass all stakeholders. It also gives a brief description of the role to be played by each stakeholder. This includes ad hoc and existing management work groups and multi-disciplinary technical teams that should be formed to support the project.

REFERENCED DOCUMENTS (CHAPTER 3 OF THE VALIDATION PLAN DOCUMENT)

This is a list of all documents used in the preparation of this Validation Plan. This usually includes the Project Plan, (if one was written), and the applicable Requirements Documents. Reference to other documents, such as descriptions of external systems, standards, a Concept of Operations, and manuals may also be included.

² In-process validation is reviewing the needs and requirements during the definition stage by the stakeholders to ensure that all the needs have been identified and traced to appropriate requirements and have been reviewed for completeness for each of the needs.

CONDUCTING VALIDATION (CHAPTER 4 OF THE VALIDATION PLAN DOCUMENT)

This section provides details on how validation is accomplished. It defines: who does the validation; when and where it is to be done; the responsibilities of each participant before, during, and after validation; the deployed hardware and software configuration; and the documents to be prepared as a record of the validation activity.

This section also defines how anomalies are to be handled (that is, what to do when an unexpected situation or a failure occurs during validation).

In general, the following information should be included in this section:

- A description of the participating organizations and personnel and identification of their roles and responsibilities. This may include for example, a validation conductor, validation recorder, users/operators, and/or engineering support.
- Identification of the location of the validation effort, that is, the place, or places, where the validation must be observed.
- The deployed hardware and software configuration for all of the validation cases, including hardware and software under validation and any supporting equipment, software, or external systems. Several configurations may be necessary.
- Identification of the documents to be prepared to support the validation, including Validation Procedures, a Validation Report and descriptions of special equipment and software.
- Details of the actual conduct of validation, including:
 - Notification of participants
 - Emphasis on the management role of the validation conductor
 - Procedures for approving last minute changes to the procedures
 - The processes for handling a failure, including recording of critical information, determination of whether to stop the validation, restart, or skip a procedure, resolution of the cause of a failure (e.g. fix the software, reset the system, and/or change the requirements), and determination of the re-validation activities necessary as a result of the failure.

VALIDATION IDENTIFICATION (CHAPTER 5 OF THE VALIDATION PLAN DOCUMENT)

This section identifies the specific validation cases to be performed. A validation case is a logical grouping of functions and performance criteria (all from the Concept of Operations Document) that are to be validated together. For instance, a specific validation case may cover CCTV System user permissions by the CCTV System Manager. There may be several individual user

needs that define this capability, and they all are validated in one case. The actual grouping of user needs into a case is arbitrary; however, the grouping is usually based on the grouping of user needs and the operational scenarios in the Concept of Operations. They should be related and easily combined into a reasonable set of procedure actions. Suggested validation cases that may be used in the Validation Plan document are included in the Validation Plan Sample Cases table (Appendix E).

Each case should contain at least the following information:

- A description name and a reference number.
- A description of the objective of the validation case, usually taken from the wording of the user need and/or scenario, to aid the reader understanding the scope of the case.
- A complete list of user needs and scenarios to be validated. For ease of tracing of user needs and scenarios into the Validation Plan and other documents, the user needs and scenarios are given numbers, so they can be accurately and conveniently referenced without repetition.
- Any data to be recorded or noted during validation, such as expected results of a step. Other data, such as a recording of a digital message sent to an external system, may be required to validate the performance of the system.
- A statement of the pass/fail criteria. Often this is just a statement that the system operates per the user need or scenario.
- A description of the validation configuration. That is a list of the hardware and software items needed for validation and how they should be connected (in most cases this is the deployed system configuration). Often, the same configuration is used for several validation cases.
- A list of any other important assumptions and constraints necessary to conduct the validation case.

Each validation case in Appendix E corresponds to the same name of a section of user needs in Section 4 of the ConOps model document. The applicable operational scenarios defined in Section 8 of the ConOps are referenced in each validation case. The details of each validation case will need to be added as the system is further defined.

CHAPTER 6. PURCHASING A SYSTEM USING SYSTEMS ENGINEERING DOCUMENTS

TRADITIONAL APPROACHES ARE RISKY FOR TECHNOLOGY PROJECTS

Most agencies purchase systems by first exploring the marketplace to identify which technologies and products have the features they want, and then work from the sample specifications provided by the vendors of those technologies and products. They prepare plans and specifications, and then go out for bid. They then select the lowest responsible bidder, but they determine whether a bidder is responsible based on reputation or product affiliation. The bidder receives the contract, and then as part of mobilization, provides a material submittal, which includes product cut sheets describing what materials they intend to provide on the project.

For technology projects, prospective bidders select system and product providers based on cost or standing relationship, and usually require those providers to provide technical information needed to support the bid, and materials to include in the submittal.

The agency usually accepts the submittal unless it points to technologies and products different from what they had explored. If the contractor proposed a different provider, a negotiation begins where the contractor and the agency eventually come to an agreement.

The basis of the selection of the contractor and the contractor's providers is based mostly on cost. The acceptance of those providers is negotiated based on preferences, rather than on objective evaluation.

The problem emerges during implementation and testing, when the agency first has access to the supplied systems and products. At that point, they are able to see things not visible during market research, and the difference between what they have bought and what they are receiving come into focus. Those differences exist because their product selection (or the contractor's selection) did not actually do what they needed it to do, and as acceptance testing wears on, the agency comes to understand their needs and requirements more clearly.

Only two possibilities exist for resolving unmet emerging requirements: Either the agency sets those requirements aside (and does without), or the contractor and providers exceed their expected costs by modifying their product. Usually, both of these occur, and the outcome for the agency is that the system is more expensive than expected and less useful than needed. Even if the agency succeeds in requiring the contractor to absorb those extra costs, it is difficult to say that the project is as successful as it could have been.

One might call this the "consumer reports" approach, where we make choices based on testimonials, short demonstrations, and advertising claims. The process is shown in Figure 4.

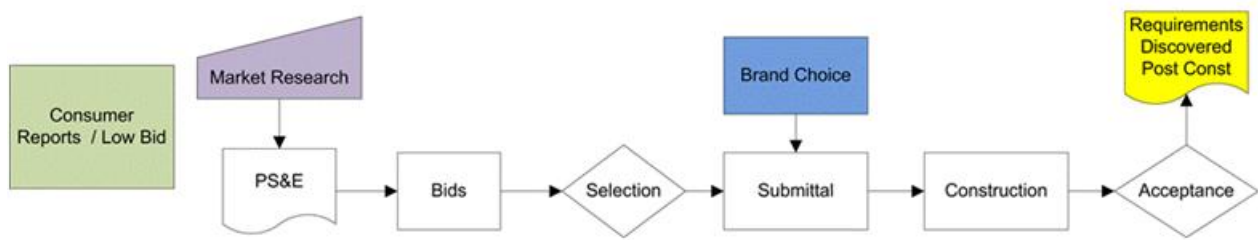


Figure 4: “Consumer Reports” acquisition approach

This process follows the traditional approach used for highway construction, and works reasonably well when all the requirements are clearly understood and documented before the acquisition process begins. When the requirements are not clearly understood beforehand, they will be discovered during the project, but after money has been spent and often too late to fulfill them completely.

REDUCING RISK USING REQUIREMENTS

With well-documented requirements in hand, the agency can still use the low-bid process. However, the requirements have a specific effect at several key milestones of the project, and shown in Figure 5.

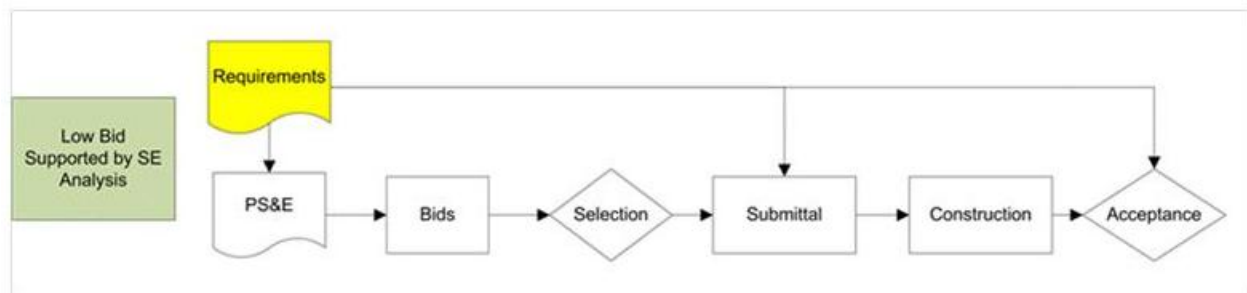


Figure 5: Low-bid process supported by requirements

Firstly, requirements developed before design can be used to evaluate design choices, and to provide a means by which the designer can know and demonstrate, by applying the Verification Plan to the design, that the design is complete and correct. This gives the agency a reason to have more confidence in the design documents.

Secondly, because the requirements will be included in the bid documents, the bidder has a basis for selecting technology and product providers. If a provider falls short later in the process, the contractor cannot claim that the requirements emerged after bidding, as is often the case with the first approach. This reduces the likelihood of the contractor making a poor choice and having to correct it at his expense during implementation.

Thirdly, the requirements give the agency a means of evaluating the materials submittal explicitly, without having to depend completely on brand reputation, testimonials, or sales

activities. The agency should include a requirement in the Special Provisions governing the materials submittal, requiring the contractor to provide a detailed explanation of how the proposed material supply will fulfill each contract. This is, in essence, a pass through the Verification Plan. The agency can assess the materials submittal with much greater clarity and with much more leverage with the contractor if requirements are not fulfilled as expected.

Finally, the requirements provide a direct means of assessing work progress, and of determining when the system can be accepted.

REDUCING RISK FURTHER BY USING REQUIREMENTS FOR SELECTION

Agencies often believe that Federally funded projects require a competitive-bid selection process. This is the case only for infrastructure construction, and does not apply to the acquisition of software systems. Software systems, like engineering services, can be acquired using a technical selection process based on a proposal. This process, when applied to Federal acquisitions, is called the Best Value approach, because the selection of the most technically competent propose provides the best value even if they do not have the lowest price. In most States, this process is exactly the same as an engineering services acquisition, where cost is negotiated after making a technical selection. This process is shown in Figure 6.

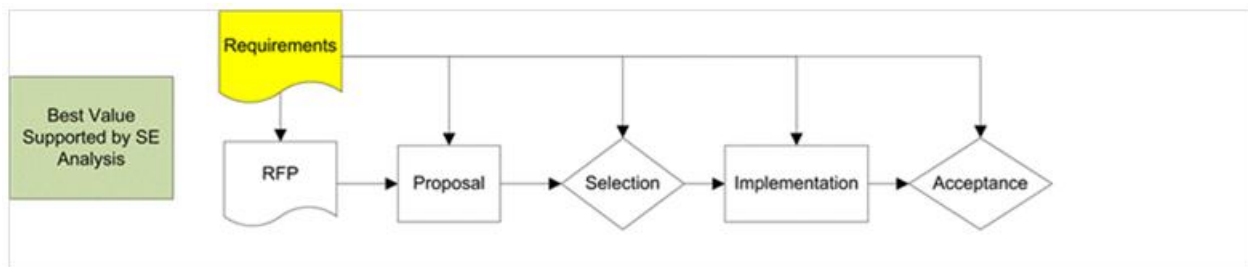


Figure 6: RFP-based technical selection acquisition process

In this process, the documented requirements are included in the request for proposals (RFP). The instructions to the proposers request that they provide a detailed explanation of how their proposed approach fulfills each contract. The RFP should include the Concept of Operations, the Requirements, and the Verification Plan. The proposal will then be the proposer's written verification of their proposed approach.

The agency can then select the system that most closely fulfills their most important requirements. Even when none of the proposers fulfill all the requirements, agencies are able to make a reasoned and informed selection based on their needs.

The benefit this process offers over the previous process is that agencies can verify requirements fulfillment as the basis for selection, rather than after selection. This minimizes the risk of choosing the wrong provider.

SOLE-SOURCE ACQUISITIONS

According to Title 23 of the Code of Federal Regulations, Section 635, paragraph 411³, federally funded projects must be competitively acquired. However, there are exceptions, which include:

1. The State DOT certifies that there is no competing product that meets the specification. In a requirements-led process, this can be demonstrated by providing a requirements analysis that shows that only one product fulfills all the requirements.
2. The State DOT certifies that the product is necessary for synchronization with existing installations. Justification for synchronization will be easier if the system to which the new system must be compatible was competitively acquired using a requirements-led process.
3. The FHWA finds, on being presented with sufficient justification, that acquiring the technology is in the public interest even though there are other products or systems that also fulfill the requirements. These are known as public interest findings, which are in the public record, and thus must be carefully justified and evaluated.
4. The acquisition is made for experimental⁴ purposes, on a small scale. The scale should be small enough so that if the experiment fails, it can be discarded without unreasonable loss. The agency should also provide an experimental plan identifying the gap in the knowledge in which the evaluation will be made to determine the results of the experiment. Such experimental projects are used to assist an agency to understand what will be accomplished with new technology, to provide the necessary education to support a realistic concept of operations. Experiments should not be made to verify products (i.e., to determine that they fulfill requirements). That sort of experimentation should be done using a pilot project, as discussed in the next section.

Systems installed on an experimental basis should not be expanded to a full implementation using synchronization to justify a sole-source acquisition. Doing so circumvents the meaning of the regulation and may not withstand an audit. At some point, either technical or price competition will be required without a public interest finding. Only a public interest finding can authorize sole-source acquisitions when more than one available product fulfills the requirements.

SERVICES AND INFRASTRUCTURE

The RFP-based approach only works for software and services, and can only include hardware that is incidental to those acquisitions. For example, the computers on which the software runs will usually be considered incidental. However, physical infrastructure, including, for example,

³ 23 CFR 635.411. For additional information, see Federal Highway Administration, “Construction Program Guide” web page, available at: <http://www.fhwa.dot.gov/construction/cqit/propriet.cfm>

⁴ Federal Highway Administration, “Construction Projects Incorporating Experimental Features” web page, available at: <http://www.fhwa.dot.gov/programadmin/contracts/expermnt.cfm>

communications conduit and cable, pull boxes, traffic controller foundations and cabinet installations, and so on, must be competitively bid. Many ITS implementations include software, integration services, and infrastructure construction. For these projects, the best approach is to separate the software and services from the infrastructure construction, and contract them separately, using separate processes. The software and services can follow the RFP-based approach and the construction can be contracted by low bid.

Figure 7 shows a complex project where systems services and infrastructure construction are divided into separate tracks. The project is further complicated by having a first pilot phase, which allows the agency to confirm that they fully understand their needs and requirements, and have documented them completely and correctly.

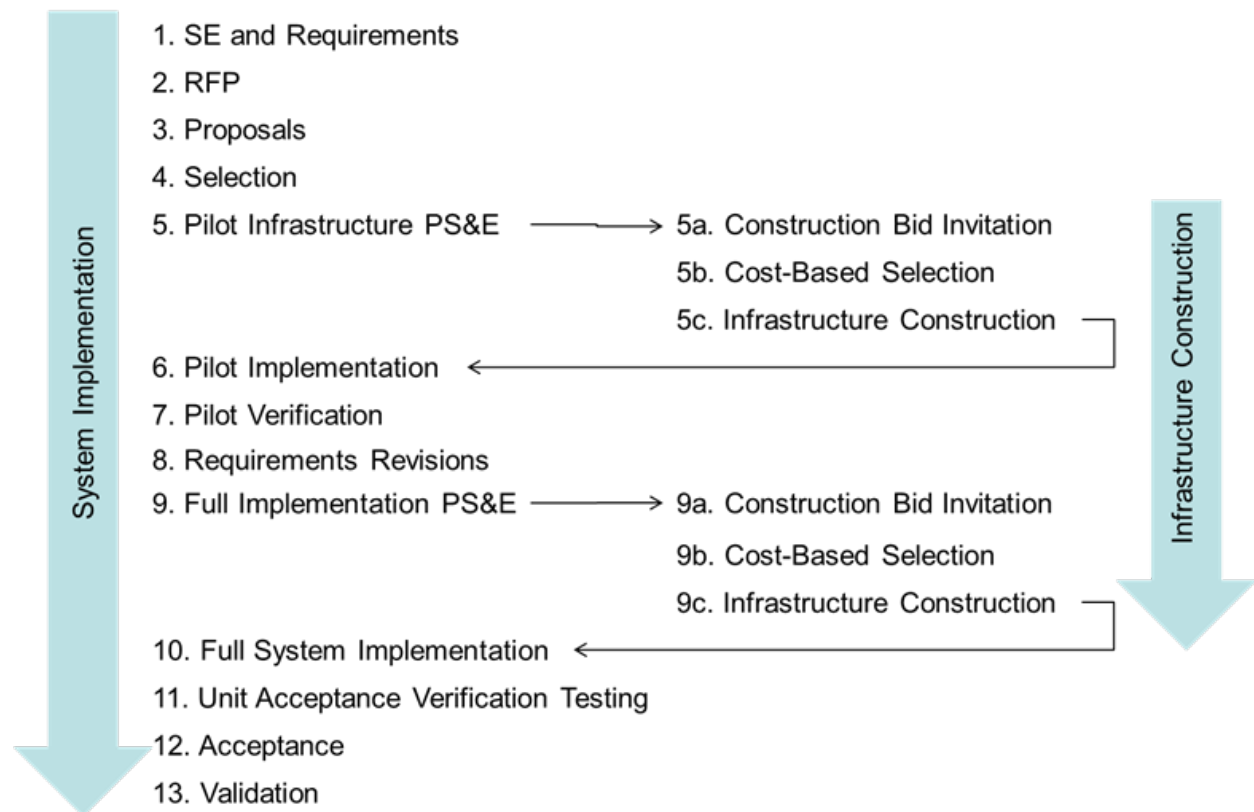


Figure 7: Complex project with both system services and infrastructure, and both pilot and full implementation phases

In this process, the concept of operations and requirements documents are completed first, and then used as the basis for a request for proposals. The agency evaluates proposals and selects a system provider based on verification of the proposed approach against the requirements. The system provider then assists the agency in developing the design and specifications for the required physical infrastructure, which is then acquired using a conventional cost-based selection process.

The agency will verify the pilot phase of construction and system services against the requirements. In so doing, the agency will discover any deficiencies in the initial concept of

operations and requirements documents, and will correct those documents as the basis for implementing the full system. The infrastructure component of the full system is then awarded to a contractor based on bid price. After implementation, the agency will verify final system against requirements, and once the implementation fulfills all requirements, the agency can accept it.

System providers usually have experience with acquisitions that separate services from infrastructure construction, and will build the cost of waiting for the completion of infrastructure construction into their negotiated price. The process should be fully identified in the initial RFP.

VERIFICATION PLAN

A very important component of the procurement plan is the verification plan. It must be prepared before a formal RFP is issued and, regardless of the procurement approach you have selected, before a contract is signed. The verification plan should set out the method by which each requirement will be verified as satisfied, who will undertake verification tests and at what stage within the process each verification test will be conducted. The plan will also include a test and verification matrix that will identify which requirement(s) is/are verified by each test.

It may be appropriate for compliance with some requirements to be demonstrated prior to selection of a vendor or system, particularly for mandatory requirements that cannot be demonstrated by reference to existing operation with other agencies.

The verification plan should be provided to potential vendors with the RFP. In general, the test procedures are not part of the verification plan at this stage. The procedures can only be written after the CCTV system has been selected and any customization designed. Note that it is usually most appropriate (and cost effective) to schedule tests to occur at various stages during the project, and not leave all testing until after installation is complete.

PROCUREMENT AND VERIFICATION REFERENCES

For further guidance on procurement practices for CCTV and ITS projects, consult the following references.

Federal-Aid Essentials for Local Public Agencies: Purchasing Intelligent Traffic Systems (ITS) and Traffic Technology: <http://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=100>

Special Experimental Project 14 (SEP 14):

http://www.fhwa.dot.gov/programadmin/contracts/sep_a.cfm

The Road to Successful ITS Software Acquisition:

<http://www.fhwa.dot.gov/publications/research/operations/its/98036/rdsuccessvol2.pdf>

For further guidance on preparation of verification plans, see:

Systems Engineering for Intelligent Transportation Systems, A Guide for Transportation Professionals

<http://ops.fhwa.dot.gov/publications/seitsguide/section4.htm#s4.7>

Systems Engineering Guidebook for ITS

<http://www.fhwa.dot.gov/cadiv/segb/>

Purchasing Intelligent Traffic Systems (ITS) and Traffic Technology

<http://www.fhwa.dot.gov/federal-aidessentials/catmod.cfm?id=100>

APPENDIX A: CONCEPT OF OPERATIONS TABLE OF SAMPLE STATEMENTS

ConOps Reference Number	ConOps Sample Statements
1	Chapter 1: Scope
1.1	Document Purpose and Scope
1.1-1	The scope of this document covers the consideration of a CCTV System for use within [describe the agency and/or geographic area covered by this consideration].
1.1-2	This document describes and provides a rationale for the expected operations of the proposed CCTV System.
1.1-3	It documents the outcome of stakeholder discussions and consensus building that has been undertaken to ensure that the system that is implemented is operationally feasible and has the support of stakeholders.
1.1-4	The intended audience of this document includes: system users/operators, remote system users/operators, administrators, decision-makers, elected officials, other nontechnical readers and other stakeholders who will share the operation of the system or be directly affected by it.
1.2	Project Purpose and Scope
1.2-1	A CCTV System provides real-time video feeds and images of current conditions for [describe region, corridors, and sections of roadways].
1.2-2	The purpose of having a CCTV System is to enhance situational awareness of [describe why it is needed, such as verifying incidents, etc.].
1.2-3	This project will allow [specify agency name] to monitor current conditions [describe conditions, such as equipment, traffic, environmental, etc.].
1.2-4	Other agencies [specify which agencies] will be able to access the CCTV System to view camera feeds and images.
1.2-5	Other agencies [specify which agencies] will be able to access the CCTV System to control camera PTZ characteristics.
1.2-6	The CCTV System will be integrated with [name other systems, such as a traffic management software system].
1.3	Procurement
1.3-1	The CCTV System will be procured using [Edit this or choose alternative statement].
1.3-1.1	a combination of best value procurement for software and system integration services, and low-bid procurement for equipment and construction services.
1.3-1.2	a best value procurement process based on responses to a request for proposals.
1.3-1.3	a low-bid process based on detailed plans and technical specifications.

ConOps Reference Number	ConOps Sample Statements
1.3-2	A request for qualifications (RFQ) will be issued to all potential vendors. Responses will be used to develop a short list of suitable systems and a request for proposals (RFP) will be issued to those vendors. The selected system will be the one that provides the best value, subject to financial and schedule constraints.
1.3-3	Field equipment (parts and labor) will be procured using a low-bid process based on detailed plans and technical specifications.
1.3-4	A detailed procurement plan will be prepared after the system requirements have been determined.
2	Chapter 2: Referenced Documents
2-1	The following documents have been used in the preparation of this Concept of Operations and stakeholder discussions. Some of these documents provide policy guidance for CCTV System operation in this area, some are standards with which the system must comply, while others report the conclusions of discussions, workshops and other research used to define the needs of the project and subsequently identify project requirements.
2-1.1	References Specific to the CCTV System Locations • Business Planning / Strategic Planning Documents for relevant agencies • Concept of Operations for related agency/facility-specific systems • Requirements of related systems • Studies identifying operational needs • Regional ITS Architecture documents • Planning studies and Master Plans • Transportation Improvement Programs (TIP) • Long Range Transportation Plans
2-1.2	Systems Engineering • “Systems Engineering Guidebook for ITS”, California Department of Transportation, Division of Research & Innovation, Version 3.0, http://www.fhwa.dot.gov/cadiv/segb/ • “Systems Engineering for Intelligent Transportation Systems, An Introduction for Transportation Professionals”, http://ops.fhwa.dot.gov/publications/seitsguide/index.htm • “Developing Functional Requirements for ITS Projects”, Mitretek Systems, April 2002 • “Developing and Using a Concept of Operations in Transportation Management System, FHWA TMC Pooled-Fund Study (https://tmcdfs.ops.fhwa.dot.gov/projects/devuoptmc.htm)
2-1.3	CCTV Systems Insert any CCTV Systems used as a reference here.

ConOps Reference Number	ConOps Sample Statements
2-1.4	ITS, Operations, Architecture, Other • 23 CFR part 940, Intelligent Transportation System Architecture and Standards • Regional ITS Architecture Guidance Document; “Developing, Using, and Maintaining an ITS Architecture for your Region; National ITS Architecture Team; October, 2001
2-1.5	NTCIP • NTCIP 1205 – NTCIP Objects for CCTV Camera Control • NTCIP 1208 – NTCIP Objects for Video Switches • List other applicable NTCIP standards
2-1.6	NEMA • List applicable NEMA standards
2-1.7	Procurement • NCHRP 560: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_560.pdf • Special Experimental Project 14 (SEP 14): http://www.fhwa.dot.gov/programadmin/contracts/sep_a.cfm • The Road to Successful ITS Software Acquisition: http://www.fhwa.dot.gov/publications/research/operations/its/98036/rdsuccessvol2.pdf
3	Chapter 3: User-Oriented Operational Description
3.1	The Existing Situation and Limitations of the Existing System
3.1-1	[Explain how the lack of or inadequacy of CCTV is preventing achieving transportation management operational objectives. Describe the problem to be solved by deploying CCTV technologies.]
3.2	Vision, Goals, and Objectives for the Proposed System
3.2-1	The agencies vision, goals and objectives for the proposed system are: [extract a summary from relevant planning documents. If planning documents do not provide vision, goals and objectives for the role of CCTV in transportation management, summarize that role here].
3.3	Strategies to be Applied by the Improved System
3.3-1	A set of use cases describe the strategies applied for a new or improved CCTV System. The use cases defined in chapter three provide the framework for the user needs defined in chapter four of this document.
3.3.1	General Actors

ConOps Reference Number	ConOps Sample Statements
3.3.1-1	The general actors listed below represent the various roles and systems that interact with the CCTV System. Each actor represents a role, a user can have multiple roles and there can be multiple for the same type of actor. For example, a CCTV System Maintainer and a CCTV System User could be the same person or they could be different people.
3.3.1.1	CCTV System Owner
3.3.1.1-1	The CCTV System Owner actor represents the agency or organization that owns the system and sets policy for its use.
3.3.1.2	CCTV System Manager
3.3.1.2-1	This actor represents the role of a manager of the CCTV system. The CCTV System Manager is expected to have full control of the system. The CCTV System Manager assigns CCTV System Users, External Systems and CCTV System Maintainers their system permissions and capabilities.
3.3.1.3	CCTV System User
3.3.1.3-1	CCTV System Users are granted access to the system for various duties, including viewing, controlling, and configuring the system, as configured by the CCTV System Manager. Users may be local or remote, but have access to the system controlling the camera in question. A CCTV System User also includes external systems such as an ATMS (Advanced Traffic Management System) whose users are not identified as users of the CCTV System. It is left up to the ATMS for example to control the access of the ATMS users. This is distinct from identifying remote users who gain access through an External System, for whom the CCTV System will be responsible for handling their access control.
3.3.1.4	External System
3.3.1.4-1	The External System actor represents the role of any type of external system to the CCTV System, through which a remote user may gain access to the system. This includes external video distribution.
3.3.1.5	CCTV System Maintainer
3.3.1.5-1	This actor represents the role of a maintainer of the CCTV System responsible for diagnosing and testing the CCTV System.
3.3.1.6	CCTV System Designer
3.3.1.6-1	The CCTV System Designer actor represents the role of the designer of the CCTV System taking into account overall system requirements and constraints.
3.3.2	Use Cases
3.3.2-1	Use cases capture the high-level typical interactions between a user and a computer system. A use case needs to address a discrete goal of the user. Besides the common use cases of system support (e.g., configuration, maintenance, etc.) the CCTV System use cases give the system user the ability to better judge a transportation-related situation.

ConOps Reference Number	ConOps Sample Statements
3.3.2.1	Configure CCTV System
3.3.2.1-1	The CCTV System Manager configures the CCTV System to control system access by other users (CCTV System User, CCTV System Maintainer and External Systems).
3.3.2.1-2	Various users will have different access to the CCTV System capabilities such as selecting CCTV cameras, controlling CCTV cameras, controlling CCTV System video distribution and running system diagnostics and testing.
3.3.2.1-3	The CCTV System Manger will set each user's permissions to access these capabilities.
3.3.2.1-4	The CCTV System Manager configures the CCTV System to arbitrate competing user requests for CCTV System access such as particular CCTV cameras.
3.3.2.1-5	The CCTV System Manager configures external video stream performance based on the limitations and capabilities of the CCTV System and its communications capabilities.
3.3.2.1-6	The CCTV System Owner specifies the number of users to be accommodated by the CCTV System at any one time based on CCTV system design and bandwidth considerations.
3.3.2.2	Check for Camera in Coverage Area
3.3.2.2-1	Given a location of interest by the CCTV System User, the CCTV System provides the user with CCTV cameras in viewing range of that location.
3.3.2.3	CCTV Monitoring
3.3.2.3-1	For general CCTV monitoring, the CCTV System User interacts with the CCTV System performing camera selection, camera control and camera viewing for display on video monitors.
3.3.2.3-2	The CCTV System User configures CCTV System camera preset settings for general location viewing.
3.3.2.3-3	The CCTV System User configures CCTV System camera preset settings to a much higher degree for automatic detection capabilities.
3.3.2.3-4	The CCTV System User programs the CCTV System cameras to perform tours through coverage areas.
3.3.2.3-5	The CCTV System User monitors clear and steady images from the CCTV System cameras.
3.3.2.3-6	The CCTV System User monitors CCTV System cameras in reduced visibility conditions.
3.3.2.4	Provide CCTV System Video
3.3.2.4-1	The CCTV System User uses the CCTV System to create low bandwidth copies of CCTV video feeds for both the general public and the media.
3.3.2.4-2	The CCTV System User uses the CCTV System to disable any public video feeds.
3.3.2.4-3	The CCTV System User uses the CCTV System to share video streams and/or images with local and regional users.

ConOps Reference Number	ConOps Sample Statements
3.3.2.4-4	The CCTV System User uses the CCTV System to share video streams and/or images with a regional video clearinghouse.
3.3.2.4-5	The CCTV System User uses the CCTV System to share real-time video streams with traveler information systems.
3.3.2.4-6	The CCTV System User uses the CCTV System to share real-time incident information on major arterials to the public and/or media.
3.3.2.4-7	The CCTV System User configures the CCTV System to direct video streams to individual users of an External System.
3.3.2.4-8	The CCTV System User configures the CCTV System to handle the maximum number of video feeds that can be simultaneously displayed by any one user.
3.3.2.4-9	The CCTV System User uses the CCTV System to direct video from non-camera sources (e.g., broadcast television programming and externally supplied video streams) to video monitors.
3.3.2.5	Verify Non-CCTV Field Device Status using CCTV
3.3.2.5-1	The CCTV System User uses the CCTV System to verify the operation of non-CCTV field devices using CCTV cameras.
3.3.2.6	Relinquish CCTV Monitoring
3.3.2.6-1	The CCTV System User uses the CCTV System to relinquish their CCTV camera monitoring.
3.3.2.6-2	Based on configuration parameters, the CCTV System can automatically relinquish a CCTV System Users monitoring use based on non-use.
3.3.2.7	CCTV Automatic Detection
3.3.2.7-1	The CCTV System notifies the CCTV System User when it automatic detects incidents and wrong-way vehicles.
3.3.2.8	Remote Control of a CCTV Device
3.3.2.8-1	Based on configuration parameters, the CCTV System allows an External System to monitor and control its CCTV cameras
3.3.2.8-2	The CCTV System User uses the CCTV System to manually suspend access to External Systems.
3.3.2.9	Logging CCTV System Data
3.3.2.9-1	The CCTV System Maintainer specifies what CCTV System events are logged.
3.3.2.9-2	The CCTV System Maintainer specifies the size and timeframe of the CCTV Systems log.
3.3.2.9-3	The CCTV System Maintainer accesses the log of the CCTV System to review it.
3.3.2.9-4	The CCTV System Maintainer accesses the log of the CCTV System to review diagnostic and alarms.
3.3.2.10	Recorded Video

ConOps Reference Number	ConOps Sample Statements
3.3.2.10-1	The CCTV System User instructs the CCTV System to record video from one or more CCTV cameras.
3.3.2.10-2	The CCTV System User instructs the CCTV System when to schedule video recordings
3.3.2.10-3	The CCTV System User configures the CCTV System to begin recording based on the presence of a defined condition.
3.3.2.10-4	The CCTV System User instructs the CCTV System to playback a CCTV cameras recorded video feed.
3.3.2.10-5	The CCTV System User instructs the CCTV System to distribute a CCTV cameras recorded video feed.
3.3.2.10-6	The CCTV System User instructs the CCTV System to delete a CCTV cameras recorded video feed.
3.3.2.10-7	The CCTV System User configures the CCTV System to log all CCTV cameras video recordings.
3.3.2.10-8	The CCTV System User configures the CCTV System retention rules for all CCTV cameras video recordings.
3.3.2.10-9	The CCTV System User configures the CCTV System retain specified video recordings in permanent storage.
3.3.2.11	CCTV Camera Siting
3.3.2.11-1	The CCTV System Designer will specify the CCTV camera siting characteristics taking into account CCTV System User viewing and system maintenance requirements.
3.3.2.12	CCTV System Maintenance
3.3.2.12-1	The CCTV System Maintainer maintains the CCTV System by performing and testing all CCTV System camera capabilities both locally and remotely.
3.3.2.12-2	The CCTV System Maintainer maintains the CCTV System by performing remote updates of the camera, PTZ controller firmware and CCTV system software.
3.3.2.13	Interfacing with External Systems
3.3.2.13-1	The CCTV System User interfaces with CCTV cameras from different manufacturers within the CCTV System.
3.3.2.13-2	The CCTV System Maintainer replaces CCTV cameras from different manufacturers within the CCTV System.
3.3.2.13-3	The CCTV System Designer specifies different camera interface standards within the CCTV System.
3.3.2.13-4	The CCTV System Designer specifies the existing camera interfaces in order to integrate new cameras into an existing CCTV System.
3.3.2.13-5	The CCTV System Designer specifies the existing camera interfaces in order to integrate a new CCTV System with existing CCTV cameras.
3.3.2.13-6	The CCTV System User interfaces with external CCTV Systems to specify cameras, direct camera feeds to monitoring displays as well as controlling the cameras.
3.3.2.13-7	The CCTV System User interfaces with external CCTV Systems to allow the External System to specify cameras, direct camera feeds to monitoring displays as well as controlling the cameras of the CCTV System.

ConOps Reference Number	ConOps Sample Statements
3.4	Alternative Strategies Considered
3.4-1	CCTV systems provide visual surveillance of the transportation system, and meet the needs of users whose processes require visual surveillance, particularly for situations requiring human judgment to assess the situation and determine the appropriate response. CCTV may not be the appropriate technology for data collection or quantified performance monitoring, which may alternatively use other detection and performance measurement technologies.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4	Chapter 4: Operational Needs	
4.1	Control Access to CCTV System (Choose the user needs in this group if you chose the Configure CCTV System use case in Chapter Three)	
4.1.1	The CCTV System Manager needs access to the CCTV System.	3.1.1.1 The CCTV System shall enforce access control of all users.
4.1.1.1	The CCTV System Manager needs access for CCTV System configuration.	Note: Satisfied by sub-requirements
4.1.1.1.1	The CCTV System Manager needs to configure CCTV System User access.	3.1.1.2 The CCTV System shall allow the CCTV System Manager to assign access control credentials to CCTV System Users.
4.1.1.1.2	The CCTV System Manager needs to configure CCTV System Maintainer access.	3.1.1.3 The CCTV System shall allow the CCTV System Manager to assign access control credentials to CCTV System Maintainers.
4.1.1.1.3	The CCTV System Manager needs to configure External System access.	3.1.1.4 The CCTV System shall allow the CCTV System Manager to assign access control credentials to External Systems.
4.1.1.2	The CCTV System Manager needs access to the CCTV System to receive distributed video.	3.1.1.5 The CCTV System shall allow the CCTV System Manager to receive distributed video.
4.1.1.3	The CCTV System Manager needs access to the CCTV System to select cameras.	3.1.1.6 The CCTV System shall allow the CCTV System Manager to select cameras.
4.1.1.4	The CCTV System Manager needs access to the CCTV System to control cameras.	3.1.1.7 The CCTV System shall allow the CCTV System Manager to control cameras.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.1.1.5	The CCTV System Manager needs access to the CCTV System to control video distribution.	3.1.1.8 The CCTV System shall allow the CCTV System Manager to route input video to designated video outputs. (Outputs are displays or external channels.)
4.1.2	The CCTV System User needs access to the CCTV System as configured by the CCTV System Manager.	Note: Satisfied by sub-requirements
4.1.2.1	The CCTV System User needs access to the CCTV System to receive distributed video.	3.1.1.9 The CCTV System shall allow the CCTV System User to receive distributed video.
4.1.2.2	The CCTV System User needs access to the CCTV System to select cameras.	3.1.1.10 The CCTV System shall allow the CCTV System User to select cameras.
4.1.2.3	The CCTV System User needs access to the CCTV System to control cameras.	3.1.1.11 The CCTV System shall allow the CCTV System User to control cameras.
4.1.2.4	The CCTV System User needs access to the CCTV System to control video distribution.	3.1.1.12 The CCTV System shall allow the CCTV System User to route input video to designated video outputs. (Outputs are displays or external channels.)
4.1.3	The CCTV System Maintainer needs access to the CCTV System as configured by the CCTV System Manager.	Note: Satisfied by sub-requirements
4.1.3.1	The CCTV System Maintainer needs access to the CCTV System to receive distributed video.	3.1.1.13 The CCTV System shall allow the CCTV System Maintainer to receive distributed video.
4.1.3.2	The CCTV System Maintainer needs access to the CCTV System to select cameras.	3.1.1.14 The CCTV System shall allow the CCTV System Maintainer to select cameras.
4.1.3.3	The CCTV System Maintainer needs access to the CCTV System to control cameras.	3.1.1.15 The CCTV System shall allow the CCTV System Maintainer to control cameras.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.1.3.4	The CCTV System Maintainer needs access to the CCTV System to control video distribution.	3.1.1.16 The CCTV System shall allow the CCTV System Maintainer to route input video to designated video outputs. (Outputs are displays or external channels.)
4.1.3.5	The CCTV System Maintainer needs access to the CCTV System to run system diagnostics and testing.	3.1.1.17 The CCTV System shall allow the CCTV System Maintainer to run system diagnostics and testing.
4.1.3.6	The CCTV System Maintainer needs access to the CCTV System to repair it.	3.1.1.18 The CCTV System shall allow the CCTV System Maintainer access for repairs.
4.1.4	The External System needs access to the CCTV System as configured by the CCTV System Manager.	Note: Satisfied by sub-requirements
4.1.4.1	The External System needs access to the CCTV System to receive distributed video.	3.1.1.19 The CCTV System shall allow an External System to receive distributed video.
4.1.4.2	The External System needs access to the CCTV System to select cameras.	3.1.1.20 The CCTV System shall allow an External System to select cameras.
4.1.4.3	The External System needs access to the CCTV System to control cameras.	3.1.1.21 The CCTV System shall allow an External System to control cameras.
4.1.4.4	The External System needs access to the CCTV System to control video distribution.	3.1.1.22 The CCTV System shall allow an External System to route input video to designated video outputs. (Outputs are displays or external channels.)
4.2	Configure CCTV System (Choose the user needs in this group if you chose the Configure CCTV System use case in Chapter Three)	
4.2.1	The CCTV System Manager needs to configure user access to the CCTV system.	Note: Satisfied by sub-requirement

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.2.1.1	The CCTV System Manager needs to configure user permissions for configuration.	3.1.6.1.1 The CCTV System shall allow the CCTV System User to configure which users have permission to configure the CCTV System.
4.2.1.2	The CCTV System Manager needs to configure user permissions for video viewing.	3.1.6.1.2 The CCTV System shall allow the CCTV System User to configure which users have permission to view video.
4.2.1.3	The CCTV System Manager needs to configure user permissions for camera selection.	3.1.6.1.3 The CCTV System shall allow the CCTV System User to configure which users have permission to select a specified camera.
4.2.1.4	The CCTV System Manager needs to configure user permissions for camera control.	3.1.6.1.4 The CCTV System shall allow the CCTV System User to configure which users have permission to control a specified camera.
4.2.2	The CCTV System Manager needs to accommodate [specify] users with access to the CCTV System. [This may be further defined by type of user and their bandwidth consumption.]	3.1.6.1.5 The CCTV System shall accommodate [specify number of users] users accessing the CCTV System based on configuration parameters by the CCTV System User. [This requirement can be supplemented to define parameters such as types of users and corresponding bandwidth usage.]
4.2.3	The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]	3.1.6.1.6 The CCTV System shall arbitrate competing requests for CCTV System resources based on configuration parameters by the CCTV System User.

ConOps Reference Number	ConOps Sample Statement	System Requirements
		3.1.6.1.6.1 The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on an ownership configuration parameter by the CCTV System User. 3.1.6.1.6.2 The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a priority configuration parameter by the CCTV System User. 3.1.6.1.6.3 The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a usage timeout configuration parameter by the CCTV System User. 3.1.6.1.6.4 The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a first come first served configuration parameter by the CCTV System User. 3.1.6.1.6.5 The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a [specify other] configuration parameter by the CCTV System User. 3.1.6.1.6.6 The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on an ownership configuration parameter by the CCTV System User.

ConOps Reference Number	ConOps Sample Statement	System Requirements
		3.1.6.1.6.7 The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a priority configuration parameter by the CCTV System User. 3.1.6.1.6.8 The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a usage timeout configuration parameter by the CCTV System User. 3.1.6.1.6.9 The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a first come first served configuration parameter by the CCTV System User. 3.1.6.1.6.10 The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a [specify other] configuration parameter by the CCTV System User. 3.1.6.1.6.11 The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on an ownership configuration parameter by the CCTV System User. 3.1.6.1.6.12 The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a priority configuration parameter by the CCTV System User.

ConOps Reference Number	ConOps Sample Statement	System Requirements
		3.1.6.1.6.13 The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a usage timeout configuration parameter by the CCTV System User. 3.1.6.1.6.14 The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a first come first served configuration parameter by the CCTV System User. 3.1.6.1.6.15 The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a [specify other] configuration parameter by the CCTV System User. 3.1.6.1.6.16 The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on an ownership configuration parameter by the CCTV System User. 3.1.6.1.6.17 The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a priority configuration parameter by the CCTV System User. 3.1.6.1.6.18 The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a usage timeout configuration parameter by the CCTV System User.

ConOps Reference Number	ConOps Sample Statement	System Requirements
	3.1.6.1.6.19 The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a first come first served configuration parameter by the CCTV System User. 3.1.6.1.6.20 The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a [specify other] configuration parameter by the CCTV System User. 3.1.6.1.6.21 The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on an ownership configuration parameter by the CCTV System User. 3.1.6.1.6.22 The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a priority configuration parameter by the CCTV System User. 3.1.6.1.6.23 The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a usage timeout configuration parameter by the CCTV System User. 3.1.6.1.6.24 The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a first come first served configuration parameter by the CCTV System User.	

ConOps Reference Number	ConOps Sample Statement	System Requirements
		3.1.6.1.6.25 The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a [specify other] configuration parameter by the CCTV System User.
4.2.4	The CCTV System Manager needs to configure the performance of external video streams based on the capabilities and limitations of the system and communications.	3.1.6.1.7 The CCTV System shall accept parameters for controlling the video performance of video streams supplied to external systems. (This control may be provided in the communications or digital video standard being supported.) [Specify the performance requirements for the external video streams] 3.1.6.1.8 The CCTV System shall accept configuration parameters that limit user-specified external video feeds to single-frame snapshots. 3.1.6.1.9 The CCTV System shall accept configuration parameters that control the interval at which single-frame snapshots are sent to external video feeds configured to receive them.
4.3	Check for Camera in Coverage Area (Choose the user needs in this group if you chose the Check for Camera in Coverage Area use case in Chapter Three)	
4.3.1	The CCTV System User needs to identify cameras with a view of a location of interest.	3.1.2.1 The CCTV System shall identify to the CCTV System User the closest camera(s) based on the location specified by the user.
4.4	CCTV Monitoring (Choose the user needs in this group if you chose the CCTV Monitoring use case in Chapter Three)	

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.4.1	The CCTV System User needs to select camera feeds to display on video monitors.	3.1.2.2 The CCTV System shall allow the CCTV System User to view CCTV cameras available for viewing. 3.1.2.3 The CCTV System shall allow the CCTV System User to route a CCTV camera feed to a specified video monitor. 3.1.2.4 The CCTV System shall allow the CCTV System User to route a CCTV camera feed to more than one video monitor.
4.4.2	The CCTV System User needs to control the camera being viewed	3.1.3.1.1 The CCTV System shall allow a CCTV System User to control the camera being viewed. (If so configured by the CCTV System Manager). 3.1.3.1.1.1 The CCTV System shall allow a CCTV System User to rotate the camera about a vertical axis (pan the camera). 3.1.3.1.1.2 The CCTV System shall allow a CCTV System User to zoom the camera. 3.1.3.1.1.3 The CCTV System shall allow a CCTV System User to rotate the camera about a horizontal axis at right angles to the direction the camera is pointing (tilt the camera).

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.4.3	The CCTV System User needs to request control of a camera.	3.1.2.5 The CCTV System shall allow the CCTV System User to view CCTV cameras available to be controlled. 3.1.3.1.2 The CCTV System shall allow a CCTV System User to request control of a camera (If so configured by the CCTV System Manager).
4.4.4	The CCTV System User needs to reassign control of a camera to different user.	3.1.3.1.3 The CCTV System shall allow a CCTV System User to reassign control of a camera to another user.
4.4.5	The CCTV System User needs to configure [specify number] camera presets (PTZ settings).	3.1.3.1.4 The CCTV System shall allow the CCTV System User to configure individual camera presets [specify PTZ settings].
4.4.5.1	The CCTV System User needs to return the camera to a preset location repeatedly and accurately [define accurate- this will be a much stiffer standard for cameras that are used for detection, versus cameras used just for viewing. This need should describe both to support their separate requirements. For detection, the camera must reset so that the detection zone remains in the correct lane and location, probably with an accuracy in the viewed field of +/- 1 feet. For viewing, the reset field of view needs to be recognizably the correct location at full zoom.].	3.1.3.1.5 The CCTV System shall allow a CCTV System User to return a camera to a preset location with specified accuracy. [Specify the accuracy requirements.]
4.4.5.2	The CCTV System User needs to program cameras to tour their coverage area.	3.1.3.1.6 The CCTV System shall allow a CCTV System User to direct a camera to tour its defined presets.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.5	Provide CCTV System Video (Choose the user needs in this group if you chose the Provide CCTV System Video use case in Chapter Three)	
4.5.1	The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the general public via internet sites.	3.1.4.1.1 The CCTV System shall allow a CCTV System Manager to create low bandwidth [specify attributes] copies of video feeds. 3.1.4.1.2 The CCTV System shall make available the low bandwidth video feeds to a web-page server. [Specify the requirements imposed by the web-page server.] 3.1.6.1.7 The CCTV System shall accept parameters for controlling the video performance of video streams supplied to external systems. (This control may be provided in the communications or digital video standard being supported.) [Specify the performance requirements for the external video streams] 3.1.6.1.8 The CCTV System shall accept configuration parameters that limit user-specified external video feeds to single-frame snapshots. 3.1.6.1.9 The CCTV System shall accept configuration parameters that control the interval at which single-frame snapshots are sent to external video feeds configured to receive them.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.5.2	The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the media and Information Service Providers through a media feed.	3.1.4.1.3 The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.]
4.5.3	The CCTV System User needs to disable any or all public video feeds at will, such as during emergencies, security events or other events of a sensitive nature.	3.1.4.1.4 The CCTV System shall allow the CCTV System User to disable immediately any individual external video feed. 3.1.4.1.5 The CCTV System shall allow the CCTV System User to disable immediately all external video feeds.
4.5.4	The CCTV System User needs to be able to share video streams/images with regional stakeholders (e.g., state and local DOTs, police and fire).	3.1.4.1.1 The CCTV System shall allow a CCTV System Manager to create low bandwidth [specify attributes] copies of video feeds. 3.1.4.1.2 The CCTV System shall make available the low bandwidth video feeds to a web-page server. [Specify the requirements imposed by the web-page server.] 3.1.4.1.3 The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.]

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.5.5	The CCTV System User needs to be able to share video streams/images with other stakeholders.	3.1.4.1.3 The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.] 3.1.4.1.6 The CCTV System shall allow the CCTV System User to share video with other stakeholders outside of the region.
4.5.6	The CCTV System User needs to be able to share video streams/images through a regional video clearinghouse.	3.1.4.1.3 The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.] 3.1.4.1.7 The CCTV System shall provide video streams/images to a regional video clearinghouse as configured by the CCTV System User.
4.5.7	The CCTV System User needs to provide real-time video feeds to the traveler information system.	3.1.4.1.3 The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.] 3.1.4.1.8 The CCTV System shall provide video streams/images to a traveler information system as configured by the CCTV System User.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.5.8	The CCTV System User needs to provide real-time incident information to the public/media for major arterials.	3.1.4.1.3 The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.] 3.1.4.1.9 The CCTV System shall provide real-time incident video to the public/media for major arterials as configured by the CCTV System User.
4.5.9	The CCTV System User needs to configure the CCTV system for individual users of external system to which the video will be directed.	3.1.4.1.10 The CCTV System shall be configured by the CCTV System User to provide direct video to individual users of an External System.
4.5.10	The CCTV System User needs to configure the maximum number of video feeds that can be simultaneously displayed by any one user.	3.1.4.1.11 The CCTV System shall be configured by the CCTV System Manager to set the maximum number of simultaneous video feeds directed to a single user.
4.5.11	The CCTV System User needs to direct video from non-camera sources to video monitors managed by the system.	3.1.4.1.12 The CCTV System shall allow the CCTV System User to direct video from non-camera sources to the video displays.
4.5.11.1	The CCTV System User needs to direct broadcast television programming to video displays managed by the system.	3.1.4.1.12.1 The CCTV System shall allow the CCTV System User to direct broadcast television programming to the CCTV System video displays.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.5.11.2	The CCTV System User needs to direct externally supplied video streams to video displays managed by the system.	3.1.4.1.12.2 The CCTV System shall allow the CCTV System User to direct externally supplied video streams to the CCTV System video displays. 3.1.6.1.10 The CCTV System shall accept configuration parameters that control the interval at which single-frame snapshots are sent from external video feeds configured to receive them.
4.5.11.3	The CCTV System User needs to display external base-band video. (Base-band video is an analog video signal.)	3.1.4.1.12.3 The CCTV System shall allow the CCTV System User to direct externally supplied base-band video signals to the CCTV System video displays.
4.6	Verify Non-CCTV Field Device Status using CCTV (Choose the user needs in this group if you chose the Verify Non-CCTV Field Device Status use case in Chapter Three)	3.1.3.1.7 Verification of Field Device Status
4.6.1	The CCTV System User needs to select displayed camera feeds of field devices to display on video monitors.	3.1.3.1.7.1 The CCTV System shall allow the CCTV System User to select a CCTV camera feed assigned to a field device to be displayed on specified video monitors. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2	The CCTV System User needs to verify transportation asset operation using CCTV.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.1	The CCTV System User needs to verify DMS status and message display.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.2	The CCTV System User needs to verify roadway gates (e.g., HOV, HOT, Hurricane evacuation).	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.3	The CCTV System User needs to verify ramp meter operation.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.4	The CCTV System User needs to verify traffic signal operation.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.5	The CCTV System User needs to verify toll plazas operation.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.6	The CCTV System User needs to verify lane control signal operation.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.7	The CCTV System User needs to verify variable speed limit sign operation.	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.6.2.8	The CCTV System User needs to verify operation of other general devices [specify others].	3.1.3.1.7.2 The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors. 3.1.3.1.7.3 The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom. 3.1.6.1.11 The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.
4.7	Relinquish CCTV Monitoring (Choose the user needs in this group if you chose the Relinquish CCTV Monitoring use case in Chapter Three)	3.1.4.2 Relinquish Camera Control
4.7.1	The CCTV System User needs to relinquish monitoring via the CCTV System.	3.1.4.2.1 The CCTV System shall allow the CCTV System User to relinquish control of the CCTV cameras.
4.7.1.1	The CCTV System User will need to manually relinquish control of a camera to make it available for other users.	3.1.3.1.8.1 The CCTV System shall relinquish control upon CCTV System User command. 3.1.4.2.1.1 The CCTV System shall allow the CCTV System User to manually relinquish control of a camera to make it available to other users.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.7.1.2	The CCTV System User needs to relinquish control automatically after a period of non-use, which the user needs to configure.	3.1.4.2.1.2 The CCTV System shall allow the CCTV System User to configure a period of non-use after which the system will automatically relinquish control of a camera to make it available to other users.
4.8	CCTV Automatic Detection (Choose the user needs in this group if you chose the CCTV Automatic Detection use case in Chapter Three) [Model document users must expand on further details, and related requirements.]	3.1.5 CCTV Automatic Detection
4.8.1	The CCTV System User needs to provide automatic identification and notification of incidents on mainline lanes. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.	3.1.5.1 The CCTV System shall automatically detect incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing. 3.1.5.2 The CCTV System shall automatically identify incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing. 3.1.5.3 The CCTV System shall automatically notify the CCTV System User of incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.8.2	The CCTV System User needs to provide automatic identification and notification of incidents on ramps. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.	3.1.5.4 The CCTV System shall automatically detect incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing. 3.1.5.5 The CCTV System shall automatically identify incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing. 3.1.5.6 The CCTV System shall automatically notify the CCTV System User of incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.8.3	The CCTV System User needs to provide automatic identification and notification of incidents on shoulders. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.	3.1.5.7 The CCTV System shall automatically detect incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing. 3.1.5.8 The CCTV System shall automatically identify incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing. 3.1.5.9 The CCTV System shall automatically notify the CCTV System User of incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.
4.8.4	The CCTV System User needs automatic identification and notification of wrong-way vehicles.	3.1.5.10 The CCTV System shall automatically detect wrong way vehicles. 3.1.5.11 The CCTV System shall automatically identify wrong way vehicles. 3.1.5.12 The CCTV System shall automatically notify the CCTV System User of wrong way vehicles.
4.8.5	The CCTV System User needs the camera with a field of view that includes the detected incident to be automatically positioned for viewing the incident.	3.1.5.5 The CCTV System shall automatically position the field of view camera to the detected incident for viewing.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.9	Remote Control of a CCTV Device (Choose the user needs in this group if you chose the Remote Control of a CCTV Device use case in Chapter Three)	3.1.3.2 Remote Control
4.9.1	The External System needs to request a change to the parameters of a CCTV device, such as camera position, operated by another center in order to view an event, see real-time traffic conditions, or verify an incident.	3.1.3.2.1 The CCTV System shall allow an External System to request a change in the parameters of a CCTV camera. 3.1.3.2.1.1 The CCTV System shall allow an External System to request a change in the camera position parameters of a CCTV camera. 3.1.3.2.1.2 The CCTV System shall allow an External System to request a change in the parameters to view an event by a CCTV camera. 3.1.3.2.1.3 The CCTV System shall allow an External System to request a change in the parameters for viewing real-time traffic conditions by a CCTV camera. 3.1.3.2.1.4 The CCTV System shall allow an External System to request a change in the parameters for verifying an incident by a CCTV camera.
4.9.2	The External System needs to monitor cameras from external locations.	3.1.3.2.2 The CCTV System shall allow an External System to monitor cameras.
4.9.3	The External System needs to control cameras from external locations.	3.1.3.2.3 The CCTV System shall allow an External System to control cameras.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.9.4	The CCTV System User needs to manually suspend an external video feed in real time for any reason.	3.1.4.1.4 The CCTV System shall allow the CCTV System User to disable immediately any individual external video feed.
4.10	CCTV System Logging (Choose the user needs in this group if you chose the Logging CCTV System Data use case in Chapter Three)	3.1.6.2 System Logging
4.10.1	The CCTV System Maintainer needs to access and review the CCTV System log(s).	3.1.6.2.1 The CCTV System shall allow the CCTV System Maintainer to access and review the CCTV System log(s).
4.10.2	The CCTV System Maintainer needs to specify what CCTV System events are logged.	3.1.6.2.2 The CCTV System shall allow the CCTV System Maintainer to specify what CCTV System events [specify, events may be alarms, user actions, or diagnostic] are logged.
4.10.3	The CCTV System Maintainer needs to specify the log size and/or duration for the CCTV System.	3.1.6.2.3 The CCTV System shall allow the CCTV System Maintainer to specify the size of the CCTV System log(s). 3.1.6.2.4 The CCTV System shall allow the CCTV System Maintainer to specify the length of time that entries in the CCTV System log(s) will be retained.
4.10.4	The CCTV System Maintainer needs to access and review a history (log) of the following diagnostic information [specify] and alarms [specify] for a period of [specify] days.	3.1.6.2.5 The CCTV System shall allow the CCTV System Maintainer to configure diagnostic reports of logged information for a period of [specify] days. [Specify pre-configured reports that may be needed by the maintainer.]

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.11	Recorded Video (Choose the user needs in this group if you chose the Recorded Video use case in Chapter Three)	3.1.6.3 Recorded Video
4.11.1	The CCTV System User needs to record video for later use.	3.1.6.3.1 The CCTV System shall allow the CCTV System User to record video for later use.
4.11.2	The CCTV System User needs to initiate recording of a particular camera's video feed.	3.1.6.3.2 The CCTV System shall allow the CCTV System User to initiate recording of a particular camera's video feed.
4.11.2.1	The CCTV System User needs to schedule and set the start and duration of the video recording.	3.1.6.3.2.1 The CCTV System shall allow the CCTV System User to schedule and set the start and duration of the video recording.
4.11.2.2	The CCTV System User may initiate the recording based on a configured time-of-day schedule.	3.1.6.3.2.2 The CCTV System shall allow the CCTV System User to initiate the recording based on a time of day schedule.
4.11.2.3	The CCTV System User may initiate the recording based on the presence of a defined condition [user must define these trigger conditions, which may include such events as detected incidents].	3.1.6.3.2.3 The CCTV System shall allow the CCTV System User to define a trigger condition at which the CCTV System will commence recording. [Specify the trigger condition(s)].

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.11.3	The CCTV System User needs to initiate playback of a particular camera's recorded video feed.	3.1.6.3.3 The CCTV System shall allow the CCTV System User to play back a particular camera's recorded video feed. 3.1.6.3.3.1 The CCTV System shall allow the CCTV System User to initiate playback. 3.1.6.3.3.2 The CCTV System shall allow the CCTV System User to pause the playback. 3.1.6.3.3.3 The CCTV System shall allow the CCTV System User to advance the video playback at higher speed. 3.1.6.3.3.4 The CCTV System shall allow the CCTV System User to reverse the video playback. 3.1.6.3.3.5 The CCTV System shall allow the CCTV System User to reverse the video at higher speed. 3.1.6.3.3.6 The CCTV System shall allow the CCTV System User to select a specific location in the video recording to commence playback. 3.1.6.3.3.7 The CCTV System shall allow the CCTV System User to record single-frame snapshots as separate images during video playback.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.11.4	The CCTV System User needs to be able to distribute a particular camera's recorded video feed.	3.1.6.3.4 The CCTV System shall allow the CCTV System User to route a particular camera's recorded video feed to any available video destination controlled by the system.
4.11.5	The CCTV System User needs to delete recordings of a particular camera's recorded video feed.	3.1.6.3.5 The CCTV System shall allow the CCTV System User to delete recordings of a particular camera's video feed. 3.1.6.3.5.1 The CCTV System shall require user confirmation when deleting a recorded video feed.
4.11.6	The CCTV System User needs a log of all video recordings. [to include location, camera, timestamp, duration, and whatever else the user specifies]	3.1.6.3.6 The CCTV System shall allow the CCTV System User to log all video recordings [specify location, camera, timestamp, duration, anything else].
4.11.7	The CCTV System User needs to apply retention rules [must be defined by the user] to recorded video.	3.1.6.3.7 The CCTV System shall allow the CCTV System User to apply retention rules to the recorded video. [Specify the retention rules, or reference the appropriate retention policy document.]
4.11.8	The CCTV System User needs to automatically delete videos in accordance with retention rules.	3.1.6.3.8 The CCTV System shall automatically delete videos in accordance with the retention rules specified by the CCTV System User.
4.11.9	The CCTV System User needs to mark recordings for permanent storage.	3.1.6.3.9 The CCTV System shall allow the CCTV System User to mark video recordings for permanent storage.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.11.10	The CCTV System User needs to store the video efficiently. [Describe the preferred standard compression algorithm.]	3.1.6.3.10 The CCTV System shall store the video recordings according to a specified compression algorithm. [Specify preferred standard compression algorithm(s)].
4.12	CCTV Camera Characteristics (Choose the user needs in this group if you chose the CCTV Camera Siting use case in Chapter Three)	3.1.7 CCTV Camera Characteristics
4.12.1	The CCTV System User needs to view images in reduced visibility conditions.	3.1.7.1 The CCTV System shall allow the CCTV System User to view images in reduced visibility conditions. [The CCTV System Designer will be expected to design features of cameras that fulfill these requirements, including heaters, wipers, infrared sensitivity, lighting, etc.]
4.12.1.1	The CCTV System User needs to view images at night.	3.1.7.1.1 The CCTV System shall allow the CCTV System User to view images at night.
4.12.1.2	The CCTV System User needs to view images in fog.	3.1.7.1.2 The CCTV System shall allow the CCTV System User to view images in fog.
4.12.1.3	The CCTV System User needs to view images in rain.	3.1.7.1.3 The CCTV System shall allow the CCTV System User to view images in rain.
4.12.1.4	The CCTV System User needs to view images in snow conditions.	3.1.7.1.4 The CCTV System shall allow the CCTV System User to view images in snow conditions.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.12.1.5	The CCTV System User needs to view images in other reduced visibility conditions [specify].	3.1.7.1.5 The CCTV System shall allow the CCTV System User to view images in other reduced visibility conditions [specify conditions].
4.12.2	The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]	3.1.7.2 The CCTV System shall allow the CCTV System User to view clear, steady images. 3.1.7.2.1 The CCTV System shall provide a specified image quality. 3.1.7.2.1.1 The CCTV System shall support resolutions of [specify 480i, 480P, 720P, 1080P, 4K, etc.]. 3.1.7.2.1.2 The CCTV System shall support frame rates of [specify]. 3.1.7.2.1.3 The CCTV System shall support a color gamut of [specify, may be embodied in those SDTV and HDTV standards]. 3.1.7.2.2 The CCTV System shall provide adequate bandwidth to accommodate [specify number] of CCTV System Users at a given time. 3.1.7.2.3 The CCTV System shall provide latency less than [specify] milliseconds. [This the time lag from reality to displayed image, and affects control lag. 100 ms is a typical value.]

ConOps Reference Number	ConOps Sample Statement	System Requirements
		3.1.7.2.4 The CCTV System shall provide camera mounting systems sufficiently rigid to provide steady images. (The designer will be required to specify, for the relevant location and camera lens focal length, the required rigidity.) 3.1.7.2.5 The CCTV System shall provide camera image stabilization. 3.1.7.2.6 The CCTV System shall provide camera optics with a zoom range that provides optical coverage that fulfills all the requirements included in this document. [Include one of the child requirements below] 3.1.7.2.6.1 The CCTV camera shall not use digital zoom. 3.1.7.2.6.2 The CCTV System shall provide digital zooming of the cameras [specify] beyond their optical zooming capability.
4.12.3	The CCTV System User needs to program cameras to return to preset angle, zoom and focus [at the needed specified accuracy] when not under active CCTV System User control.	3.1.3.1.5 The CCTV System shall allow a CCTV System User to return a camera to a preset location with specified accuracy. [Specify the accuracy requirements.] 3.1.7.2.7 The CCTV System shall allow the CCTV System User to program camera presets to return to specified preset angle, zoom and focus [specify accuracy] when not under active CCTV System user control.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.12.4	The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]	3.1.7.3 The CCTV System shall allow the CCTV System User to store information about each CCTV camera. 3.1.7.3.1 The CCTV System shall allow the CCTV System User to set and store the CCTV Owner information of the CCTV camera. 3.1.7.3.2 The CCTV System shall allow the CCTV System User to store the unique identifier of the CCTV camera. 3.1.7.3.3 The CCTV System shall allow the CCTV System User to set and store the CCTV Location information of the CCTV camera. 3.1.7.3.4 The CCTV System shall allow the CCTV System User to set and store the CCTV image rate characteristics information [specify still image, slow scan, streaming video (e.g., 30 fps, etc.)] of the CCTV camera. 3.1.7.3.5 The CCTV System shall allow the CCTV System User to set and store the supported formats [specify JPEG, MPEG, etc. and protocols] for the CCTV camera. 3.1.7.3.6 The CCTV System shall allow the CCTV System User to set and store the supported image size in pixels for the CCTV camera.

ConOps Reference Number	ConOps Sample Statement	System Requirements
		3.1.7.3.7 The CCTV System shall allow the CCTV System User to set and store the CCTV cameras' distribution policies [specify, not for public, on as needed basis, etc.]. 3.1.7.3.8 The CCTV System shall allow the CCTV System User to set and store whether the CCTV camera is available for remote control. 3.1.7.3.9 The CCTV System shall allow the CCTV System User to set and store other CCTV camera characteristics [specify].
4.13	CCTV Camera Siting and Viewing (Choose the user needs in this group if you chose the CCTV Camera Siting use case in Chapter Three)	3.1.8 CCTV Camera Siting and Viewing
4.13.1	The CCTV System User needs to monitor segments of the transportation environment requiring multiple CCTV cameras.	3.1.8.1 The CCTV System Designer shall locate CCTV cameras to provide [specify] coverage of segments of the transportation environment.
4.13.1.1	The CCTV System User needs to view contiguous segments of roadway [This need should be addressed by the agency in preparing the plans, not necessarily as a requirement on the CCTV system vendor. Need to reconcile.].	3.1.8.1.1 The CCTV System Designer shall locate multiple CCTV cameras that view contiguous segments of roadway. [Specify roadway segments.]

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.13.1.2	The CCTV System User needs CCTV cameras with overlapping coverage to prevent coverage gap due to a single camera failure. [This need should be addressed by the agency in preparing the plans, not necessarily as a requirement on the CCTV system vendor. Need to reconcile. Leave a place for the agency to specify, with instructions for tailoring the related requirements.]	3.1.8.1.2 The CCTV System Designer shall locate multiple CCTV cameras with overlapping CCTV camera coverage to prevent camera gaps resulting from a single camera failure. [Specify extent of required coverage area.]
4.13.1.3	The CCTV System User needs to place cameras in specific locations. [Depending on whether we support just vendor requirements or also consultant design requirements, this need may replace all the others in this group].	3.1.8.1.3 The CCTV System Designer shall determine CCTV camera placement based on other user requirements. [Specify other requirements.]
4.13.1.4	The CCTV System User needs to monitor regular lanes.	3.1.8.1.4 The CCTV System Designer shall determine CCTV camera placement to allow the CCTV System User to monitor regular lanes.
4.13.1.5	The CCTV System User needs to monitor express lanes.	3.1.8.1.5 The CCTV System Designer shall determine CCTV camera placement to monitor express lanes.
4.13.1.6	The CCTV System User needs to monitor reversible lanes.	3.1.8.1.6 The CCTV System Designer shall determine CCTV camera placement to monitor reversible lanes.
4.13.1.7	The CCTV System User needs to monitor shoulders and/or shoulder running lanes.	3.1.8.1.7 The CCTV System Designer shall determine CCTV camera placement to monitor shoulders and/or shoulder running lanes.
4.13.1.8	The CCTV System User needs to monitor freeways and arterials with [specify] allowable gaps.	3.1.8.1.8 The CCTV System Designer shall determine CCTV camera placement to monitor freeways and arterials with [specify] allowable gaps.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.13.1.9	The CCTV System User needs camera coverage of all lanes in both directions.	3.1.8.1.9 The CCTV System Designer shall determine CCTV camera placement for camera coverage of all lanes in both directions.
4.13.1.10	The CCTV System User needs to monitor the condition of alternate routes during an incident.	3.1.8.1.10 The CCTV System Designer shall determine CCTV camera placement to monitor alternate route conditions during an incident.
4.13.1.11	The CCTV System User needs to monitor an interchange.	3.1.8.1.11 The CCTV System Designer shall determine CCTV camera placement to monitor an interchange.
4.13.1.12	The CCTV System User needs to monitor toll facilities.	3.1.8.1.12 The CCTV System Designer shall determine CCTV camera placement to monitor toll facilities.
4.13.1.13	The CCTV System User needs to monitor interchange merge areas.	3.1.8.1.13 The CCTV System Designer shall determine CCTV camera placement to monitor interchange merge areas.
4.13.1.14	The CCTV System User needs to monitor interchange diverge areas.	3.1.8.1.14 The CCTV System Designer shall determine CCTV camera placement to monitor interchange diverge areas.
4.13.1.15	The CCTV System User needs to monitor interchange weave areas.	3.1.8.1.15 The CCTV System Designer shall determine CCTV camera placement to monitor interchange weave areas.
4.13.1.16	The CCTV System User needs to monitor events.	3.1.8.1.16 The CCTV System Designer shall determine CCTV camera placement to monitor events.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.13.1.17	The CCTV System User needs to visually verify events.	3.1.8.1.17 The CCTV System Designer shall determine CCTV camera placement to visually verify events.
4.13.1.18	The CCTV System User needs to monitor for incidents.	3.1.8.1.18 The CCTV System Designer shall determine CCTV camera placement to monitor for incidents.
4.13.1.19	The CCTV System User needs to visually verify incidents.	3.1.8.1.19 The CCTV System Designer shall determine CCTV camera placement to visually verify incidents.
4.13.1.20	The CCTV System User needs to monitor bridges, including drawbridges.	3.1.8.1.20 The CCTV System Designer shall determine CCTV camera placement to monitor bridges, including drawbridges.
4.13.1.21	The CCTV System User needs to monitor tunnels.	3.1.8.1.21 The CCTV System Designer shall determine CCTV camera placement to monitor tunnels.
4.13.1.22	The CCTV System User needs to monitor for stalled vehicles in HOV lanes.	3.1.8.1.22 The CCTV System Designer shall determine CCTV camera placement to monitor for stalled vehicles in HOV lanes.
4.13.1.23	The CCTV System User needs to tour HOV lane cameras and determine lane clearance.	3.1.8.1.23 The CCTV System Designer shall determine CCTV camera placement to tour HOV lane CCTV cameras and determine lane clearance.
4.13.1.24	The CCTV System User needs to monitor HOT lane entry and exit points.	3.1.8.1.24 The CCTV System Designer shall determine CCTV camera placement to monitor HOT lane entry and exit points.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.13.1.25	The CCTV System User needs to monitor managed lanes.	3.1.8.1.25 The CCTV System Designer shall determine CCTV camera placement to monitor managed lanes.
4.13.1.26	The CCTV System User needs to monitor part-time shoulder use.	3.1.8.1.26 The CCTV System Designer shall determine CCTV camera placement to monitor part-time shoulder use.
4.13.1.27	The CCTV System User needs to monitor planned events.	3.1.8.1.27 The CCTV System Designer shall determine CCTV camera placement to monitor planned events.
4.13.1.28	The CCTV System User needs to monitor planned lane or interchange closures or diversions, including long-term construction, parades and festivals.	3.1.8.1.28 The CCTV System Designer shall determine CCTV camera placement to monitor planned lane or interchange closures or diversions, including long-term construction, parades and festivals.
4.13.1.29	The CCTV System User needs to detect and monitor traffic conditions due to unplanned events such as early school closures.	3.1.8.1.29 The CCTV System Designer shall determine CCTV camera placement to detect and monitor traffic conditions due to unplanned events such as early school closures.
4.13.1.30	The CCTV System User needs to observe and note overall traffic conditions on the arterial network.	3.1.8.1.30 The CCTV System Designer shall determine CCTV camera placement to observe and note overall traffic conditions on the arterial network.
4.13.1.31	The CCTV System User needs to observe the effectiveness of arterial signal timing. That effectiveness includes queuing, intersection blockage, traffic signal faults and excessive delays.	3.1.8.1.31 The CCTV System Designer shall determine CCTV camera placement to observe the effectiveness [specify queuing, intersection blockage, traffic signal faults and excessive delays, etc.] of arterial signal timing.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.13.1.32	The CCTV System User needs to observe and monitor key "high accident" locations.	3.1.8.1.32 The CCTV System Designer shall determine CCTV camera placement to observe and monitor key 'high accident' locations.
4.13.2	The CCTV System Designer needs to have camera siting take into account maintenance needs. [specify]	3.1.8.2 The CCTV System designer shall site the camera to accommodate maintenance activities. [Specify activities.] 3.1.8.2.1 The CCTV System camera siting shall accommodate parking a maintenance vehicle off the highway. 3.1.8.2.2 The CCTV System camera shall be mounted to provide access to a CCTV System maintainer without use of a bucket truck or person lift. (This may be accommodated by use of a lowering device or other access technology.) 3.1.8.2.3 The CCTV System camera siting shall take into account other constraints [specify].
4.13.3	Special Operational Viewing Needs	3.1.8.3 Special Operational Viewing Requirements
4.13.3.1	The CCTV System User needs to read hazmat placards.	3.1.8.3.1 The CCTV System shall allow the CCTV System User to read HAZMAT placards.
4.13.3.2	The CCTV System User needs to read license plates.	3.1.8.3.2 The CCTV System shall allow the CCTV System User to read license plates.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.13.3.3	The CCTV System User needs to determine incident severity.	3.1.8.3.3 The CCTV System shall allow the CCTV System User to determine incident severity.
4.13.3.4	The CCTV System User needs to identify individuals.	3.1.8.3.4 The CCTV System shall allow the CCTV System User to identify individuals.
4.13.4	The CCTV System User needs to view a minimum of [specify] video feeds at any one time.	3.1.8.4 The CCTV System shall allow the CCTV System User to view a minimum [specify number] of video feeds simultaneously.
4.13.5	The CCTV System User needs to manage a minimum of [specify] cameras.	3.1.8.5 The CCTV System shall allow the CCTV System User to manage a minimum [specify number] of cameras.
4.14	CCTV System Maintenance (Choose the user needs in this group if you chose the CCTV System Maintenance use case in Chapter Three)	3.1.9 CCTV System Maintenance
4.14.1	The CCTV System Maintainer needs to maintain CCTV System operations.	3.1.9.1 The CCTV System shall allow the CCTV System Maintainer to maintain CCTV System operations.
4.14.1.1	The CCTV System User needs durable equipment. [Add descriptions of what this means]	3.1.9.2 The CCTV System shall provide the CCTV System User with durable equipment [specify description of what durable equipment means].

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.14.1.2	The CCTV System User needs equipment designed for environmental conditions. Specify what this entails. [Description needs to include conditions under which the equipment will be operated. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus cameras.]	3.1.9.3 The CCTV System Designer shall provide field equipment that complies with environmental standards. 3.1.9.3.1 The CCTV System Field Equipment shall comply with NEMA TS1 temperature standards 3.1.9.3.2 The CCTV System Field Equipment shall comply with ANSI/IEC 60529-2004 standards. 3.1.9.3.3 The CCTV System Ground infrastructure shall be NEMA Type R (rainproof). 3.1.9.3.4 The CCTV System Ground infrastructure shall be NEMA Type X (submersible).
4.14.1.3	The CCTV System User needs to monitor cameras from multiple locations.	3.1.9.4 The CCTV System shall allow the CCTV System Users to monitor cameras from multiple locations.
4.14.1.4	The CCTV System Maintainer needs serviceable field equipment.	3.1.9.5 The CCTV System shall provide the CCTV System Maintainer with serviceable field equipment. 3.1.9.5.1 The CCTV System field equipment [specify] shall have a Mean Time Between Failure (MTBF) of [specify]. 3.1.9.5.2 The CCTV System field equipment [specify] shall have a Mean Time To Repair (MTTR) of [specify].

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.14.1.5	The CCTV System Maintainer needs to have access to replacement parts for the life of the system [specified period of time].	3.1.9.6 The CCTV System shall have replacement parts [specify type and quantity] available through the CCTV System Owner to provide to the CCTV System Maintainer for the life of the system [specified period of time].
4.14.1.6	The CCTV System Maintainer needs to remotely test devices via IP protocol.	3.1.9.7 The CCTV System shall allow the CCTV System Maintainer to remotely test devices [specify] via IP protocol.
4.14.1.7	The CCTV System Maintainer needs diagnostic information that the camera collects about itself at the direction of the Maintainer.	3.1.9.8 The CCTV System shall allow the CCTV System Maintainer to access CCTV camera current diagnostic information.
4.14.1.8	The CCTV System Maintainer needs the following failure conditions to trigger alarms visible to the CCTV System User. Failure conditions may include failure of zoom, focus, aperture control, or temperatures outside of environmental limits.	3.1.9.9 The CCTV System shall allow the CCTV System Maintainer to setup the following [specify, such as loss of communication, failure to zoom, focus, aperture control or temperatures outside the environmental limits] failure conditions to trigger alarms visible to the CCTV System User.
4.14.2	The CCTV devices in a CCTV System need to be uniquely identifiable and locatable.	3.1.7.3.2 The CCTV System shall allow the CCTV System User to store the unique identifier of the CCTV camera. 3.1.7.3.3 The CCTV System shall allow the CCTV System User to set and store the CCTV Location information of the CCTV camera.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.14.3	The CCTV System Maintainer needs to have safe access to CCTV locations for maintenance.	3.1.8.2.1 The CCTV System camera siting shall accommodate parking a maintenance vehicle off the highway. 3.1.8.2.2 The CCTV System camera shall be mounted to provide access to a CCTV System maintainer without use of a bucket truck or person lift. (This may be accommodated by use of a lowering device or other access technology.)
4.14.4	The CCTV System Maintainer needs to update camera and PTZ controller firmware remotely.	3.1.9.10 The CCTV System Provider shall provide the CCTV System Maintainer with remote updates of camera and PTZ controller firmware.
4.14.5	The CCTV System Maintainer needs to update CCTV system software remotely.	3.1.9.11 The CCTV System Provider shall provide the CCTV System Maintainer with remote updates of CCTV System software.
4.15	Interfaces (Choose the user needs in this group if you chose the Interfacing with External Systems use case in Chapter Three)	3.1.10 Constraints/External Interfaces
4.15.1	The CCTV System User needs to interface with cameras from different manufacturers within the same system, while satisfying all the user needs. [specify what cameras are being used]	3.1.10.1 The CCTV System shall allow the CCTV System User to interface with cameras from different manufacturers within the same system, meeting the same user needs. [Specify the different products to be supported by this requirement.]
4.15.2	The CCTV System Maintainer needs to replace cameras with cameras from different manufacturers.	3.1.10.2 The CCTV System shall support cameras from different manufacturers. [Specify manufacturers and products.]

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.15.3	The CCTV System Designer needs to adopt ONVIF IP-based camera interface standards, which may require coexisting with NTCIP-based interfaces on the same IP network [specify].	3.1.10.3 The CCTV System shall support ONVIF IP-based camera interface standards [specify]. 3.1.10.4 The CCTV System shall support the coexistence of ONVIF IP-based camera interface standards and NTCIP-based interfaces on the same IP network.
4.15.4	The CCTV System Designer needs to integrate new cameras with an existing CCTV System [specify existing system interface].	3.1.10.5 The CCTV System shall allow the CCTV System Maintainer to integrate new cameras with an existing CCTV System [specify existing system interface and standards].
4.15.5	The CCTV System Designer needs to integrate a new CCTV System with existing cameras, which may include analog video feeds from an existing analog CCTV System. [Specify existing camera interfaces].	3.1.10.6 The CCTV System shall allow the CCTV System Maintainer to integrate with existing cameras. Existing cameras may include analog video feeds from an existing analog CCTV System [specify existing camera interfaces].
4.15.6	The CCTV System Designer needs to accommodate existing communications interfaces [specify].	3.1.10.7 The CCTV System shall accommodate existing communications interfaces [specify].
4.15.7	The CCTV System Designer needs to follow agency IT policies. [specify]	3.1.10.8 The CCTV System shall accommodate agency IT policies [specify].
4.15.8	The CCTV System User needs to interface with an external system to identify incident locations and direct a camera with appropriate coverage area to the incident.	3.1.10.9 The CCTV System shall allow the CCTV System User to interface with an external system to identify incident locations and direct a camera with appropriate coverage area to the incident.

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.15.9	The CCTV System User needs to interface with external CCTV Systems to direct the display of video from the other system, to control the cameras on the other system, or to configure the other system.	3.1.10.10 The CCTV System shall allow the CCTV System User to interface with an external CCTV System to direct the display of video from the other system. 3.1.10.11 The CCTV System shall allow the CCTV System User to interface with an external CCTV System to control the cameras on the other system. 3.1.10.12 The CCTV System shall allow the CCTV System User to interface with an external CCTV System to configure the other system.
4.15.10	The CCTV System User needs to interface with external CCTV Systems to allow the other system to direct the display of video, to control the cameras, or to configure the user's CCTV system.	3.1.10.13 The CCTV System shall allow external CCTV Systems to route video within the CCTV System. 3.1.10.14 The CCTV System shall allow external CCTV Systems to control the cameras on the CCTV System. 3.1.10.15 The CCTV System shall allow external CCTV Systems to configure the CCTV System.
4.15.11	The CCTV System User needs to interface with existing NTCIP system components [specify], such as for automatic camera selection or control, or automatic video feed display assignment. The NTCIP components may have to coexist with ONVIF-based interfaces.	3.1.10.16 The CCTV System shall interface with NTCIP system components [specify], such as automatic camera selection or control, or automatic video feed display assignment. (The NTCIP components may have to coexist with ONVIF-based interfaces.)
4.16	CCTV System Performance	3.1.11 CCTV System Performance

ConOps Reference Number	ConOps Sample Statement	System Requirements
4.16.1	The CCTV System Owner needs to accommodate [specify] users at any one time. (This may be defined by bandwidth consumption per user.)	3.1.11.1 The CCTV System shall accommodate [specify, this may be defined by bandwidth consumption per user] users at any one time. 3.1.11.2 The CCTV System shall accommodate [specify] number of users simultaneously controlling the CCTV System's cameras.

ConOps Reference Number	ConOps Sample Statements
5	Chapter 5: Envisioned CCTV System Overview
5.1	Operational Objectives
5.1.1	An objective of the agency is to use the CCTV System to monitor traffic conditions in order to better manage the transportation network.
5.1.2	An objective of the agency is to use the CCTV System to provide users with visibility of the environmental conditions affecting the transportation network in order to better manage the transportation network.
5.1.3	An objective of the agency will be to verify non-CCTV field device status using the CCTV System.
5.1.4	An objective of the agency is to have the CCTV System automatically detect adverse traffic conditions and notify the users.
5.1.5	An objective of the agency is to allow External Systems to remotely monitor and control CCTV System cameras.
5.1.6	An objective of the agency is to provide CCTV System recording features of the camera video feeds for user playback.
5.2	Operational Policies and Constraints
5.2.1	The operation of the CCTV System will enforce user access control based on the user's role and permissions as specified by the CCTV operational policy.
5.2.2	External Systems will be given lower priority for camera monitoring and control when there is a conflict with the CCTV System users.
5.2.3	The CCTV System will have a limitation of [specify number] of system users at a given time.
5.2.4	The CCTV System will have a limitation of [specify number] of video monitors on the video wall.
5.2.5	The CCTV System users (and by extension the External System users/operators) will follow the CCTV System policy guidelines for appropriate display of video feeds/snapshots to the public.
5.3	Description of the Proposed System
5.3.1	User/Operator Access
5.3.1.1	Users/Operators and maintenance staff will be assigned different levels of authority, and access to equipment for which they are authorized, based on their roles and responsibilities. This will allow them to control, view, monitor, analyze and maintain the operation of the CCTV System as appropriate.
5.3.1.2	The CCTV System will be connected to the agency's LAN/WAN, allowing access to all authorized users.
5.3.1.3	The CCTV System will allow access by authorized users outside the agency via a firewall.
5.3.2	Operational Environment

ConOps Reference Number	ConOps Sample Statements
5.3.2.1	The CCTV System will be housed in a facility with suitable environmental characteristics based on the requirements of the procured CCTV System equipment.
5.3.2.2	The CCTV System cameras will meet the environmental condition requirements of the region where they are deployed.
5.3.2.3	The CCTV System facility will provide physical access control.
5.3.2.4	The CCTV System facility will provide access to communication system(s) from the CCTV System to the CCTV cameras.
5.3.2.5	The CCTV System facility will provide access to communication system(s) from the CCTV System to other External Systems.
5.3.3	Major CCTV System Components
5.3.3.1	The CCTV System will include CCTV System software running on one or more computer servers.
5.3.3.2	The CCTV System will include one or more user workstations containing [specify number] of user workstation displays.
5.3.3.3	The CCTV System will include a video wall containing multiple monitors.
5.3.3.4	The CCTV System will include a LAN connecting the CCTV System server(s), workstation(s) and video wall.
5.3.4	External System Interfaces
5.3.4.1	The CCTV System will communicate with External Systems over the following communications systems [specify].
5.3.4.2	The CCTV System will communicate with External Systems following standardized communication protocols [specify].
5.3.5	Estimated Cost of CCTV System Operation
5.3.5.1	The estimated annual cost of CCTV System operations is [specify].
5.3.6	Operational Risk Factors
5.3.6.1	A CCTV System operational risk factor includes providing inappropriate, as defined in the CCTV System policy guidelines, video feeds or snapshots to the public.
5.3.6.2	A CCTV System operational risk factor includes malicious usage of the CCTV System by authorized and unauthorized users.
5.3.6.3	A CCTV System operational risk factor includes the loss of electrical power.
5.3.6.4	A CCTV System operational risk factor includes the loss of communications.

ConOps Reference Number	ConOps Sample Statements
5.3.7	Performance Characteristics
5.3.7.1	The CCTV System will provide the CCTV System user with camera monitoring response throughput times of [specify].
5.3.7.2	The CCTV System will provide the CCTV System user with camera control capabilities without noticeable lag between camera commands and camera video response.
5.3.7.3	The CCTV System will support [specify number] simultaneous displayed camera feeds.
5.3.7.4	The CCTV System will support [specify number] simultaneous users.
6	Chapter 6: CCTV System Operational Environment
6-01	The system will be operated and monitored from the [specify agency] [specify overall system name such as TMC].
6-02	The system will be operated and monitored from workstations located [specify who will have workstations and where they will be located].
6-03	The central server equipment will be housed at [specify location] in an [air-conditioned or non-air-conditioned] environment.
6-04	The [in-house operators and/or on-call contract staff] will handle complaints or requests for changes in operation on an as-needed basis.
6-05	Maintenance of all field equipment will be performed by [in-house and/or contract] staff
6-06	Maintenance of the following field equipment will be performed by [in-house and/or contract] staff. [specify what equipment will be maintained by whom]
6-07	Funding for maintenance of the CCTV System will come from [specify funding program or source]. An increase of [specify \$] per year will be required to accommodate the additional equipment installed for the CCTV System.
6-08	Additional communications equipment and annual fees will be incurred with the CCTV System. This will amount to approximately [specify \$] per year, and will be covered by the [specify program or budget allocation details].
6-09	Replacement or repair of defective or failed equipment will be covered for [specify years] by the manufacturers' warranties. The labor cost of replacement during this period will be included in the purchase price.
6-10	The agency expects maintenance of parts and equipment for a period of [specify years] will be included in the purchase price.

ConOps Reference Number	ConOps Sample Statements
6-11	The agency expects maintenance of all CCTV system management software for a period of [specify years] will be included in the purchase price.
6-12	The agency expects to operate this system using the latest software for a period of [specify years].
6-13	The agency will seek technical support from the vendor for assistance in using the CCTV system management software for [specify years].
6-14	Operations and maintenance staff will have the ability to log in to the system from remote locations via the internet, and have full functionality consistent with their access level.
6-15	Include any additional needs for support or information from the vendor that will be needed by your agency, and that will become requirements in the contract or purchase documents.
6.1	
6.1-1	The central server will be a standard platform maintained by the [specify agency department] and able to be replaced independently from the software.
6.1-2	The agency selection of CCTV cameras will not be constrained by the CCTV System software.
7	Chapter 7: CCTV System Support Environment
7.1	Institutions and Stakeholders
7.1-1	Existing stakeholders of the CCTV System include: [list all stakeholders, such as:] • Sponsoring agency • Neighboring agencies that will access the CCTV System • Etc.
7.1-2	The stakeholders who will be affected by or have a direct interest in the CCTV System are: [list existing and include new stakeholders].
7.1-3	The activities that will be undertaken by the CCTV System stakeholders include: system operation, system monitoring and adjustment, system performance monitoring and evaluation.
7.1-4	The organizational structures of the units responsible for installation, operation and maintenance are illustrated in the attached organization chart. The roles, responsibilities and required qualifications and experience are described below. [Describe as appropriate]
7.2	Facilities
7.2-1	Describe the current and/or proposed [TMC or CCTV System Center].
7.2-2	Will there be a satellite and/or backup [TMC or CCTV System Center]?

ConOps Reference Number	ConOps Sample Statements
7.2-3	Describe the locations elsewhere within the agency, such as on a LAN or WAN, from which access to the system will be required?
7.2-4	Is air-conditioning required?
7.2-5	Describe the location where a separate server will be located. (e.g., IT server room, TMC back room, remote hub)
7.2-6	Describe who is responsible for providing and maintaining staff facilities (e.g., personnel, public works, building services, etc.?)
7.2-7	Describe who is responsible for fire control facilities (e.g., part of operating group's responsibility, or the responsibility of another group, such as building services?)
7.2-8	Describe who is responsible for secure access to the TMC, workshop, or office with CCTV system workstations? (e.g., Is it the responsibility of the operating group or another group, such as building services?)
7.3	System Architecture Constraints
7.3-1	The CCTV System processor/server will be protected within the agency's firewalls. The IT Department will provide resources, equipment and system management so that users/operators will have appropriate access to the system locally, from within the agency's LAN and from remote locations.
7.3-2	The communications media available for use by the system will be: [List Available Media, Provide a map or block diagram as appropriate. Show locations of any gaps, bandwidth and latency constraints, protocols and available alternatives.]
7.3-3	The [specify which State or Region] [Statewide or Regional] ITS Architecture provides the context for the CCTV System project. The CCTV System project fits within the ITS Architecture as illustrated in Figure XX. [Explain each architectural element and information flow in the CCTV System project. If additional elements or interfaces are added, explain why].
7.4	Utilities
7.4-1	Are utilities the responsibility of the operating group, or are they the responsibility of another group, such as building services?
7.5	Equipment
7.5-1	Describe what test equipment is required to support the CCTV system (e.g., communications testers, fiber testers, CCTV camera and switch testers). Is this currently available or is additional equipment required?
7.5-2	Will vehicles be the responsibility of the operating group or another group within the agency? What types of vehicles will be required, and how many?

ConOps Reference Number	ConOps Sample Statements
7.6	Computing hardware
7.6-1	Describe the additional computing equipment required to support CCTV system operation, such as printer, copier, additional monitors, and scanner.
7.6-2	Describe who is responsible for maintenance and repair of the computing equipment?
7.6-3	Describe who is responsible for replacement of the computing equipment when it reaches the end of its useful life?
7.7	Software
7.7-1	Who is responsible for keeping software up to date?
7.7-2	Who is responsible for keeping software licenses current?
7.7-3	What controls are proposed governing software use and availability on workstations and other support computers?
7.8	Personnel
7.8-1	Describe how many users/operators will be available for routine operations. Will this be provided by existing staff or will additional staff be required?
7.8-2	Describe what hours users/operators will be available.
7.8-3	Describe what training users/operators will need.
7.8-4	Describe what maintenance staff will be required. Will this be provided by existing staff or will additional staff be required?
7.8-5	What qualifications and training will the maintenance staff require?
7.9	Operating procedures
7.9-1	Describe who will be responsible for backing up databases. How often will backups be required? Will backups be stored off-site?
7.10	Maintenance
7.10-1	Describe the arrangements for maintenance. (E.g., is it done in-house or contracted out? Is it 24/7? Is equipment repair done in-house or externally?)
8	Chapter 8: Operational Scenarios
8.1	Overview

ConOps Reference Number	ConOps Sample Statements
8.1-1	The following operational scenarios describe how the system is expected to operate under various conditions. The proposed CCTV system is expected to be able to manage the following operational scenarios and issues envisioned for both the current and future project locations. Scenarios are described for the following operational conditions: [Edit to suit your situation.] • Configure CCTV System • Check for Camera in Coverage Area • CCTV Monitoring • Provide CCTV System Video • Verify Non-CCTV Field Device Status using CCTV • CCTV Automatic Detection • Remote Control of a CCTV Device • CCTV System Logging • Recorded Video • CCTV System Maintenance [For each scenario, describe the following elements: • Operational objectives • Users • Summary of operations].
8.2	Configure CCTV System
8.2.1	Operational Objectives
8.2.1-1	The operational objectives for the configuration of the CCTV System are to: • Provide the capability to configure CCTV System user access and permissions to and from the CCTV System • Specify CCTV System parameters affecting CCTV System performance • Provide the capability to configure External System access and permissions to and from the CCTV System
8.2.2	Users

ConOps Reference Number	ConOps Sample Statements
8.2.2-1	The users involved with the configuration of the CCTV System are: • CCTV System Manager is the primary user responsible for setting access and permissions for all users including External Systems • CCTV System User • CCTV System Maintainer • External Systems
8.2.3	Summary of Operations
8.2.3-1	The CCTV System Manager will prepare and monitor the CCTV System operation by controlling access of the various users and External Systems to the CCTV System. Specifically the CCTV System Manager configures who can select particular cameras, control these cameras, receive distributed video, and control video distribution. Additionally, the CCTV Manager gives CCTV System Maintainers the ability to run diagnostics and tests on the CCTV System in order to enact repairs. The CCTV Manager also configures the CCTV System by setting the number and types of users allowed access to the CCTV System at any given time. The CCTV Manager also sets other parameters to handle competing user access to shared capabilities as well as camera ownership, permissions, etc. In addition, the CCTV System Manager monitors and configures the performance of external video streams based on usage and communications limitations.
8.3	Check for Camera in Coverage Area
8.3.1	Operational Objectives
8.3.1-1	The operational objective for checking for cameras in a coverage area is to: • Provide a list of cameras in a given coverage area based on a location
8.3.2	Users
8.3.2-1	The user involved with checking for cameras in a coverage area is: • CCTV System User
8.3.3	Summary of Operations
8.3.3-1	Given a location of interest entered by the CCTV System User, the CCTV System returns a list of cameras to view that location within a specified coverage area. For example, an incident is reported and needs to be visually verified to determine if the incident is valid and what resources are needed.

ConOps Reference Number	ConOps Sample Statements
8.4	CCTV Monitoring
8.4.1	Operational Objectives
8.4.1-1	The operational objective for CCTV monitoring is to: • Allow the CCTV System User to visually monitor a given coverage area
8.4.2	Users
8.4.2-1	The user involved with CCTV monitoring is: • CCTV System User
8.4.3	Summary of Operations
8.4.3-1	The CCTV System provides CCTV System Users the ability to monitor area conditions for incident detection, current traffic conditions, current weather conditions, etc. in order to have a better understanding of the state of the transportation network. The CCTV System User can select particular cameras to be displayed on video monitors, set camera PTZ presets and program a set of cameras to perform a tour of a given coverage area. For automated incident detection, the CCTV System User can program cameras to return to preset locations repeatedly and accurately.
8.5	Provide CCTV System Video
8.5.1	Operational Objectives
8.5.1-1	The operational objectives for providing CCTV System video are to: • Share video feeds to external systems • Share image snapshots of the video feed to external systems • Allow the CCTV System User to select and direct non-camera sources to the CCTV System video monitors
8.5.2	Users
8.5.2-1	The users involved with providing CCTV System video are: • CCTV System User • External System
8.5.3	Summary of Operations

ConOps Reference Number	ConOps Sample Statements
8.5.3-1	With video-sharing agreements in place, the CCTV System User initiates provision of CCTV System video feeds and/or video snapshots based on external system requests. These requests for a common video data distribution channel can come from the media, traveler information providers, state and local DOTs, emergency services agencies and other users with a need for video. The CCTV System User can selectively disable any and all video feeds to one or more users for any reason. The CCTV System User can also configure the maximum number of video feeds allowed to each user. In addition, the CCTV System User can select and direct video from non-camera sources, such as broadcast television video feeds, to the CCTV System video monitors.
8.6	Verify Non-CCTV Field Device Status using CCTV
8.6.1	Operational Objectives
8.6.1-1	The operational objective for verifying Non-CCTV field device status using CCTV is to: • Using the CCTV System to ensure non-CCTV field devices are working properly
8.6.2	Users
8.6.2-1	The user involved with CCTV monitoring is: • CCTV System User
8.6.3	Summary of Operations
8.6.3-1	Based on a request or known change of state of a field device, the CCTV System User selects camera feeds of the field device to display on one or more video monitors. The CCTV System User verifies that the field device (e.g., DMS, roadway gates, ramp meter, traffic signal, toll plaza, lane control signals, variable speed limit signs and other devices) is working properly.
8.7	CCTV Automatic Detection
8.7.1	Operational Objectives
8.7.1-1	The operational objective for automatic detection by the CCTV System is to: • Identify and notify the CCTV System User of dangerous road network conditions involving vehicles
8.7.2	Users
8.7.2-1	The user involved with CCTV monitoring is: • CCTV System User
8.7.3	Summary of Operations

ConOps Reference Number	ConOps Sample Statements
8.7.3-1	Cameras controlled by a CCTV System are configured by the CCTV System User to be trained on fixed locations in order to identify and notify the CCTV System User about roadway incidents, incidents on ramps and shoulders as well as wrong-way vehicles.
8.8	Remote Control of CCTV Devices
8.8.1	Operational Objectives
8.8.1-1	The operational objective for remote control of CCTV devices is to: • Allow an External System access a CCTV System camera to monitor and control it
8.8.2	Users
8.8.2-1	The users involved in remotely controlling a CCTV device are: • CCTV System User • External System
8.8.3	Summary of Operations
8.8.3-1	External Systems can access the CCTV System's cameras to monitor their video feeds and control them. For example, the External System may need to view an event, see real-time traffic conditions or verify an incident. The CCTV System User can manually suspend the external video feed and camera access for any reason. Conversely, the CCTV System can monitor and control External System cameras.
8.9	Logging CCTV System Data
8.9.1	Operational Objectives
8.9.1-1	The operational objectives for logging CCTV System data are to: • Allow the specification of log events and characteristics • Allow access and review of the CTV system log(s)
8.9.2	Users
8.9.2-1	The user involved in logging CCTV System data is: • CCTV System Maintainer
8.9.3	Summary of Operations
8.9.3-1	The CCTV System Maintainer specifies which CCTV System events are logged along with the size of the log(s) and each logs duration. The CCTV System Maintainer accesses the logs and reviews the history for general system oversight and to perform diagnostics testing due to triggered alarms.
8.10	Recorded Video

ConOps Reference Number	ConOps Sample Statements
8.10.1	Operational Objectives
8.10.1-1	The operational objectives for recorded video are to: • Provide CCTV video recording and playback capabilities • Allow for video recordings to be archived, distributed to other systems, logged and deleted
8.10.2	Users
8.10.2-1	The user involved with recorded video is: • CCTV System User
8.10.3	Summary of Operations
8.10.3-1	The CCTV System User can initiate recording of particular CCTV camera feeds. They can also setup a schedule of recordings based on time-of-day or start and duration. The recorded video can be played back by the CCTV System User including fast forward and rewind capabilities. The recorded video can be distributed to other users and/or External Systems. The recorded video is logged as an event in the system. The recorded vide can be deleted which also is logged as an event. Retention rules for the recorded video can be set by the CCTV System User whereby the recorded video is deleted based on the rules. Video recordings can be marked by the CCTV System User for permanent storage. The CCTV System may use a standard video compression method to store the recorded video.
8.11	CCTV System Maintenance
8.11.1	Operational Objectives
8.11.1-1	The operational objectives for CCTV System maintenance are to: • Ensure the CCTV System continues to be operational • Provide serviceable CCTV System equipment • Allow for remote testing and diagnostics of the CCTV System • Notification of failure conditions • Remote update of CCTV System device firmware and software
8.11.2	Users
8.11.2-1	The users involved in CCTV System maintenance are: • CCTV System User • CCTV System Maintainer
8.11.3	Summary of Operations

ConOps Reference Number	ConOps Sample Statements
8.11.3-1	Maintaining CCTV System operations requires equipment designed for their location. Based on a CCTV System User request or CCTV System failure notification, the CCTV System Maintainer can remotely test the CCTV System including running diagnostics and updating device firmware and system software. It is important that the CCTV System Maintainer has safe access to all aspects of the CCTV System for repairs.

APPENDIX B: SYSTEM REQUIREMENTS TABLE OF SAMPLE STATEMENTS

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1	Functional System Requirements	
3.1.1	Access Control	
3.1.1.1	The CCTV System shall enforce access control of all users.	4.1.1 The CCTV System Manager needs access to the CCTV System.
3.1.1.2	The CCTV System shall allow the CCTV System Manager to assign access control credentials to CCTV System Users.	4.1.1.1.1 The CCTV System Manager needs to configure CCTV System User access.
3.1.1.3	The CCTV System shall allow the CCTV System Manager to assign access control credentials to CCTV System Maintainers.	4.1.1.1.2 The CCTV System Manager needs to configure CCTV System Maintainer access.
3.1.1.4	The CCTV System shall allow the CCTV System Manager to assign access control credentials to External Systems.	4.1.1.1.3 The CCTV System Manager needs to configure External System access.
3.1.1.5	The CCTV System shall allow the CCTV System Manager to receive distributed video.	4.1.1.2 The CCTV System Manager needs access to the CCTV System to receive distributed video.
3.1.1.6	The CCTV System shall allow the CCTV System Manager to select cameras.	4.1.1.3 The CCTV System Manager needs access to the CCTV System to select cameras.
3.1.1.7	The CCTV System shall allow the CCTV System Manager to control cameras.	4.1.1.4 The CCTV System Manager needs access to the CCTV System to control cameras.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.1.8	The CCTV System shall allow the CCTV System Manager to route input video to designated video outputs. (Outputs are displays or external channels.)	4.1.1.5 The CCTV System Manager needs access to the CCTV System to control video distribution.
3.1.1.9	The CCTV System shall allow the CCTV System User to receive distributed video.	4.1.2.1 The CCTV System User needs access to the CCTV System to receive distributed video.
3.1.1.10	The CCTV System shall allow the CCTV System User to select cameras.	4.1.2.2 The CCTV System User needs access to the CCTV System to select cameras.
3.1.1.11	The CCTV System shall allow the CCTV System User to control cameras.	4.1.2.3 The CCTV System User needs access to the CCTV System to control cameras.
3.1.1.12	The CCTV System shall allow the CCTV System User to route input video to designated video outputs. (Outputs are displays or external channels.)	4.1.2.4 The CCTV System User needs access to the CCTV System to control video distribution.
3.1.1.13	The CCTV System shall allow the CCTV System Maintainer to receive distributed video.	4.1.3.1 The CCTV System Maintainer needs access to the CCTV System to receive distributed video.
3.1.1.14	The CCTV System shall allow the CCTV System Maintainer to select cameras.	4.1.3.2 The CCTV System Maintainer needs access to the CCTV System to select cameras.
3.1.1.15	The CCTV System shall allow the CCTV System Maintainer to control cameras.	4.1.3.3 The CCTV System Maintainer needs access to the CCTV System to control cameras.
3.1.1.16	The CCTV System shall allow the CCTV System Maintainer to route input video to designated video outputs. (Outputs are displays or external channels.)	4.1.3.4 The CCTV System Maintainer needs access to the CCTV System to control video distribution.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.1.17	The CCTV System shall allow the CCTV System Maintainer to run system diagnostics and testing.	4.1.3.5 The CCTV System Maintainer needs access to the CCTV System to run system diagnostics and testing.
3.1.1.18	The CCTV System shall allow the CCTV System Maintainer access for repairs.	4.1.3.6 The CCTV System Maintainer needs access to the CCTV System to repair it.
3.1.1.19	The CCTV System shall allow an External System to receive distributed video.	4.1.4.1 The External System needs access to the CCTV System to receive distributed video.
3.1.1.20	The CCTV System shall allow an External System to select cameras.	4.1.4.2 The External System needs access to the CCTV System to select cameras.
3.1.1.21	The CCTV System shall allow an External System to control cameras.	4.1.4.3 The External System needs access to the CCTV System to control cameras.
3.1.1.22	The CCTV System shall allow an External System to route input video to designated video outputs. (Outputs are displays or external channels.)	4.1.4.4 The External System needs access to the CCTV System to control video distribution.
3.1.2	Camera Selection	
3.1.2.1	The CCTV System shall identify to the CCTV System User the closest camera(s) based on the location specified by the user.	4.3.1 The CCTV System User needs to identify cameras with a view of a location of interest.
3.1.2.2	The CCTV System shall allow the CCTV System User to view CCTV cameras available for viewing.	4.4.1 The CCTV System User needs to select camera feeds to display on video monitors.
3.1.2.3	The CCTV System shall allow the CCTV System User to route a CCTV camera feed to a specified video monitor.	4.4.1 The CCTV System User needs to select camera feeds to display on video monitors.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.2.4	The CCTV System shall allow the CCTV System User to route a CCTV camera feed to more than one video monitor.	4.4.1 The CCTV System User needs to select camera feeds to display on video monitors.
3.1.2.5	The CCTV System shall allow the CCTV System User to view CCTV cameras available to be controlled.	4.4.3 The CCTV System User needs to request control of a camera.
3.1.3	Camera Control	
3.1.3.1	CCTV System Control	
3.1.3.1.1	The CCTV System shall allow a CCTV System User to control the camera being viewed. (If so configured by the CCTV System Manager).	4.4.2 The CCTV System User needs to control the camera being viewed.
3.1.3.1.1.1	The CCTV System shall allow a CCTV System User to rotate the camera about a vertical axis (pan the camera).	4.4.2 The CCTV System User needs to control the camera being viewed.
3.1.3.1.1.2	The CCTV System shall allow a CCTV System User to zoom the camera.	4.4.2 The CCTV System User needs to control the camera being viewed.
3.1.3.1.1.3	The CCTV System shall allow a CCTV System User to rotate the camera about a horizontal axis at right angles to the direction the camera is pointing (tilt the camera).	4.4.2 The CCTV System User needs to control the camera being viewed.
3.1.3.1.2	The CCTV System shall allow a CCTV System User to request control of a camera (If so configured by the CCTV System Manager).	4.4.3 The CCTV System User needs to request control of a camera.
3.1.3.1.3	The CCTV System shall allow a CCTV System User to reassign control of a camera to another user.	4.4.4 The CCTV System User needs to reassign control of a camera to different user.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.3.1.4	The CCTV System shall allow the CCTV System User to configure [specify number] individual camera presets. (A preset includes the pan, tilt, and zoom settings).	4.4.5 The CCTV System User needs to configure [specify number] camera presets (PTZ settings).
3.1.3.1.5	The CCTV System shall allow a CCTV System User to return a camera to a preset location with specified accuracy. [Specify the accuracy requirements.]	4.4.5.1 The CCTV System User needs to return the camera to a preset location repeatedly and accurately [define accurate-this will be a much stiffer standard for cameras that are used for detection, versus cameras used just for viewing. This need should describe both to support their separate requirements. For detection, the camera must reset so that the detection zone remains in the correct lane and location, probably with an accuracy in the viewed field of +/- 1 feet. For viewing, the reset field of view needs to be recognizably the correct location at full zoom.]. 4.12.3 The CCTV System User needs to program cameras to return to preset angle, zoom and focus [at the needed specified accuracy] when not under active CCTV System User control.
3.1.3.1.6	The CCTV System shall allow a CCTV System User to direct a camera to tour its defined presets.	4.4.5.2 The CCTV System User needs to program cameras to tour their coverage area.
3.1.3.1.7	Verification of Field Device Status	4.6 Verify Non-CCTV Field Device Status using CCTV

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.3.1.7.1	The CCTV System shall allow the CCTV System User to select a CCTV camera feed assigned to a field device to be displayed on specified video monitors.	4.6.1 The CCTV System User needs to select displayed camera feeds of field devices to display on video monitors.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.3.1.7.2	The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors.	4.6.2 The CCTV System User needs to verify transportation asset operation using CCTV. 4.6.2.1 The CCTV System User needs to verify DMS status and message display. 4.6.2.2 The CCTV System User needs to verify roadway gates (e.g., HOV, HOT, Hurricane evacuation). 4.6.2.3 The CCTV System User needs to verify ramp meter operation. 4.6.2.4 The CCTV System User needs to verify traffic signal operation. 4.6.2.5 The CCTV System User needs to verify toll plazas operation. 4.6.2.6 The CCTV System User needs to verify lane control signal operation. 4.6.2.7 The CCTV System User needs to verify variable speed limit sign operation. 4.6.2.8 The CCTV System User needs to verify operation of other general devices [specify others].

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.3.1.7.3	The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom.	4.6.2 The CCTV System User needs to verify transportation asset operation using CCTV. 4.6.2.1 The CCTV System User needs to verify DMS status and message display. 4.6.2.2 The CCTV System User needs to verify roadway gates (e.g., HOV, HOT, Hurricane evacuation). 4.6.2.3 The CCTV System User needs to verify ramp meter operation. 4.6.2.4 The CCTV System User needs to verify traffic signal operation. 4.6.2.5 The CCTV System User needs to verify toll plazas operation. 4.6.2.6 The CCTV System User needs to verify lane control signal operation. 4.6.2.7 The CCTV System User needs to verify variable speed limit sign operation. 4.6.2.8 The CCTV System User needs to verify operation of other general devices [specify others].

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.3.1.8.1	The CCTV System shall relinquish control upon CCTV System User command.	4.7.1.1 The CCTV System User will need to manually relinquish control of a camera to make it available for other users.
3.1.3.2	Remote Control	4.9 Remote Control of a CCTV Device
3.1.3.2.1	The CCTV System shall allow an External System to request a change in the parameters of a CCTV camera.	4.9.1 The External System needs to request a change to the parameters of a CCTV device, such as camera position, operated by another center in order to view an event, see real-time traffic conditions, or verify an incident.
3.1.3.2.1.1	The CCTV System shall allow an External System to request a change in the camera position parameters of a CCTV camera.	4.9.1 The External System needs to request a change to the parameters of a CCTV device, such as camera position, operated by another center in order to view an event, see real-time traffic conditions, or verify an incident.
3.1.3.2.1.2	The CCTV System shall allow an External System to request a change in the parameters to view an event by a CCTV camera.	4.9.1 The External System needs to request a change to the parameters of a CCTV device, such as camera position, operated by another center in order to view an event, see real-time traffic conditions, or verify an incident.
3.1.3.2.1.3	The CCTV System shall allow an External System to request a change in the parameters for viewing real-time traffic conditions by a CCTV camera.	4.9.1 The External System needs to request a change to the parameters of a CCTV device, such as camera position, operated by another center in order to view an event, see real-time traffic conditions, or verify an incident.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.3.2.1.4	The CCTV System shall allow an External System to request a change in the parameters for verifying an incident by a CCTV camera.	4.9.1 The External System needs to request a change to the parameters of a CCTV device, such as camera position, operated by another center in order to view an event, see real-time traffic conditions, or verify an incident.
3.1.3.2.2	The CCTV System shall allow an External System to monitor cameras.	4.9.2 The External System needs to monitor cameras from external locations.
3.1.3.2.3	The CCTV System shall allow an External System to control cameras.	4.9.3 The External System needs to control cameras from external locations.
3.1.4	Video Stream Management	
3.1.4.1	Video Dissemination	
3.1.4.1.1	The CCTV System shall allow a CCTV System Manager to create low bandwidth [specify attributes] copies of video feeds.	4.5.1 The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the general public via internet sites.
3.1.4.1.1	The CCTV System shall allow a CCTV System Manager to create low bandwidth [specify attributes] copies of video feeds.	4.5.4 The CCTV System User needs to be able to share video streams/images with regional stakeholders (e.g., state and local DOTs, police, fire). (This may be done by using an external video feed or a web page.) [Choose the appropriate requirement.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.4.1.2	The CCTV System shall make available the low bandwidth video feeds to a web-page server. [Specify the requirements imposed by the web-page server.]	4.5.1 The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the general public via internet sites. 4.5.4 The CCTV System User needs to be able to share video streams/images with regional stakeholders (e.g., state and local DOTs, police, fire). (This may be done by using an external video feed or a web page.) [Choose the appropriate requirement.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.4.1.3	The CCTV System shall make available the low bandwidth video feeds to an external interface. [Specify interface requirements. This requirement may need to be repeated for each of multiple external interfaces.]	4.5.2 The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the media and Information Service Providers through a media feed. 4.5.4 The CCTV System User needs to be able to share video streams/images with regional stakeholders (e.g., state and local DOTs, police and fire). (This may be done by using an external video feed or a web page.) [Choose the appropriate requirement.] 4.5.5 The CCTV System User needs to be able to share video streams/images with other stakeholders. 4.5.6 The CCTV System User needs to be able to share video streams/images through a regional video clearinghouse. 4.5.7 The CCTV System User needs to provide real-time video feeds to the traveler information system. 4.5.8 The CCTV System User needs to provide real-time incident information to the public/media for major arterials.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.4.1.4	The CCTV System shall allow the CCTV System User to disable immediately any individual external video feed.	4.5.3 The CCTV System User needs to disable any or all public video feeds at will, such as during emergencies, security events or other events of a sensitive nature. 4.9.4 The CCTV System User needs to manually suspend an external video feed in real time for any reason.
3.1.4.1.5	The CCTV System shall allow the CCTV System User to disable immediately all external video feeds.	4.5.3 The CCTV System User needs to disable any or all public video feeds at will, such as during emergencies, security events or other events of a sensitive nature.
3.1.4.1.6	The CCTV System shall allow the CCTV System User to share video with other stakeholders outside of the region.	4.5.5 The CCTV System User needs to be able to share video streams/images with other stakeholders.
3.1.4.1.7	The CCTV System shall provide video streams/images to a regional video clearinghouse as configured by the CCTV System User.	4.5.6 The CCTV System User needs to be able to share video streams/images through a regional video clearinghouse.
3.1.4.1.8	The CCTV System shall provide video streams/images to a traveler information system as configured by the CCTV System User.	4.5.7 The CCTV System User needs to provide real-time video feeds to the traveler information system.
3.1.4.1.9	The CCTV System shall provide real-time incident video to the public/media for major arterials as configured by the CCTV System User.	4.5.8 The CCTV System User needs to provide real-time incident information to the public/media for major arterials.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.4.1.10	The CCTV System shall be configured by the CCTV System User to provide direct video to individual users of an External System.	4.5.9 The CCTV System User needs to configure the CCTV system for individual users of external system to which the video will be directed. (When there is no knowledge of an external system's users, it acts in the role of a CCTV System User. If it acts as an external system, it must provide the ability to reach its individual users to fulfill the requirements associated with this need.)
3.1.4.1.11	The CCTV System shall be configured by the CCTV System Manager to set the maximum number of simultaneous video feeds directed to a single user.	4.5.10 The CCTV System Manager needs to configure the maximum number of video feeds that can be simultaneously displayed by any one user.
3.1.4.1.12	The CCTV System shall allow the CCTV System User to direct video from non-camera sources to the video displays.	4.5.11 The CCTV System User needs to direct video from non-camera sources to video monitors managed by the system.
3.1.4.1.12.1	The CCTV System shall allow the CCTV System User to direct broadcast television programming to the CCTV System video displays.	4.5.11.1 The CCTV System User needs to direct broadcast television programming to video displays managed by the system.
3.1.4.1.12.2	The CCTV System shall allow the CCTV System User to direct externally supplied video streams to the CCTV System video displays.	4.5.11.2 The CCTV System User needs to direct externally supplied video streams to video displays managed by the system.
3.1.4.1.12.3	The CCTV System shall allow the CCTV System User to direct externally supplied base-band video signals to the CCTV System video displays.	4.5.11.3 The CCTV System User needs to display external base-band video. (Base-band video is an analog video signal.)
3.1.4.2	Relinquish Camera Control	4.7 Relinquishing CCTV Camera Control

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.4.2.1	The CCTV System shall allow the CCTV System User to relinquish control of the CCTV cameras.	4.7.1 The CCTV System User needs to relinquish control via the CCTV System.
3.1.4.2.1.1	The CCTV System shall allow the CCTV System User to manually relinquish control of a camera to make it available to other users.	4.7.1.1 The CCTV System User will need to manually relinquish control of a camera to make it available for other users.
3.1.4.2.1.2	The CCTV System shall allow the CCTV System User to configure a period of non-use after which the system will automatically relinquish control of a camera to make it available to other users.	4.7.1.2 The CCTV System User needs to relinquish control automatically after a period of non-use, which the user needs to configure.
3.1.5	CCTV Automatic Detection	4.8 CCTV Automatic Detection [Model document users must provide the expansion, and related requirements.]
3.1.5.1	The CCTV System shall automatically detect incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.1 The CCTV System User needs to provide automatic identification and notification of incidents on mainline lanes. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.
3.1.5.2	The CCTV System shall automatically identify incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.1 The CCTV System User needs to provide automatic identification and notification of incidents on mainline lanes. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.5.3	The CCTV System shall automatically notify the CCTV System User of incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.1 The CCTV System User needs to provide automatic identification and notification of incidents on mainline lanes. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.
3.1.5.4	The CCTV System shall automatically detect incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.2 The CCTV System User needs to provide automatic identification and notification of incidents on ramps. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.
3.1.5.5	The CCTV System shall automatically identify incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.2 The CCTV System User needs to provide automatic identification and notification of incidents on ramps. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing. 4.8.5 The CCTV System User needs the camera with a field of view that includes the detected incident to be automatically positioned for viewing the incident.
3.1.5.6	The CCTV System shall automatically notify the CCTV System User of incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.2 The CCTV System User needs to provide automatic identification and notification of incidents on ramps. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.5.7	The CCTV System shall automatically detect incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.3 The CCTV System User needs to provide automatic identification and notification of incidents on shoulders. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.
3.1.5.8	The CCTV System shall automatically identify incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.3 The CCTV System User needs to provide automatic identification and notification of incidents on shoulders. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.
3.1.5.9	The CCTV System shall automatically notify the CCTV System User of incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	4.8.3 The CCTV System User needs to provide automatic identification and notification of incidents on shoulders. Incidents include disabled vehicles, crashes, unplanned work zones, and other unplanned events that require viewing.
3.1.5.10	The CCTV System shall automatically detect wrong way vehicles.	4.8.4 The CCTV System User needs automatic identification and notification of wrong-way vehicles.
3.1.5.11	The CCTV System shall automatically identify wrong way vehicles.	4.8.4 The CCTV System User needs automatic identification and notification of wrong-way vehicles.
3.1.5.12	The CCTV System shall automatically notify the CCTV System User of wrong way vehicles.	4.8.4 The CCTV System User needs automatic identification and notification of wrong-way vehicles.
3.1.6	System Management	
3.1.6.1	Configuration	

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.1	The CCTV System shall allow the CCTV System User to configure which users have permission to configure the CCTV System.	4.2.1.1 The CCTV System Manager needs to configure user permissions for configuration.
3.1.6.1.2	The CCTV System shall allow the CCTV System User to configure which users have permission to view video.	4.2.1.2 The CCTV System Manager needs to configure user permissions for video viewing.
3.1.6.1.3	The CCTV System shall allow the CCTV System User to configure which users have permission to select a specified camera.	4.2.1.3 The CCTV System Manager needs to configure user permissions for camera selection.
3.1.6.1.4	The CCTV System shall allow the CCTV System User to configure which users have permission to control a specified camera.	4.2.1.4 The CCTV System Manager needs to configure user permissions for camera control.
3.1.6.1.5	The CCTV System shall accommodate [specify number of users] users accessing the CCTV System based on configuration parameters by the CCTV System User. [This requirement can be supplemented to define parameters such as types of users and corresponding bandwidth usage.]	4.2.2 The CCTV System Manager needs to accommodate [specify] users with access to the CCTV System. [This may be further defined by type of user and their bandwidth consumption.]
3.1.6.1.6	The CCTV System shall arbitrate competing requests for CCTV System resources based on configuration parameters by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.1	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on an ownership configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.2	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a priority configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.3	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a usage timeout configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.4	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a first come first served configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.5	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a [specify other] configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.6	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on an ownership configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.7	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a priority configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.8	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a usage timeout configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.9	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a first come first served configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.10	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a [specify other] configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.11	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on an ownership configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.12	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a priority configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.13	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a usage timeout configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.14	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a first come first served configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.15	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a [specify other] configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.16	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on an ownership configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.17	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a priority configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.18	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a usage timeout configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.19	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a first come first served configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.20	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a [specify other] configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.21	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on an ownership configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.22	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a priority configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.23	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a usage timeout configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.6.24	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a first come first served configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.6.25	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a [specify other] configuration parameter by the CCTV System User.	4.2.3 The CCTV System Manager needs to configure the system to arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other camera control user access issues. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: Camera ownership, last user control, first-come-first-served, etc.]
3.1.6.1.7	The CCTV System shall accept parameters for controlling the video performance of video streams supplied to external systems. (This control may be provided in the communications or digital video standard being supported.) [Specify the performance requirements for the external video streams]	4.2.4 The CCTV System Manager needs to configure the performance of video streams directed to external destinations based on the capabilities and limitations of the external system and communications. 4.5.1 The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the general public via internet sites.
3.1.6.1.8	The CCTV System shall accept configuration parameters that limit user-specified external video feeds to single-frame snapshots.	4.2.4 The CCTV System Manager needs to configure the performance of video streams directed to external destinations based on the capabilities and limitations of the external system and communications. 4.5.1 The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the general public via internet sites.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.1.9	The CCTV System shall accept configuration parameters that control the interval at which single-frame snapshots are sent to external video feeds configured to receive them.	4.2.4 The CCTV System Manager needs to configure the performance of video streams directed to external destinations based on the capabilities and limitations of the external system and communications. 4.5.1 The CCTV System User needs to create low bandwidth copies of CCTV video feeds and make them available to the general public via internet sites.
3.1.6.1.10	The CCTV System shall accept parameters for controlling the video performance of video streams supplied from external systems. (This control may be provided in the communications or digital video standard being supported.) [Specify the performance requirements for the external video streams]	4.5.11.2 The CCTV System User needs to direct externally supplied video streams to video displays managed by the system.
3.1.6.1.11	The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.	4.6.1 The CCTV System User needs to select displayed camera feeds of field devices to display on video monitors. 4.6.2 The CCTV System User needs to verify transportation asset operation using CCTV. 4.6.2.1 The CCTV System User needs to verify DMS status and message display. 4.6.2.2 The CCTV System User needs to verify roadway gates (e.g., HOV, HOT, Hurricane evacuation).

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
		4.6.2.3 The CCTV System User needs to verify ramp meter operation. 4.6.2.4 The CCTV System User needs to verify traffic signal operation. 4.6.2.5 The CCTV System User needs to verify toll plazas operation. 4.6.2.6 The CCTV System User needs to verify lane control signal operation. 4.6.2.7 The CCTV System User needs to verify variable speed limit sign operation. 4.6.2.8 The CCTV System User needs to verify operation of other general devices [specify others].
3.1.6.2	System Logging	4.10 CCTV System Logging
3.1.6.2.1	The CCTV System shall allow the CCTV System Maintainer to access and review the CCTV System log(s).	4.10.1 The CCTV System Maintainer needs to access and review the CCTV System log(s).
3.1.6.2.2	The CCTV System shall allow the CCTV System Maintainer to specify what CCTV System events [specify, events may be alarms, user actions, or diagnostic] are logged.	4.10.2 The CCTV System Maintainer needs to specify what CCTV System events are logged.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.2.3	The CCTV System shall allow the CCTV System Maintainer to specify the size of the CCTV System log(s).	4.10.3 The CCTV System Maintainer needs to specify the log size and/or duration for the CCTV System.
3.1.6.2.4	The CCTV System shall allow the CCTV System Maintainer to specify the length of time that entries in the CCTV System log(s) will be retained.	4.10.3 The CCTV System Maintainer needs to specify the log size and/or duration for the CCTV System.
3.1.6.2.5	The CCTV System shall allow the CCTV System Maintainer to configure diagnostic reports of logged information for a period of [specify] days. [Specify pre-configured reports that may be needed by the maintainer.]	4.10.4 The CCTV System Maintainer needs to access and review a history (log) of the following diagnostic information [specify] and alarms [specify] for a period of [specify] days.
3.1.6.3	Recorded Video	4.11 Recorded Video
3.1.6.3.1	The CCTV System shall allow the CCTV System User to record video for later use.	4.11.1 The CCTV System User needs to record video for later use.
3.1.6.3.2	The CCTV System shall allow the CCTV System User to initiate recording of a particular camera's video feed.	4.11.2 The CCTV System User needs to initiate recording of a particular camera's video feed.
3.1.6.3.2.1	The CCTV System shall allow the CCTV System User to schedule and set the start and duration of the video recording.	4.11.2.1 The CCTV System User needs to schedule and set the start and duration of the video recording.
3.1.6.3.2.2	The CCTV System shall allow the CCTV System User to initiate the recording based on a time of day schedule.	4.11.2.2 The CCTV System User may initiate the recording based on a configured time-of-day schedule.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.3.2.3	The CCTV System shall allow the CCTV System User to define a trigger condition at which the CCTV System will commence recording. [Specify the trigger condition(s)].	4.11.2.3 The CCTV System User may initiate the recording based on the presence of a defined condition [user must define these trigger conditions, which may include such events as detected incidents].
3.1.6.3.3	The CCTV System shall allow the CCTV System User to play back a particular camera's recorded video feed.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.1	The CCTV System shall allow the CCTV System User to initiate playback.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.2	The CCTV System shall allow the CCTV System User to pause the playback.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.3	The CCTV System shall allow the CCTV System User to advance the video playback at higher speed.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.4	The CCTV System shall allow the CCTV System User to reverse the video playback.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.5	The CCTV System shall allow the CCTV System User to reverse the video at higher speed.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.6	The CCTV System shall allow the CCTV System User to select a specific location in the video recording to commence playback.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.
3.1.6.3.3.7	The CCTV System shall allow the CCTV System User to record single-frame snapshots as separate images during video playback.	4.11.3 The CCTV System User needs to initiate playback of a particular camera's recorded video feed.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.6.3.4	The CCTV System shall allow the CCTV System User to route a particular camera's recorded video feed to any available video destination controlled by the system.	4.11.4 The CCTV System User needs to be able to distribute a particular camera's recorded video feed.
3.1.6.3.5	The CCTV System shall allow the CCTV System User to delete recordings of a particular camera's video feed.	4.11.5 The CCTV System User needs to delete recordings of a particular camera's recorded video feed.
3.1.6.3.5.1	The CCTV System shall require user confirmation when deleting a recorded video feed.	4.11.5 The CCTV System User needs to delete recordings of a particular camera's recorded video feed.
3.1.6.3.6	The CCTV System shall allow the CCTV System User to log all video recordings [specify location, camera, timestamp, duration, anything else].	4.11.6 The CCTV System User needs a log of all video recordings. [to include location, camera, timestamp, duration, and whatever else the user specifies]
3.1.6.3.7	The CCTV System shall allow the CCTV System User to apply retention rules to the recorded video. [Specify the retention rules, or reference the appropriate retention policy document.]	4.11.7 The CCTV System User needs to apply retention rules [must be defined by the user] to recorded video.
3.1.6.3.8	The CCTV System shall automatically delete videos in accordance with the retention rules specified by the CCTV System User.	4.11.8 The CCTV System User needs to automatically delete videos in accordance with retention rules.
3.1.6.3.9	The CCTV System shall allow the CCTV System User to mark video recordings for permanent storage.	4.11.9 The CCTV System User needs to mark recordings for permanent storage.
3.1.6.3.10	The CCTV System shall store the video recordings according to a specified compression algorithm. [Specify preferred standard compression algorithm(s)].	4.11.10 The CCTV System User needs to store the video efficiently. [Describe the preferred standard compression algorithm.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7	CCTV Camera Characteristics	4.12 CCTV Camera Characteristics
3.1.7.1	The CCTV System shall allow the CCTV System User to view images in reduced visibility conditions. [The CCTV System Designer will be expected to design features of cameras that fulfill these requirements, including heaters, wipers, infrared sensitivity, lighting, etc.]	4.12.1 The CCTV System User needs to view images in reduced visibility conditions.
3.1.7.1.1	The CCTV System shall allow the CCTV System User to view images at night.	4.12.1.1 The CCTV System User needs to view images at night.
3.1.7.1.2	The CCTV System shall allow the CCTV System User to view images in fog.	4.12.1.2 The CCTV System User needs to view images in fog.
3.1.7.1.3	The CCTV System shall allow the CCTV System User to view images in rain.	4.12.1.3 The CCTV System User needs to view images in rain.
3.1.7.1.4	The CCTV System shall allow the CCTV System User to view images in snow conditions.	4.12.1.4 The CCTV System User needs to view images in snow conditions.
3.1.7.1.5	The CCTV System shall allow the CCTV System User to view images in other reduced visibility conditions [specify conditions].	4.12.1.5 The CCTV System User needs to view images in other reduced visibility conditions [specify].
3.1.7.2	The CCTV System shall allow the CCTV System User to view clear, steady images.	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.2.1	The CCTV System shall provide a specified image quality.	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.1.1	The CCTV System shall support resolutions of [specify 480i, 480P, 720P, 1080P, 4K, etc.]	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.1.2	The CCTV System shall support frame rates of [specify].	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.1.3	The CCTV System shall support a color gamut of [specify, may be embodied in those SDTV and HDTV standards].	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.2.2	The CCTV System shall provide adequate bandwidth to accommodate [specify number] of CCTV System Users at a given time.	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.3	The CCTV System shall provide latency less than [specify] milliseconds. [This the time lag from reality to displayed image, and affects control lag. 100 ms is a typical value.]	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.4	The CCTV System shall provide camera mounting systems sufficiently rigid to provide steady images. (The designer will be required to specify, for the relevant location and camera lens focal length, the required rigidity.)	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.5	The CCTV System shall provide camera image stabilization.	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.2.6	The CCTV System shall provide camera optics with a zoom range that provides optical coverage that fulfills all the requirements included in this document. [Include one of the child requirements below]	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.6.1	The CCTV camera shall not use digital zoom.	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.6.2	The CCTV System shall provide digital zooming of the cameras [specify] beyond their optical zooming capability.	4.12.2 The CCTV System User needs to view steady, clear images. [Leads to requirements for bandwidth, latency, image reliability, pole stiffness, camera imaging standard, vibration reduction/image stabilization, digital zooming, etc.]
3.1.7.2.7	The CCTV System shall allow the CCTV System User to program camera presets to return to specified preset angle, zoom and focus [specify accuracy] when not under active CCTV System user control.	4.12.3 The CCTV System User needs to program cameras to return to preset angle, zoom and focus [at the needed specified accuracy] when not under active CCTV System User control.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.3	The CCTV System shall allow the CCTV System User to store information about each CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]
3.1.7.3.1	The CCTV System shall allow the CCTV System User to set and store the CCTV Owner information of the CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.3.2	The CCTV System shall allow the CCTV System User to store the unique identifier of the CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]
3.1.7.3.2	The CCTV System shall allow the CCTV System User to store the unique identifier of the CCTV camera.	4.14.2 The CCTV devices in a CCTV System need to be uniquely identifiable and locatable.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.3.3	The CCTV System shall allow the CCTV System User to set and store the CCTV Location information of the CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics] 4.14.2 • The CCTV devices in a CCTV System need to be uniquely identifiable and locatable.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.3.4	The CCTV System shall allow the CCTV System User to set and store the CCTV image rate characteristics information [specify still image, slow scan, streaming video (e.g., 30 fps, etc.) of the CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]
3.1.7.3.5	The CCTV System shall allow the CCTV System User to set and store the supported formats [specify JPEG, MPEG, etc. and protocols] for the CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.3.6	The CCTV System shall allow the CCTV System User to set and store the supported image size in pixels for the CCTV camera.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]
3.1.7.3.7	The CCTV System shall allow the CCTV System User to set and store the CCTV cameras' distribution policies [specify, not for public, on as needed basis, etc.].	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.7.3.8	The CCTV System shall allow the CCTV System User to set and store whether the CCTV camera is available for remote control.	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]
3.1.7.3.9	The CCTV System shall allow the CCTV System User to set and store other CCTV camera characteristics [specify].	4.12.4 The CCTV System User needs to store the following information in the CCTV System: • CCTV Owner • CCTV Unique Identifier • CCTV Location (physical, part of a corridor) • Image Rates (still image, slow scan, streaming video (e.g., 30 fps), etc.) • Available Formats (JPEG/MPEG, etc.)/Protocols • Image size in pixels • Distribution policies (e.g., not for public, on as needed basis, etc.) • CCTV available for remote control? • [Specify other camera characteristics]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.8	CCTV Camera Siting and Viewing	4.13 CCTV Camera Siting and Viewing
3.1.8.1	The CCTV System Designer shall locate CCTV cameras to provide [specify] coverage of segments of the transportation environment.	4.13.1 The CCTV System User needs to monitor segments of the transportation environment requiring multiple CCTV cameras.
3.1.8.1.1	The CCTV System Designer shall locate multiple CCTV cameras that view contiguous segments of roadway. [Specify roadway segments.]	4.13.1.1 The CCTV System User needs to view contiguous segments of roadway [This need should be addressed by the agency in preparing the plans, not necessarily as a requirement on the CCTV system vendor. Need to reconcile.].
3.1.8.1.2	The CCTV System Designer shall locate multiple CCTV cameras with overlapping CCTV camera coverage to prevent camera gaps resulting from a single camera failure. [Specify extent of required coverage area.]	4.13.1.2 The CCTV System User needs CCTV cameras with overlapping coverage to prevent coverage gap due to a single camera failure. [This need should be addressed by the agency in preparing the plans, not necessarily as a requirement on the CCTV system vendor. Need to reconcile. Leave a place for the agency to specify, with instructions for tailoring the related requirements.]
3.1.8.1.3	The CCTV System Designer shall determine CCTV camera placement based on other user requirements. [Specify other requirements.]	4.13.1.3 The CCTV System User needs to place cameras in specific locations. [Depending on whether we support just vendor requirements or also consultant design requirements, this need may replace all the others in this group].
3.1.8.1.4	The CCTV System Designer shall determine CCTV camera placement to allow the CCTV System User to monitor regular lanes.	4.13.1.4 The CCTV System User needs to monitor regular lanes.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.8.1.5	The CCTV System Designer shall determine CCTV camera placement to monitor express lanes.	4.13.1.5 The CCTV System User needs to monitor express lanes.
3.1.8.1.6	The CCTV System Designer shall determine CCTV camera placement to monitor reversible lanes.	4.13.1.6 The CCTV System User needs to monitor reversible lanes.
3.1.8.1.7	The CCTV System Designer shall determine CCTV camera placement to monitor shoulders and/or shoulder running lanes.	4.13.1.7 The CCTV System User needs to monitor shoulders and/or shoulder running lanes.
3.1.8.1.8	The CCTV System Designer shall determine CCTV camera placement to monitor freeways and arterials with [specify] allowable gaps.	4.13.1.8 The CCTV System User needs to monitor freeways and arterials with [specify] allowable gaps.
3.1.8.1.9	The CCTV System Designer shall determine CCTV camera placement for camera coverage of all lanes in both directions.	4.13.1.9 The CCTV System User needs camera coverage of all lanes in both directions.
3.1.8.1.10	The CCTV System Designer shall determine CCTV camera placement to monitor alternate route conditions during an incident.	4.13.1.10 The CCTV System User needs to monitor the condition of alternate routes during an incident.
3.1.8.1.11	The CCTV System Designer shall determine CCTV camera placement to monitor an interchange.	4.13.1.11 The CCTV System User needs to monitor an interchange.
3.1.8.1.12	The CCTV System Designer shall determine CCTV camera placement to monitor toll facilities.	4.13.1.12 The CCTV System User needs to monitor toll facilities.
3.1.8.1.13	The CCTV System Designer shall determine CCTV camera placement to monitor interchange merge areas.	4.13.1.13 The CCTV System User needs to monitor interchange merge areas.
3.1.8.1.14	The CCTV System Designer shall determine CCTV camera placement to monitor interchange diverge areas.	4.13.1.14 The CCTV System User needs to monitor interchange diverge areas.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.8.1.15	The CCTV System Designer shall determine CCTV camera placement to monitor interchange weave areas.	4.13.1.15 The CCTV System User needs to monitor interchange weave areas.
3.1.8.1.16	The CCTV System Designer shall determine CCTV camera placement to monitor events.	4.13.1.16 The CCTV System User needs to monitor events.
3.1.8.1.17	The CCTV System Designer shall determine CCTV camera placement to visually verify events.	4.13.1.17 The CCTV System User needs to visually verify events.
3.1.8.1.18	The CCTV System Designer shall determine CCTV camera placement to monitor for incidents.	4.13.1.18 The CCTV System User needs to monitor for incidents.
3.1.8.1.19	The CCTV System Designer shall determine CCTV camera placement to visually verify incidents.	4.13.1.19 The CCTV System User needs to visually verify incidents.
3.1.8.1.20	The CCTV System Designer shall determine CCTV camera placement to monitor bridges, including drawbridges.	4.13.1.20 The CCTV System User needs to monitor bridges, including drawbridges.
3.1.8.1.21	The CCTV System Designer shall determine CCTV camera placement to monitor tunnels.	4.13.1.21 The CCTV System User needs to monitor tunnels.
3.1.8.1.22	The CCTV System Designer shall determine CCTV camera placement to monitor for stalled vehicles in HOV lanes.	4.13.1.22 The CCTV System User needs to monitor for stalled vehicles in HOV lanes.
3.1.8.1.23	The CCTV System Designer shall determine CCTV camera placement to tour HOV lane CCTV cameras and determine lane clearance.	4.13.1.23 The CCTV System User needs to tour HOV lane cameras and determine lane clearance.
3.1.8.1.24	The CCTV System Designer shall determine CCTV camera placement to monitor HOT lane entry and exit points.	4.13.1.24 The CCTV System User needs to monitor HOT lane entry and exit points.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.8.1.25	The CCTV System Designer shall determine CCTV camera placement to monitor managed lanes.	4.13.1.25 The CCTV System User needs to monitor managed lanes.
3.1.8.1.26	The CCTV System Designer shall determine CCTV camera placement to monitor part-time shoulder use.	4.13.1.26 The CCTV System User needs to monitor part-time shoulder use.
3.1.8.1.27	The CCTV System Designer shall determine CCTV camera placement to monitor planned events.	4.13.1.27 The CCTV System User needs to monitor planned events.
3.1.8.1.28	The CCTV System Designer shall determine CCTV camera placement to monitor planned lane or interchange closures or diversions, including long-term construction, parades and festivals.	4.13.1.28 The CCTV System User needs to monitor planned lane or interchange closures or diversions, including long-term construction, parades and festivals.
3.1.8.1.29	The CCTV System Designer shall determine CCTV camera placement to detect and monitor traffic conditions due to unplanned events such as early school closures.	4.13.1.29 The CCTV System User needs to detect and monitor traffic conditions due to unplanned events such as early school closures.
3.1.8.1.30	The CCTV System Designer shall determine CCTV camera placement to observe and note overall traffic conditions on the arterial network.	4.13.1.30 The CCTV System User needs to observe and note overall traffic conditions on the arterial network.
3.1.8.1.31	The CCTV System Designer shall determine CCTV camera placement to observe the effectiveness [specify queuing, intersection blockage, traffic signal faults and excessive delays, etc.] of arterial signal timing.	4.13.1.31 The CCTV System User needs to observe the effectiveness of arterial signal timing. That effectiveness includes queuing, intersection blockage, traffic signal faults and excessive delays.
3.1.8.1.32	The CCTV System Designer shall determine CCTV camera placement to observe and monitor key 'high accident' locations.	4.13.1.32 The CCTV System User needs to observe and monitor key "high accident" locations.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.8.2	The CCTV System designer shall site the camera to accommodate maintenance activities. [Specify activities.]	4.13.2 The CCTV System Designer needs to have camera siting take into account maintenance needs. [specify]
3.1.8.2.1	The CCTV System camera siting shall accommodate parking a maintenance vehicle off the highway.	4.13.2 The CCTV System Designer needs to have camera siting take into account maintenance needs. [specify] 4.14.3 The CCTV System Maintainer needs to have safe access to CCTV locations for maintenance.
3.1.8.2.2	The CCTV System camera shall be mounted to provide access to a CCTV System maintainer without use of a bucket truck or person lift. (This may be accommodated by use of a lowering device or other access technology.)	4.13.2 The CCTV System Designer needs to have camera siting take into account maintenance needs. [specify] 4.14.3 The CCTV System Maintainer needs to have safe access to CCTV locations for maintenance.
3.1.8.2.3	The CCTV System camera siting shall take into account other constraints [specify].	4.13.2 The CCTV System Designer needs to have camera siting take into account maintenance needs. [specify]
3.1.8.3	Special Operational Viewing Requirements	4.13.3 Special Operational Viewing Needs
3.1.8.3.1	The CCTV System shall allow the CCTV System User to read HAZMAT placards.	4.13.3.1 The CCTV System User needs to read hazmat placards.
3.1.8.3.2	The CCTV System shall allow the CCTV System User to read license plates.	4.13.3.2 The CCTV System User needs to read license plates.
3.1.8.3.3	The CCTV System shall allow the CCTV System User to determine incident severity.	4.13.3.3 The CCTV System User needs to determine incident severity.
3.1.8.3.4	The CCTV System shall allow the CCTV System User to identify individuals.	4.13.3.4 The CCTV System User needs to identify individuals.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.8.4	The CCTV System shall allow the CCTV System User to view a minimum [specify number] of video feeds simultaneously.	4.13.4 The CCTV System User needs to view a minimum of [specify] video feeds at any one time.
3.1.8.5	The CCTV System shall allow the CCTV System User to manage a minimum [specify number] of cameras.	4.13.5 The CCTV System User needs to manage a minimum of [specify] cameras.
3.1.9	CCTV System Maintenance	4.14 CCTV System Maintenance
3.1.9.1	The CCTV System shall allow the CCTV System Maintainer to maintain CCTV System operations.	4.14.1 The CCTV System Maintainer needs to maintain CCTV System operations.
3.1.9.2	The CCTV System shall provide the CCTV System User with durable equipment [specify description of what durable equipment means].	4.14.1.1 The CCTV System User needs durable equipment. [Add descriptions of what this means]
3.1.9.3	The CCTV System Designer shall provide field equipment that complies with environmental standards.	4.14.1.2 The CCTV System User needs equipment designed for environmental conditions. Specify what this entails. [Description needs to include conditions under which the equipment will be operated. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus cameras.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.9.3.1	The CCTV System Field Equipment shall comply with NEMA TS1 temperature standards	4.14.1.2 The CCTV System User needs equipment designed for environmental conditions. Specify what this entails. [Description needs to include conditions under which the equipment will be operated. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus cameras.]
3.1.9.3.2	The CCTV System Field Equipment shall comply with ANSI/IEC 60529-2004 standards.	4.14.1.2 The CCTV System User needs equipment designed for environmental conditions. Specify what this entails. [Description needs to include conditions under which the equipment will be operated. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus cameras.]
3.1.9.3.3	The CCTV System Ground infrastructure shall be NEMA Type R (rainproof).	4.14.1.2 The CCTV System User needs equipment designed for environmental conditions. Specify what this entails. [Description needs to include conditions under which the equipment will be operated. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus cameras.]

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.9.3.4	The CCTV System Ground infrastructure shall be NEMA Type X (submersible).	4.14.1.2 The CCTV System User needs equipment designed for environmental conditions. Specify what this entails. [Description needs to include conditions under which the equipment will be operated. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus cameras.]
3.1.9.4	The CCTV System shall allow the CCTV System Users to monitor cameras from multiple locations.	4.14.1.3 The CCTV System User needs to monitor cameras from multiple locations.
3.1.9.5	The CCTV System shall provide the CCTV System Maintainer with serviceable field equipment.	4.14.1.4 The CCTV System Maintainer needs serviceable field equipment.
3.1.9.5.1	The CCTV System field equipment [specify] shall have a Mean Time Between Failure (MTBF) of [specify].	4.14.1.4 The CCTV System Maintainer needs serviceable field equipment.
3.1.9.5.2	The CCTV System field equipment [specify] shall have a Mean Time To Repair (MTTR) of [specify].	4.14.1.4 The CCTV System Maintainer needs serviceable field equipment.
3.1.9.6	The CCTV System shall have replacement parts [specify type and quantity] available through the CCTV System Owner to provide to the CCTV System Maintainer for the life of the system [specified period of time].	4.14.1.5 The CCTV System Maintainer needs to have access to replacement parts for the life of the system [specified period of time].
3.1.9.7	The CCTV System shall allow the CCTV System Maintainer to remotely test devices [specify] via IP protocol.	4.14.1.6 The CCTV System Maintainer needs to remotely test devices via IP protocol.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.9.8	The CCTV System shall allow the CCTV System Maintainer to access CCTV camera current diagnostic information.	4.14.1.7 The CCTV System Maintainer needs diagnostic information that the camera collects about itself at the direction of the Maintainer.
3.1.9.9	The CCTV System shall allow the CCTV System Maintainer to setup the following [specify, such as loss of communication, failure to zoom, focus, aperture control or temperatures outside the environmental limits] failure conditions to trigger alarms visible to the CCTV System User.	4.14.1.8 The CCTV System Maintainer needs the following failure conditions to trigger alarms visible to the CCTV System User. Failure conditions may include failure of zoom, focus, aperture control, or temperatures outside of environmental limits.
3.1.9.10	The CCTV System Provider shall provide the CCTV System Maintainer with remote updates of camera and PTZ controller firmware.	4.14.4 The CCTV System Maintainer needs to update camera and PTZ controller firmware remotely.
3.1.9.11	The CCTV System Provider shall provide the CCTV System Maintainer with remote updates of CCTV System software.	4.14.5 The CCTV System Maintainer needs to update CCTV system software remotely.
3.1.10	Constraints/External Interfaces	4.15 Interfaces
3.1.10.1	The CCTV System shall allow the CCTV System User to interface with cameras from different manufacturers within the same system, meeting the same user needs. [Specify the different products to be supported by this requirement.]	4.15.1 The CCTV System User needs to interface with cameras from different manufacturers within the same system, while satisfying all the user needs. [specify what cameras are being used]
3.1.10.2	The CCTV System shall support cameras from different manufacturers. [Specify manufacturers and products.]	4.15.2 The CCTV System Maintainer needs to replace cameras with cameras from different manufacturers.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.10.3	The CCTV System shall support ONVIF IP-based camera interface standards [specify].	4.15.3 The CCTV System Designer needs to adopt ONVIF IP-based camera interface standards, which may require coexisting with NTCIP-based interfaces on the same IP network.
3.1.10.4	The CCTV System shall support the coexistence of ONVIF IP-based camera interface standards and NTCIP-based interfaces on the same IP network.	4.15.3 The CCTV System Designer needs to adopt ONVIF IP-based camera interface standards, which may require coexisting with NTCIP-based interfaces on the same IP network.
3.1.10.5	The CCTV System shall allow the CCTV System Maintainer to integrate new cameras with an existing CCTV System [specify existing system interface and standards].	4.15.4 The CCTV System Designer needs to integrate new cameras with an existing CCTV System [specify existing system interface].
3.1.10.6	The CCTV System shall allow the CCTV System Maintainer to integrate with existing cameras. Existing cameras may include analog video feeds from an existing analog CCTV System [specify existing camera interfaces].	4.15.5 The CCTV System Designer needs to integrate a new CCTV System with existing cameras, which may include analog video feeds from an existing analog CCTV System. [specify existing camera interfaces].
3.1.10.7	The CCTV System shall accommodate existing communications interfaces [specify].	4.15.6 The CCTV System Designer needs to accommodate existing communications interfaces [specify].
3.1.10.8	The CCTV System shall accommodate agency IT policies [specify].	4.15.7 The CCTV System Designer needs to follow agency IT policies. [specify]
3.1.10.9	The CCTV System shall allow the CCTV System User to interface with an external system to identify incident locations and direct a camera with appropriate coverage area to the incident.	4.15.8 The CCTV System User needs to interface with an external system to identify incident locations and direct a camera with appropriate coverage area to the incident.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.10.10	The CCTV System shall allow the CCTV System User to interface with an external CCTV System to direct the display of video from the other system.	4.15.9 The CCTV System User needs to interface with external CCTV Systems to direct the display of video from the other system, to control the cameras on the other system, or to configure the other system.
3.1.10.11	The CCTV System shall allow the CCTV System User to interface with an external CCTV System to control the cameras on the other system.	4.15.9 The CCTV System User needs to interface with external CCTV Systems to direct the display of video from the other system, to control the cameras on the other system, or to configure the other system.
3.1.10.12	The CCTV System shall allow the CCTV System User to interface with an external CCTV System to configure the other system.	4.15.9 The CCTV System User needs to interface with external CCTV Systems to direct the display of video from the other system, to control the cameras on the other system, or to configure the other system.
3.1.10.13	The CCTV System shall allow external CCTV Systems to route video within the CCTV System.	4.15.10 The CCTV System User needs to interface with external CCTV Systems to allow the other system to direct the display of video, to control the cameras, or to configure the user's CCTV system.
3.1.10.14	The CCTV System shall allow external CCTV Systems to control the cameras on the CCTV System.	4.15.10 The CCTV System User needs to interface with external CCTV Systems to allow the other system to direct the display of video, to control the cameras, or to configure the user's CCTV system.

Requirements Document Reference Number	System Requirements Sample Statements	Need Statement (ConOps)
3.1.10.15	The CCTV System shall allow external CCTV Systems to configure the CCTV System.	4.15.10 The CCTV System User needs to interface with external CCTV Systems to allow the other system to direct the display of video, to control the cameras, or to configure the user's CCTV system.
3.1.10.16	The CCTV System shall interface with NTCIP system components [Specify], such as automatic camera selection or control, or automatic video feed display assignment. (The NTCIP components may have to coexist with ONVIF-based interfaces.)	4.15.11 The CCTV System User needs to interface with existing NTCIP system components [specify], such as for automatic camera selection or control, or automatic video feed display assignment. The NTCIP components may have to coexist with ONVIF-based interfaces.
3.1.11	CCTV System Performance	4.16 CCTV System Performance
3.1.11.1	The CCTV System shall accommodate [specify, this may be defined by bandwidth consumption per user] users at any one time.	4.16.1 The CCTV System Owner needs to accommodate [specify] users at any one time. (This may be defined by bandwidth consumption per user.)
3.1.11.2	The CCTV System shall accommodate [specify] number of users simultaneously controlling the CCTV System's cameras.	4.16.1 The CCTV System Owner needs to accommodate [specify] users at any one time. (This may be defined by bandwidth consumption per user.)

APPENDIX C: SUGGESTED REQUIREMENTS VERIFICATION METHODS

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.1	Access Control	
3.1.1.1	The CCTV System shall enforce access control of all users.	Demonstration
3.1.1.2	The CCTV System shall allow the CCTV System Manager to assign access control credentials to CCTV System Users.	Demonstration
3.1.1.3	The CCTV System shall allow the CCTV System Manager to assign access control credentials to CCTV System Maintainers.	Demonstration
3.1.1.4	The CCTV System shall allow the CCTV System Manager to assign access control credentials to External Systems.	Demonstration
3.1.1.5	The CCTV System shall allow the CCTV System Manager to receive distributed video.	Demonstration
3.1.1.6	The CCTV System shall allow the CCTV System Manager to select cameras.	Demonstration
3.1.1.7	The CCTV System shall allow the CCTV System Manager to control cameras.	Demonstration
3.1.1.8	The CCTV System shall allow the CCTV System Manager to control means for allowing video distribution.	Demonstration
3.1.1.9	The CCTV System shall allow the CCTV System User to receive distributed video.	Demonstration
3.1.1.10	The CCTV System shall allow the CCTV System User to select cameras.	Demonstration
3.1.1.11	The CCTV System shall allow the CCTV System User to control cameras.	Demonstration
3.1.1.12	The CCTV System shall allow the CCTV System User to control means for allowing video distribution.	Demonstration
3.1.1.13	The CCTV System shall allow the CCTV System Maintainer to receive distributed video.	Demonstration
3.1.1.14	The CCTV System shall allow the CCTV System Maintainer to select cameras.	Demonstration
3.1.1.15	The CCTV System shall allow the CCTV System Maintainer to control cameras.	Demonstration
3.1.1.16	The CCTV System shall allow the CCTV System Maintainer to control means for allowing video distribution.	Demonstration
3.1.1.17	The CCTV System shall allow the CCTV System Maintainer to run system diagnostics and testing.	Demonstration
3.1.1.18	The CCTV System shall allow the CCTV System Maintainer access for repairs.	Demonstration
3.1.1.19	The CCTV System shall allow an External System to receive distributed video.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.1.20	The CCTV System shall allow an External System to select cameras.	Demonstration
3.1.1.21	The CCTV System shall allow an External System to control cameras.	Demonstration
3.1.1.22	The CCTV System shall allow an External System to control means for allowing video distribution.	Demonstration
3.1.2	Camera Selection	
3.1.2.1	The CCTV System shall identify to the CCTV System User the closest camera(s) based on the location specified by the user.	Demonstration
3.1.2.2	The CCTV System shall allow the CCTV System User to view CCTV cameras available for viewing.	Demonstration
3.1.2.3	The CCTV System shall allow the CCTV System User to select a CCTV camera feed to be displayed on specified video monitors.	Demonstration
3.1.2.4	The CCTV System shall allow the CCTV System User to select a CCTV camera feed to be displayed on more than one video monitor.	Demonstration
3.1.2.5	The CCTV System shall allow the CCTV System User to view CCTV cameras available to be controlled.	Demonstration
3.1.3	Camera Control	
3.1.3.1	CCTV System Control	
3.1.3.1.1	The CCTV System shall allow a CCTV System User to control the camera being viewed. (If so configured by the CCTV System Manager).	Demonstration
3.1.3.1.1.1	The CCTV System shall allow a CCTV System User to rotate the camera about a vertical axis (pan the camera).	Demonstration
3.1.3.1.1.2	The CCTV System shall allow a CCTV System User to zoom the camera.	Demonstration
3.1.3.1.1.3	The CCTV System shall allow a CCTV System User to rotate the camera about a horizontal axis at right angles to the direction the camera is pointing (tilt the camera).	Demonstration
3.1.3.1.2	The CCTV System shall allow a CCTV System User to request control of a camera (If so configured by the CCTV System Manager).	Demonstration
3.1.3.1.3	The CCTV System shall allow a CCTV System User to reassign control of a camera to another user.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.3.1.4	The CCTV System shall allow the CCTV System User to configure individual camera presets [specify PTZ settings].	Demonstration
3.1.3.1.5	The CCTV System shall allow a CCTV System User to return a camera to a preset location. [Specify]	Demonstration
3.1.3.1.6	The CCTV System shall allow a CCTV System User to program a set of cameras to tour their coverage area. [Specify]	Demonstration
3.1.3.1.7	Verification of Field Device Status	
3.1.3.1.7.1	The CCTV System shall allow the CCTV System User to select a CCTV camera feed assigned to a field device to be displayed on specified video monitors.	Demonstration
3.1.3.1.7.2	The CCTV System shall allow the CCTV System User to select a CCTV camera feed verifying transportation asset operation to be displayed on specified video monitors.	Demonstration
3.1.3.1.7.3	The CCTV camera shall be equipped with a lens that provides the necessary coverage to view that field device without using digital zoom.	Demonstration
3.1.3.1.8	Relinquishing Control	
3.1.3.1.8.1	The CCTV System shall relinquish control upon CCTV System User command.	Demonstration
3.1.3.2	Remote Control	
3.1.3.2.1	The CCTV System shall allow an External System to request a change in the parameters of a CCTV camera.	Demonstration
3.1.3.2.1.1	The CCTV System shall allow an External System to request a change in the camera position parameters of a CCTV camera.	Demonstration
3.1.3.2.1.2	The CCTV System shall allow an External System to request a change in the parameters to view an event by a CCTV camera.	Demonstration
3.1.3.2.1.3	The CCTV System shall allow an External System to request a change in the parameters for viewing real-time traffic conditions by a CCTV camera.	Demonstration
3.1.3.2.1.4	The CCTV System shall allow an External System to request a change in the parameters for verifying an incident by a CCTV camera.	Demonstration
3.1.3.2.2	The CCTV System shall allow an External System to monitor cameras.	Demonstration
3.1.3.2.3	The CCTV System shall allow an External System to control cameras.	Demonstration
3.1.4	Video Stream Management	
3.1.4.1	Video Dissemination	

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.4.1.1	The CCTV System shall allow a CCTV System Manager to create low bandwidth [specify attributes] copies of video feeds.	Demonstration
3.1.4.1.2	The CCTV System shall make available the low bandwidth video feeds to the general public via internet sites.	Demonstration
3.1.4.1.3	The CCTV System shall make available the low bandwidth video feeds to a web server [specify interface requirements for web server] and Information Service Providers through a media feed.	Demonstration
3.1.4.1.4	The CCTV System shall allow the CCTV System User to disable immediately any or all public video feeds.	Demonstration
3.1.4.1.5	The CCTV System shall allow the CCTV System User to disable immediately all external video feeds.	Demonstration
3.1.4.1.6	The CCTV System shall allow the CCTV System User to share video with other stakeholders outside of the region.	Demonstration
3.1.4.1.7	The CCTV System shall provide video streams/images to a regional video clearinghouse as configured by the CCTV System User.	Demonstration
3.1.4.1.8	The CCTV System shall provide video streams/images to a traveler information system as configured by the CCTV System User.	Demonstration
3.1.4.1.9	The CCTV System shall provide real-time incident video to the public/media for major arterials as configured by the CCTV System User.	Demonstration
3.1.4.1.10	The CCTV System shall be configured by the CCTV System User to provide direct video to individual users of an External System.	Demonstration
3.1.4.1.11	The CCTV System shall be configured by the CCTV System User to set the maximum number of simultaneous video feeds directed to a single user.	Demonstration
3.1.4.1.12	The CCTV System shall allow the CCTV System User to direct video from non-camera sources to the video displays.	Demonstration
3.1.4.1.12.1	The CCTV System shall allow the CCTV System User to direct broadcast television programming to the CCTV System video displays.	Demonstration
3.1.4.1.12.2	The CCTV System shall allow the CCTV System User to direct externally supplied video streams to the CCTV System video displays.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.4.1.12.3	The CCTV System shall allow the CCTV System User to direct externally supplied base-band video signals to the CCTV System video displays.	Demonstration
3.1.4.2	Relinquishing CCTV Monitoring	
3.1.4.2.1	The CCTV System shall allow the CCTV System User to relinquish monitoring by the CCTV cameras.	Demonstration
3.1.4.2.1.1	The CCTV System shall allow the CCTV System User to manually relinquish control of a camera to make it available to other users.	Demonstration
3.1.4.2.1.2	The CCTV System shall allow the CCTV System User to configure a period of non-use after which the system will automatically relinquish control of a camera to make it available to other users.	Demonstration
3.1.5	CCTV Automatic Detection	
3.1.5.1	The CCTV System shall automatically detect incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.2	The CCTV System shall automatically identify incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.3	The CCTV System shall automatically notify the CCTV System User of incidents on mainline lanes. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.4	The CCTV System shall automatically detect incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.5	The CCTV System shall automatically identify incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.6	The CCTV System shall automatically notify the CCTV System User of incidents on ramps. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.5.7	The CCTV System shall automatically detect incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.8	The CCTV System shall automatically identify incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.9	The CCTV System shall automatically notify the CCTV System User of incidents on shoulders. Incident identification includes disabled vehicles, crashes, unplanned work zones and other unplanned events requiring viewing.	Demonstration
3.1.5.10	The CCTV System shall automatically detect wrong way vehicles.	Demonstration
3.1.5.11	The CCTV System shall automatically identify wrong way vehicles.	Demonstration
3.1.5.12	The CCTV System shall automatically notify the CCTV System User of wrong way vehicles.	Demonstration
3.1.5.5	The CCTV System shall automatically position the field of view camera to the detected incident for viewing.	Demonstration
3.1.6	System Management	
3.1.6.1	Configuration	
3.1.6.1.1	The CCTV System shall allow the CCTV System User to configure which users have permission to configure the CCTV System.	Demonstration
3.1.6.1.2	The CCTV System shall allow the CCTV System User to configure which users have permission to view video.	Demonstration
3.1.6.1.3	The CCTV System shall allow the CCTV System User to configure which users have permission to select a specified camera.	Demonstration
3.1.6.1.4	The CCTV System shall allow the CCTV System User to configure which users have permission to control a specified camera.	Demonstration
3.1.6.1.5	The CCTV System shall accommodate [specify number of users] users accessing the CCTV System based on configuration parameters by the CCTV System User. This requirement can be supplanted to define parameters such as types of users and corresponding bandwidth usage.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.6.1.6	The CCTV System shall arbitrate competing requests for CCTV System resources based on configuration parameters by the CCTV System User.	Demonstration
3.1.6.1.6.1	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on an ownership configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.2	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a priority configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.3	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a usage timeout configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.4	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a first come first served configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.5	The CCTV System shall arbitrate competing requests for CCTV System resources for camera available for viewing based on a [specify other] configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.6	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on an ownership configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.7	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a priority configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.8	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a usage timeout configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.9	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a first come first served configuration parameter by the CCTV System User.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.6.1.6.10	The CCTV System shall arbitrate competing requests for CCTV System resources for camera control based on a [specify other] configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.11	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on an ownership configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.12	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a priority configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.13	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a usage timeout configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.14	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a first come first served configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.15	The CCTV System shall arbitrate competing requests for CCTV System resources for display monitor availability based on a [specify other] configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.16	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on an ownership configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.17	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a priority configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.18	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a usage timeout configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.19	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a first come first served configuration parameter by the CCTV System User.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.6.1.6.20	The CCTV System shall arbitrate competing requests for CCTV System resources for communications based on a [specify other] configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.21	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on an ownership configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.22	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a priority configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.23	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a usage timeout configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.24	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a first come first served configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.6.25	The CCTV System shall arbitrate competing requests for CCTV System resources for [specify other] based on a [specify other] configuration parameter by the CCTV System User.	Demonstration
3.1.6.1.7	The CCTV System shall accept parameters for controlling the video performance of video streams supplied to external systems. (This control may be provided in the communications or digital video standard being supported.) [Specify the performance requirements for the external video streams]	Demonstration
3.1.6.1.8	The CCTV System shall accept configuration parameters that limit user-specified external video feeds to single-frame snapshots.	Demonstration
3.1.6.1.9	The CCTV System shall accept configuration parameters that control the interval at which single-frame snapshots are sent to external video feeds configured to receive them.	Demonstration
3.1.6.1.10	The CCTV System shall accept configuration parameters that control the interval at which single-frame snapshots are sent from external video feeds configured to receive them.	Demonstration
3.1.6.1.11	The CCTV System shall allow the CCTV System User to assign specific cameras to specific field devices that may need monitoring, such as DMS, roadway gates, ramp meters, traffic signals, toll plazas, lane control signals, variable speed limit signs, etc.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.6.2	System Logging	
3.1.6.2.1	The CCTV System shall allow the CCTV System Maintainer to access and review the CCTV System log(s).	Demonstration
3.1.6.2.2	The CCTV System shall allow the CCTV System Maintainer to specify what CCTV System events [specify, events may be alarms, user actions, or diagnostic] are logged.	Demonstration
3.1.6.2.3	The CCTV System shall allow the CCTV System Maintainer to specify the size of the CCTV System log(s).	Demonstration
3.1.6.2.4	The CCTV System shall allow the CCTV System Maintainer to specify the time duration of the CCTV System log(s).	Demonstration
3.1.6.2.5	The CCTV System shall allow the CCTV System Maintainer to access and review the system log of the following diagnostic information [specify] and alarms [specify] for a period of [specify] days. [Specify pre-configured reports that may be needed by the maintainer.]	Demonstration
3.1.6.3	Recorded Video	
3.1.6.3.1	The CCTV System shall allow the CCTV System User to record video for later use.	Demonstration
3.1.6.3.2	The CCTV System shall allow the CCTV System User to initiate recording of a particular camera's video feed.	Demonstration
3.1.6.3.2.1	The CCTV System shall allow the CCTV System User to schedule and set the start and duration of the video recording.	Demonstration
3.1.6.3.2.2	The CCTV System shall allow the CCTV System User to initiate the recording based on a time of day schedule.	Demonstration
3.1.6.3.2.3	The CCTV System shall allow the CCTV System User to define a trigger condition at which the CCTV System will commence recording. [Specify the trigger condition(s)].	Demonstration
3.1.6.3.3	The CCTV System shall allow the CCTV System User to play back a particular camera's recorded video feed.	Demonstration
3.1.6.3.3.1	The CCTV System shall allow the CCTV System User to initiate playback.	Demonstration
3.1.6.3.3.2	The CCTV System shall allow the CCTV System User to pause the playback.	Demonstration
3.1.6.3.3.3	The CCTV System shall allow the CCTV System User to advance the video playback at higher speed.	Demonstration
3.1.6.3.3.4	The CCTV System shall allow the CCTV System User to reverse the video playback.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.6.3.3.5	The CCTV System shall allow the CCTV System User to reverse the video at higher speed.	Demonstration
3.1.6.3.3.6	The CCTV System shall allow the CCTV System User to select a specific location in the video recording to commence playback.	Demonstration
3.1.6.3.3.7	The CCTV System shall allow the CCTV System User to record single-frame snapshots as separate images during video playback.	Demonstration
3.1.6.3.4	The CCTV System shall allow the CCTV System User to distribute or redirect a particular camera's recorded video feed.	Demonstration
3.1.6.3.5	The CCTV System shall allow the CCTV System User to delete recordings of a particular camera's video feed.	Demonstration
3.1.6.3.6	The CCTV System shall allow the CCTV System User to log all video recordings [specify location, camera, timestamp, duration, anything else].	Demonstration
3.1.6.3.7	The CCTV System shall allow the CCTV System User to apply retention rules [specify] to the recorded video.	Demonstration
3.1.6.3.8	The CCTV System shall automatically delete videos in accordance with the retention rules specified by the CCTV System User.	Demonstration
3.1.6.3.9	The CCTV System shall allow the CCTV System User to mark video recordings for permanent storage.	Demonstration
3.1.6.3.10	The CCTV System shall store the video recordings according to a specified compression algorithm. [Specify preferred standard compression algorithm(s)].	Demonstration
3.1.7	CCTV Camera Characteristics	
3.1.7.1	The CCTV System shall allow the CCTV System User to view images in reduced visibility conditions. [The CCTV System Designer will be expected to design features of cameras that fulfill these requirements, including heaters, wipers, infrared sensitivity, lighting, etc.]	Demonstration
3.1.7.1.1	The CCTV System shall allow the CCTV System User to view images at night.	Demonstration
3.1.7.1.2	The CCTV System shall allow the CCTV System User to view images in fog.	Demonstration
3.1.7.1.3	The CCTV System shall allow the CCTV System User to view images in rain.	Demonstration
3.1.7.1.4	The CCTV System shall allow the CCTV System User to view images in snow conditions.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.7.1.5	The CCTV System shall allow the CCTV System User to view images in other reduced visibility conditions [specify conditions].	Demonstration
3.1.7.2	The CCTV System shall allow the CCTV System User to view clear, steady images.	Demonstration
3.1.7.2.1	The CCTV System shall implement camera imaging standard(s) [specify].	Inspection
3.1.7.2.1.1	The CCTV System shall support resolutions of [specify 480i, 480P, 720P, 1080P, 4K, etc.].	Demonstration
3.1.7.2.1.2	The CCTV System shall support frame rates of [specify].	Demonstration
3.1.7.2.1.3	The CCTV System shall support a color gamut of [specify, may be embodied in those SDTV and HDTV standards].	Demonstration
3.1.7.2.2	The CCTV System shall provide adequate communication bandwidth [specify] in order for the CCTV System to provide a level of service [specify] to a [specify number] of CCTV System Users at a given time.	Demonstration
3.1.7.2.3	The CCTV System shall provide latency less than [specify] in order for the CCTV System to provide a level of service [specify] to a [specify number] of CCTV System Users at a given time.	Test
3.1.7.2.4	The CCTV System shall provide camera infrastructure [specify, pole stiffness, etc.] in order for the CCTV System to provide steady, clear images.	Analysis
3.1.7.2.5	The CCTV System shall provide camera image stabilization.	Demonstration
3.1.7.2.6	The CCTV System shall provide camera optics with a zoom range that provides optical coverage that fulfills all the requirements included in this document. [Include one of the child requirements below]	Demonstration
3.1.7.2.6.1	The CCTV camera shall not use digital zoom.	Demonstration
3.1.7.2.6.2	The CCTV System shall provide digital zooming of the cameras [specify] beyond their optical zooming capability.	Demonstration
3.1.7.2.7	The CCTV System shall allow the CCTV System User to program camera presets to return to specified preset angle, zoom and focus [specify accuracy] when not under active CCTV System user control.	Demonstration
3.1.7.3	The CCTV System shall allow the CCTV System User to store information about each CCTV camera.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.7.3.1	The CCTV System shall allow the CCTV System User to set and store the CCTV Owner information of the CCTV camera.	Demonstration
3.1.7.3.2	The CCTV System shall allow the CCTV System User to store the unique identifier of the CCTV camera.	Demonstration
3.1.7.3.3	The CCTV System shall allow the CCTV System User to set and store the CCTV Location information of the CCTV camera.	Demonstration
3.1.7.3.4	The CCTV System shall allow the CCTV System User to set and store the CCTV image rate characteristics information [specify still image, slow scan, streaming video (e.g., 30 fps, etc.)] of the CCTV camera.	Demonstration
3.1.7.3.5	The CCTV System shall allow the CCTV System User to set and store the supported formats [specify JPEG, MPEG, etc. and protocols] for the CCTV camera.	Demonstration
3.1.7.3.6	The CCTV System shall allow the CCTV System User to set and store the supported image size in pixels for the CCTV camera.	Demonstration
3.1.7.3.7	The CCTV System shall allow the CCTV System User to set and store the CCTV cameras' distribution policies [specify, not for public, on as needed basis, etc.].	Demonstration
3.1.7.3.8	The CCTV System shall allow the CCTV System User to set and store whether the CCTV camera is available for remote control.	Demonstration
3.1.7.3.9	The CCTV System shall allow the CCTV System User to set and store other CCTV camera characteristics [specify].	Demonstration
3.1.8	CCTV Camera Siting and Viewing	
3.1.8.1	The CCTV System Designer shall locate CCTV cameras to provide [specify] coverage of segments of the transportation environment.	Inspection/Analysis
3.1.8.1.1	The CCTV System Designer shall locate multiple CCTV cameras [specify locations] that view contiguous segments of roadway [specify locations].	Inspection/Analysis
3.1.8.1.2	The CCTV System Designer shall locate multiple CCTV cameras [specify locations] with overlapping CCTV camera coverage [specify locations] to prevent camera gaps resulting from a single camera failure.	Inspection/Analysis
3.1.8.1.3	The CCTV System Designer shall determine CCTV camera placement [specify locations] based on [specify] other user requirements.	Inspection/Analysis

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.8.1.4	The CCTV System Designer shall determine CCTV camera placement to allow the CCTV System User to monitor regular lanes.	Inspection/Analysis
3.1.8.1.5	The CCTV System Designer shall determine CCTV camera placement to monitor express lanes.	Inspection/Analysis
3.1.8.1.6	The CCTV System Designer shall determine CCTV camera placement to monitor reversible lanes.	Inspection/Analysis
3.1.8.1.7	The CCTV System Designer shall determine CCTV camera placement to monitor shoulders and/or shoulder running lanes.	Inspection/Analysis
3.1.8.1.8	The CCTV System Designer shall determine CCTV camera placement to monitor freeways and arterials with [specify] allowable gaps.	Inspection/Analysis
3.1.8.1.9	The CCTV System Designer shall determine CCTV camera placement for camera coverage of all lanes in both directions.	Inspection/Analysis
3.1.8.1.10	The CCTV System Designer shall determine CCTV camera placement to monitor alternate route conditions during an incident.	Inspection/Analysis
3.1.8.1.11	The CCTV System Designer shall determine CCTV camera placement to monitor an interchange.	Inspection/Analysis
3.1.8.1.12	The CCTV System Designer shall determine CCTV camera placement to monitor toll facilities.	Inspection/Analysis
3.1.8.1.13	The CCTV System Designer shall determine CCTV camera placement to monitor interchange merge areas.	Inspection/Analysis
3.1.8.1.14	The CCTV System Designer shall determine CCTV camera placement to monitor interchange diverge areas.	Inspection/Analysis
3.1.8.1.15	The CCTV System Designer shall determine CCTV camera placement to monitor interchange weave areas.	Inspection/Analysis
3.1.8.1.16	The CCTV System Designer shall determine CCTV camera placement to monitor events.	Inspection/Analysis
3.1.8.1.17	The CCTV System Designer shall determine CCTV camera placement to visually verify events.	Inspection/Analysis
3.1.8.1.18	The CCTV System Designer shall determine CCTV camera placement to monitor for incidents.	Inspection/Analysis

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.8.1.19	The CCTV System Designer shall determine CCTV camera placement to visually verify incidents.	Inspection/Analysis
3.1.8.1.20	The CCTV System Designer shall determine CCTV camera placement to monitor bridges, including drawbridges.	Inspection/Analysis
3.1.8.1.21	The CCTV System Designer shall determine CCTV camera placement to monitor tunnels.	Inspection/Analysis
3.1.8.1.22	The CCTV System Designer shall determine CCTV camera placement to monitor for stalled vehicles in HOV lanes.	Inspection/Analysis
3.1.8.1.23	The CCTV System Designer shall determine CCTV camera placement to tour HOV lane CCTV cameras and determine lane clearance.	Inspection/Analysis
3.1.8.1.24	The CCTV System Designer shall determine CCTV camera placement to monitor HOT lane entry and exit points.	Inspection/Analysis
3.1.8.1.25	The CCTV System Designer shall determine CCTV camera placement to monitor managed lanes.	Inspection/Analysis
3.1.8.1.26	The CCTV System Designer shall determine CCTV camera placement to monitor part-time shoulder use.	Inspection/Analysis
3.1.8.1.27	The CCTV System Designer shall determine CCTV camera placement to monitor planned events.	Inspection/Analysis
3.1.8.1.28	The CCTV System Designer shall determine CCTV camera placement to monitor planned lane or interchange closures or diversions, including long-term construction, parades and festivals.	Inspection/Analysis
3.1.8.1.29	The CCTV System Designer shall determine CCTV camera placement to detect and monitor traffic conditions due to unplanned events such as early school closures.	Inspection/Analysis
3.1.8.1.30	The CCTV System Designer shall determine CCTV camera placement to observe and note overall traffic conditions on the arterial network.	Inspection/Analysis
3.1.8.1.31	The CCTV System Designer shall determine CCTV camera placement to observe the effectiveness [specify queuing, intersection blockage, traffic signal faults and excessive delays, etc.] of arterial signal timing.	Inspection/Analysis
3.1.8.1.32	The CCTV System Designer shall determine CCTV camera placement to observe and monitor key “high accident” locations.	Inspection/Analysis

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.8.2	The CCTV System camera siting shall take into account maintenance activities [specify] as specified by the CCTV System Designer	Demonstration
3.1.8.2.1	The CCTV System camera siting shall take into account being able to park a maintenance vehicle off the highway.	Demonstration
3.1.8.2.2	The CCTV System camera siting shall take into account being able to access camera equipment without needing a bucket truck or person lift [specify requirements for a camera lowering device or other design solution].	Demonstration
3.1.8.2.3	The CCTV System camera siting shall take into account other constraints [specify].	Demonstration
3.1.8.3	Special Operational Viewing Requirements	
3.1.8.3.1	The CCTV System shall allow the CCTV System User to read HAZMAT placards.	Demonstration
3.1.8.3.2	The CCTV System shall allow the CCTV System User to read license plates.	Demonstration
3.1.8.3.3	The CCTV System shall allow the CCTV System User to determine incident severity.	Demonstration
3.1.8.3.4	The CCTV System shall allow the CCTV System User to identify individuals.	Demonstration
3.1.8.4	The CCTV System shall allow the CCTV System User to view a minimum [specify number] of video feeds simultaneously.	Demonstration
3.1.8.5	The CCTV System shall allow the CCTV System User to manage a minimum [specify number] of cameras.	Demonstration
3.1.9	CCTV System Maintenance	
3.1.9.1	The CCTV System shall allow the CCTV System Maintainer to maintain CCTV System operations.	Demonstration
3.1.9.2	The CCTV System shall provide the CCTV System User with durable equipment [specify description of what durable equipment means].	Inspection/Analysis
3.1.9.3	The CCTV System Designer shall provide field equipment that complies with environmental standards.	Inspection/Analysis
3.1.9.3.1	The CCTV System Field Equipment shall comply with NEMA TS1 temperature standards	Inspection/Analysis
3.1.9.3.2	The CCTV System Field Equipment shall comply with ANSI/IEC 60529-2004 standards.	Inspection/Analysis
3.1.9.3.3	The CCTV System Ground infrastructure shall be NEMA Type R (rainproof).	Inspection/Analysis
3.1.9.3.4	The CCTV System Ground infrastructure shall be NEMA Type X (submersible).	Inspection/Analysis
3.1.9.4	The CCTV System shall allow the CCTV System Users to monitor cameras from multiple locations.	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.9.5	The CCTV System shall provide the CCTV System Maintainer with serviceable field equipment.	Demonstration
3.1.9.5.1	The CCTV System field equipment [specify] shall have a Mean Time Between Failure (MTBF) of [specify].	Analysis
3.1.9.5.2	The CCTV System field equipment [specify] shall have a Mean Time To Repair (MTTR) of [specify].	Analysis
3.1.9.6	The CCTV System shall have replacement parts [specify type and quantity] available through the CCTV System Owner to provide to the CCTV System Maintainer for the life of the system [specified period of time].	Inspection/Analysis
3.1.9.7	The CCTV System shall allow the CCTV System Maintainer to remotely test devices [specify] via IP protocol.	Demonstration
3.1.9.8	The CCTV System shall allow the CCTV System Maintainer to access CCTV camera current diagnostic information.	Demonstration
3.1.9.9	The CCTV System shall allow the CCTV System Maintainer to setup the following [specify, such as loss of communication, failure to zoom, focus, aperture control or temperatures outside the environmental limits] failure conditions to trigger alarms visible to the CCTV System User.	Demonstration
3.1.9.10	The CCTV System Provider shall provide the CCTV System Maintainer with remote updates of camera and PTZ controller firmware.	Demonstration
3.1.9.11	The CCTV System Provider shall provide the CCTV System Maintainer with remote updates of CCTV System software.	Demonstration
3.1.10	Constraints/External Interfaces	
3.1.10.1	The CCTV System shall allow the CCTV System User to interface with cameras [specify] from different manufacturers within the same system, meeting the same user needs.	Demonstration
3.1.10.2	The CCTV System shall be designed by the CCTV System Designer to support replacing cameras from different manufacturers.	Demonstration
3.1.10.3	The CCTV System shall support the adoption of ONVIF IP-based camera interface standards [specify].	Demonstration
3.1.10.4	The CCTV System shall support the coexistence of ONVIF IP-based camera interface standards and NTCIP-based interfaces on the same IP network [specify].	Demonstration

Requirements Reference	Requirements Statements	Verification Method (Suggested)
3.1.10.5	The CCTV System shall allow the CCTV System Maintainer to integrate new cameras with an existing CCTV System [specify existing system interface and standards].	Demonstration
3.1.10.6	The CCTV System shall allow the CCTV System Maintainer to integrate with existing cameras, which may include analog video feeds from an existing analog CCTV System [specify existing camera interfaces].	Demonstration
3.1.10.7	The CCTV System shall accommodate existing communications interfaces [specify].	Demonstration
3.1.10.8	The CCTV System shall accommodate agency IT policies [specify].	Demonstration
3.1.10.9	The CCTV System shall allow the CCTV System User to interface with an external system to identify incident locations and direct a camera with appropriate cover area to the incident.	Demonstration
3.1.10.10	The CCTV System shall allow the CCTV System User to interface with an external CCTV System to direct the display of video from the other system.	Demonstration
3.1.10.11	The CCTV System shall allow the CCTV System User to interface with an external CCTV System to control the cameras on the other system.	Demonstration
3.1.10.12	The CCTV System shall allow the CCTV System User to interface with an external CCTV System to configure the other system.	Demonstration
3.1.10.13	The CCTV System shall allow external CCTV Systems to direct the display of video for the CCTV System.	Demonstration
3.1.10.14	The CCTV System shall allow external CCTV Systems to control the cameras on the CCTV System.	Demonstration
3.1.10.15	The CCTV System shall allow external CCTV Systems to configure the CCTV System.	Demonstration
3.1.10.16	The CCTV System shall interface with NTCIP system components [specify], such as automatic camera selection or control, or automatic video feed display assignment. The NTCIP components may have to coexist with ONVIF-based interfaces.	Demonstration
3.1.11	CCTV System Performance	
3.1.11.1	The CCTV System shall accommodate [specify, this may be defined by bandwidth consumption per user] users at any one time.	Demonstration
3.1.11.2	The CCTV System shall accommodate [specify] number of users simultaneously controlling the CCTV System's cameras.	Demonstration

APPENDIX D: VERIFICATION PLAN SAMPLE CASES

Case Number	Case Name	Case Description	High-Level Requirement Number	High-Level Requirement
1	Access Control	This verification case will test the access control requirements of the CCTV system. Requirements include the CCTV System Manager assigning access control to the other user roles as well as the CCTV System allowing the various users to receive distributed video, select cameras, control cameras and controlling video distribution. The requirements also cover the CCTV System Maintainer running diagnostics and testing and allowing External Systems to also receive distributed video, select cameras, control cameras and controlling video distribution. The CCTV System user access control capabilities will be verified in accordance with their corresponding requirements. For the most part, no additional hardware or software besides the CCTV System itself is envisioned to accomplish this verification test, however the interfacing External Systems will be needed to verify the requirements involving the External Systems.	3.1.1	Access Control
2	Camera Selection	This verification case will test the camera selection requirements of the CCTV system. Requirements include the CCTV System identifying available cameras for control and/or viewing and within a particular range for viewing as well as displaying the camera feed on one or more video monitors.	3.1.2	Camera Selection

Case Number	Case Name	Case Description	High-Level Requirement Number	High-Level Requirement
3	Camera Control	This verification case will test the camera control requirements of the CCTV system. Requirements include the CCTV System allowing the CCTV System User to control a camera as well as allowing an External System to remotely control a camera.	3.1.3	Camera Control
4	Video Stream Management	This verification case will test the camera video stream management requirements of the CCTV system. Requirements include the CCTV System allowing the CCTV System Manager and CCTV System User in their various roles to disseminate video in different resolutions as well as relinquish CCTV monitoring.	3.1.4	Video Stream Management
5	CCTV Automatic Detection	This verification case will test the automatic detection requirements of the CCTV system. Requirements include the CCTV System automatically detecting incidents, wrong way vehicles and automatic positioning of the detection camera.	3.1.5	CCTV Automatic Detection
6	System Configuration	This verification case will test the system configuration requirements of the CCTV system. Requirements include the CCTV System allowing CCTV System Operator configuration of the CCTV System as well as arbitration and configuration of the parameters for video feeds.	3.1.6.1	Configuration
7	System logging	This verification case will test the system logging requirements of the CCTV system. Requirements include the CCTV System allowing the CCTV System Maintainer to specify what is logged by the CCTV System as well as access of the log.	3.1.6.2	System Logging

Case Number	Case Name	Case Description	High-Level Requirement Number	High-Level Requirement
8	Recorded Video	This verification case will test the video recording requirements of the CCTV system. Requirements include the CCTV System allowing the CCTV System User to record video of a specified camera's video feed, perform recorded video playback controls, distribution of recorded video, deletion of recorded video, logging of all video recordings, specifying retention rules for storage of recorded video. In addition, this verification test case includes testing CCTV System compression of data for video recording storage.	3.1.6.3	Recorded Video
9	CCTV Camera Characteristics	This verification case will test the CCTV camera characteristics requirements of the CCTV system. Requirements include the CCTV System providing camera images to the CCTV System User in reduced visibility conditions. This verification test case tests whether the CCTV System is providing CCTV System Users clear, steady images imposing communications bandwidth, camera infrastructure, camera image stabilization, camera optics and camera preset requirements. Additional requirements to be test by this case include the CCTV System User storing camera characteristic information about each camera in the CCTV System.	3.1.7	CCTV Camera Characteristics

Case Number	Case Name	Case Description	High-Level Requirement Number	High-Level Requirement
10	CCTV Camera Siting and Viewing	This verification case will test the CCTV camera siting and viewing requirements of the CCTV system. Requirements include how the CCTV Designer located CCTV cameras to provide coverage of the transportation environment and took into account CCTV camera operations and maintenance activities. Additional requirements include how many CCTV System video feeds can be simultaneously viewed and managed by the CCTV System User.	3.1.8	CCTV Camera Siting and Viewing
11	CCTV System Maintenance	This verification case will test the CCTV System maintenance requirements. Requirements include how the CCTV Maintainer will maintain CCTV System operations, the durability of the CCTV System equipment, field equipment that complies with environmental standards, allowing CCTV System Users to monitor the cameras from multiple locations, the serviceability of the CCTV System field equipment, availability of serviceable parts, ability of the CCTV System Maintainer to remotely test devices, ability of the CCTV System Maintainer to access CCTV camera diagnostic information, ability of the CCTV System Maintainer to set CCTV System failure conditions that trigger alarms visible to the CCTV System User, and allow the CCTV System Maintainer to remotely update software and firmware.	3.1.9	CCTV System Maintenance

Case Number	Case Name	Case Description	High-Level Requirement Number	High-Level Requirement
12	Constraints/External Interfaces	This verification case will test the CCTV System constraints and external interface requirements. Requirements include the interoperability and interchangeability of CCTV cameras with different interface standards within the CCTV System, accommodating existing communications interfaces, and accommodating agency IT policies. Additional CCTV System requirements involve allowing the CCTV System User to interface (camera monitoring, controlling, direction of video display and configuration) with External Systems as well as allowing External Systems to interface with the CCTV System.	3.1.10	Constraints/External Interfaces
13	CCTV System Performance	This verification case will test the CCTV System performance requirements. Requirements include the accommodation of multiple CCTV System Users on the CCTV System at one time, accommodation of simultaneous CCTV System Users controlling CCTV cameras and accommodation of multiple users accessing the CCTV System software at one time.	3.1.11	CCTV System Performance

APPENDIX E: VALIDATION PLAN SAMPLE CASES

Case Number	Case Name	Case Description	Need Number	Need Category
1	Control Access to the CCTV System	This validation case will validate the user needs associated with controlling user access to the CCTV System in accordance with the Configure CCTV System operational scenario. The capabilities of the CCTV System Manager accessing the CCTV System in order to provide the various CCTV System user roles with their proper CCTV System access will be validated. In addition, the capability for the CCTV System Manager to set External System access will be validated. The CCTV System user access capabilities will be validated in accordance with their corresponding user needs. For the most part, no additional hardware or software besides the CCTV System itself is envisioned to accomplish this validation case; however, the interfacing External Systems will be needed to validate the External Systems user needs.	4.1	Control Access to CCTV System
2	Configure CCTV System	This validation case will validate the user needs associated with configuring the CCTV system in accordance with the Configure CCTV System operational scenario. The System Manager's user needs of configuring user permissions as well as allowing a set number of users with CCTV access with arbitration of user requests for access will be validated. External video stream access needs by External Systems will also be validated.	4.2	Configure CCTV System

Case Number	Case Name	Case Description	Need Number	Need Category
3	Check for Camera in Coverage Area	This validation case will validate the user need associated with checking for a camera in the coverage area in accordance with the Check for Camera in Coverage Area operational scenario. The CCTV System User enters a location of interest and the CCTV System returns cameras in the vicinity.	4.3	Check for Camera in Coverage Area
4	CCTV Monitoring	This validation case will validate the user needs associated with CCTV monitoring in accordance with the CCTV Monitoring operational scenario. The CCTV System User's needs of selecting camera feeds to display on video monitors, request for camera control, control of the camera being viewed, reassignment of camera control to a different user and the configuration of a specified number of camera presets will be validated.	4.4	CCTV Monitoring
5	Provide CCTV System Video	This validation case will validate the user needs associated with providing CCTV system video in accordance with the Provide CCTV System Video operational scenario. The CCTV System User's capabilities to create and provide different types of video feeds and images will be validated as well as directing incoming external video feeds to the CCTV System.	4.5	Provide CCTV System Video
6	Verify Non-CCTV Field Device Status using CCTV	This validation case will validate the user needs associated with using the CCTV System to verify non-CCTV field device status in accordance with the Verify Non-CCTV Field Device Status using CCTV operational scenario. The ability of the CCTV System User to select and verify various types of field device operation will be validated.	4.6	Verify Non-CCTV Field Device Status using CCTV

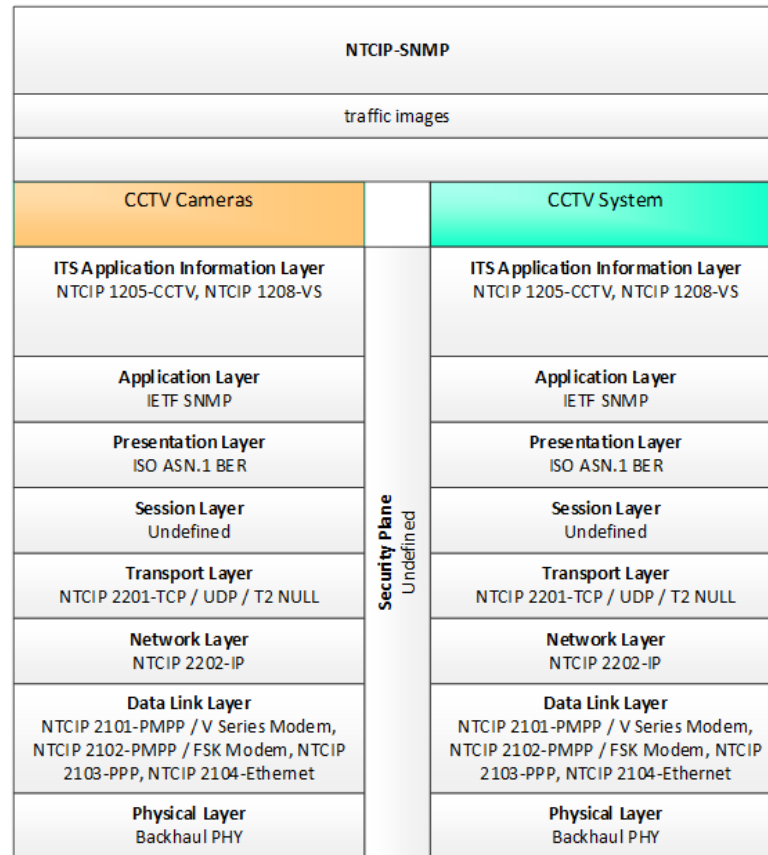
Case Number	Case Name	Case Description	Need Number	Need Category
7	Relinquish CCTV Monitoring	This validation case will validate the user needs associated with relinquishing the monitoring of the CCTV cameras in accordance with the CCTV Monitoring operational scenario. The ability of the CCTV System User to manually and automatically relinquish camera control and monitoring will be validated.	4.7	Relinquishing CCTV Camera Control
8	CCTV Automatic Detection	This validation case will validate the user needs associated with automatic detection by the CCTV System in accordance with the CCTV Automatic Detection operational scenario. The ability of the CCTV System User to automatically receive identification and notification of incidents and wrong-way vehicles as well as automatic positioning of the camera(s) making the identification will be validated.	4.8	CCTV Automatic Detection [Model document users must provide the expansion, and related requirements.]
9	Remote Control of a CCTV Device	This validation case will validate the user needs associated with remote control of a CCTV device in accordance with the Remote Control of a CCTV Device operational scenario. In accordance with the CCTV System video sharing and control policies, the ability of an External System to request changes to a CCTV device including CCTV camera control and monitoring will be validated.	4.9	Remote Control of a CCTV Device
10	CCTV System Logging	This validation case will validate the user needs associated with CCTV System logging in accordance with the Logging CCTV System Data operational scenario. The ability of the CCTV System Maintainer to specify, access and review CCTV System log(s) will be validated.	4.10	CCTV System Logging

Case Number	Case Name	Case Description	Need Number	Need Category
11	Recorded Video	This validation case will validate the user needs associated with CCTV System recorded video in accordance with the Recorded Video operational scenario. The ability of the CCTV System User to record video, playback the video and distribute recorded video will be validated. In addition, validation of the CCTV System User's ability to specify video recording retention rules and video recording deletion and logging will be covered by this validation case.	4.11	Recorded Video
12	CCTV Camera Characteristics	This validation case will validate the user needs associated with the CCTV camera characteristics in accordance with the CCTV Monitoring operational scenario. The ability of the CCTV System User to view images in clear and adverse conditions will be validated. In addition, validation of the ability of the CCTV System User to enter and store CCTV System information including CCTV System and CCTV camera characteristics will be covered by this validation case.	4.12	CCTV Camera Characteristics
13	CCTV Camera Siting and Viewing	This validation case will validate the user needs associated with the CCTV camera siting and viewing in accordance with the CCTV Monitoring operational scenario. Validation of the ability of the CCTV System User to monitor and view transportation facilities (e.g., road lanes, intersections, etc.) and various types of events over the entire extent of the CCTV System will be covered by this validation case.	4.13	CCTV Camera Siting and Viewing

Case Number	Case Name	Case Description	Need Number	Need Category
14	CCTV System Maintenance	This validation case will validate the user needs associated with CCTV System maintenance in accordance with the CCTV System Maintenance operational scenario. This validation case has two primary users: the CCTV System Maintainer and the CCTV System User. The CCTV System Maintainer needs to validate that the CCTV System allows for maintenance needs to service, test, diagnose and fix the CCTV System. The CCTV System User needs to validate that the CCTV System has durable and reliable equipment.	4.14	CCTV System Maintenance
15	Interfaces	This validation case will validate the user needs associated with CCTV System interfaces in accordance with the Remote Control of a CCTV Device operational scenario. This validation case has three primary users: the CCTV System Designer, the CCTV System Maintainer and the CCTV System User. The CCTV System User needs to validate that the CCTV System supports their needs regarding using cameras from different manufacturers as well as access External Systems to configure, control and/or direct the display of video from the External System. The CCTV System Maintainer needs to validate that the CCTV System supports their need of replacing cameras from different manufacturers. The CCTV System Designer needs to validate that the CCTV System allows different compatible interfaces and cameras.	4.15	Interfaces

Case Number	Case Name	Case Description	Need Number	Need Category
16	CCTV System Performance	This validation case will validate the user needs associated with the CCTV System performance in accordance with the CCTV Monitoring, Provide CCTV System Video and Remote Control of CCTV Devices operational scenarios. Validation of the ability of the CCTV System Owner to accommodate a specified number of users at any given time on the CCTV System will be accomplished with this validation case.	4.16	CCTV System Performance

APPENDIX F: STANDARDIZED COMMUNICATIONS PROTOCOL STACK INTERFACE DIAGRAMS



* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 8: Communications Protocol Standards for the NTCIP-SNMP Triple of CCTV Cameras → traffic images → CCTV System based on the CCTV System Project Architecture Diagram

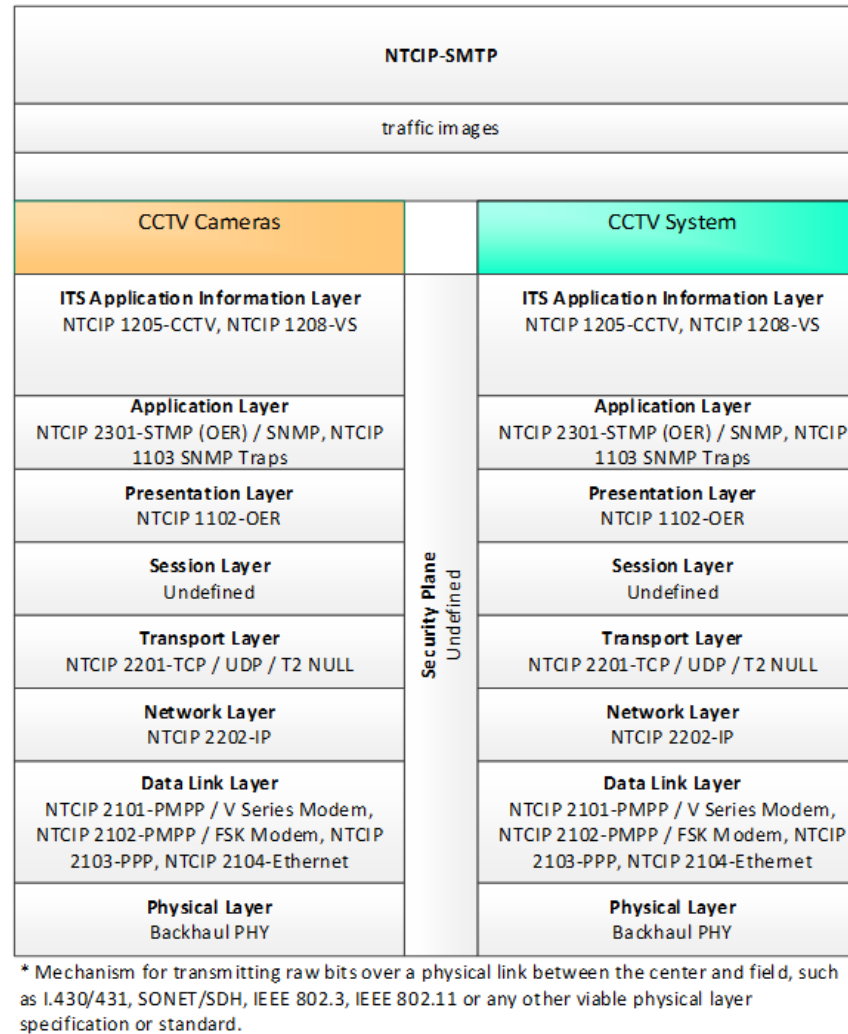


Figure 9: Communications Protocol Standards for the NTCIP-SMTP Triple of CCTV Cameras → traffic images → CCTV System based on the CCTV System Project Architecture Diagram

NTCIP-SNMP		
traffic images		
External System Cameras		External System
ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS	Security Plane Undefined	ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS
Application Layer IETF SNMP		Application Layer IETF SNMP
Presentation Layer ISO ASN.1 BER		Presentation Layer ISO ASN.1 BER
Session Layer Undefined		Session Layer Undefined
Transport Layer NTCIP 2201-TCP / UDP / T2 NULL		Transport Layer NTCIP 2201-TCP / UDP / T2 NULL
Network Layer NTCIP 2202-IP		Network Layer NTCIP 2202-IP
Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet		Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet
Physical Layer Backhaul PHY		Physical Layer Backhaul PHY

* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 10: Communications Protocol Standards for the NTCIP-SNMP Triple of External System Cameras → traffic images → External System based on the CCTV System Project Architecture Diagram

NTCIP-SMTP		
traffic images		
External System Cameras		External System
ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS	Security Plane Undefined	ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS
Application Layer NTCIP 2301-STMP (OER) / SNMP, NTCIP 1103 SNMP Traps		Application Layer NTCIP 2301-STMP (OER) / SNMP, NTCIP 1103 SNMP Traps
Presentation Layer NTCIP 1102-OER		Presentation Layer NTCIP 1102-OER
Session Layer Undefined		Session Layer Undefined
Transport Layer NTCIP 2201-TCP / UDP / T2 NULL		Transport Layer NTCIP 2201-TCP / UDP / T2 NULL
Network Layer NTCIP 2202-IP		Network Layer NTCIP 2202-IP
Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet		Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet
Physical Layer Backhaul PHY		Physical Layer Backhaul PHY

* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 11: Communications Protocol Standards for the NTCIP-SMTP Triple of External System Cameras → traffic images → External System based on the CCTV System Project Architecture Diagram

NTCIP-SNMP		
video surveillance control		
CCTV System		CCTV Cameras
ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS	Security Plane Undefined	ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS
Application Layer IETF SNMP		Application Layer IETF SNMP
Presentation Layer ISO ASN.1 BER		Presentation Layer ISO ASN.1 BER
Session Layer Undefined		Session Layer Undefined
Transport Layer NTCIP 2201-TCP / UDP / T2 NULL		Transport Layer NTCIP 2201-TCP / UDP / T2 NULL
Network Layer NTCIP 2202-IP		Network Layer NTCIP 2202-IP
Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet		Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet
Physical Layer Backhaul PHY		Physical Layer Backhaul PHY

* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 12: Communications Protocol Standards for the NTCIP-SNMP Triple of CCTV System → video surveillance control → CCTV Cameras based on the CCTV System Project Architecture Diagram

NTCIP-SMTP		
video surveillance control		
CCTV System		CCTV Cameras
ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS	Security Plane Undefined	ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS
Application Layer NTCIP 2301-STMP (OER) / SNMP, NTCIP 1103 SNMP Traps		Application Layer NTCIP 2301-STMP (OER) / SNMP, NTCIP 1103 SNMP Traps
Presentation Layer NTCIP 1102-OER		Presentation Layer NTCIP 1102-OER
Session Layer Undefined		Session Layer Undefined
Transport Layer NTCIP 2201-TCP / UDP / T2 NULL		Transport Layer NTCIP 2201-TCP / UDP / T2 NULL
Network Layer NTCIP 2202-IP		Network Layer NTCIP 2202-IP
Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet		Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet
Physical Layer Backhaul PHY		Physical Layer Backhaul PHY

* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 13: Communications Protocol Standards for the NTCIP-SMTP Triple of CCTV System → video surveillance control → CCTV Cameras based on the CCTV System Project Architecture Diagram

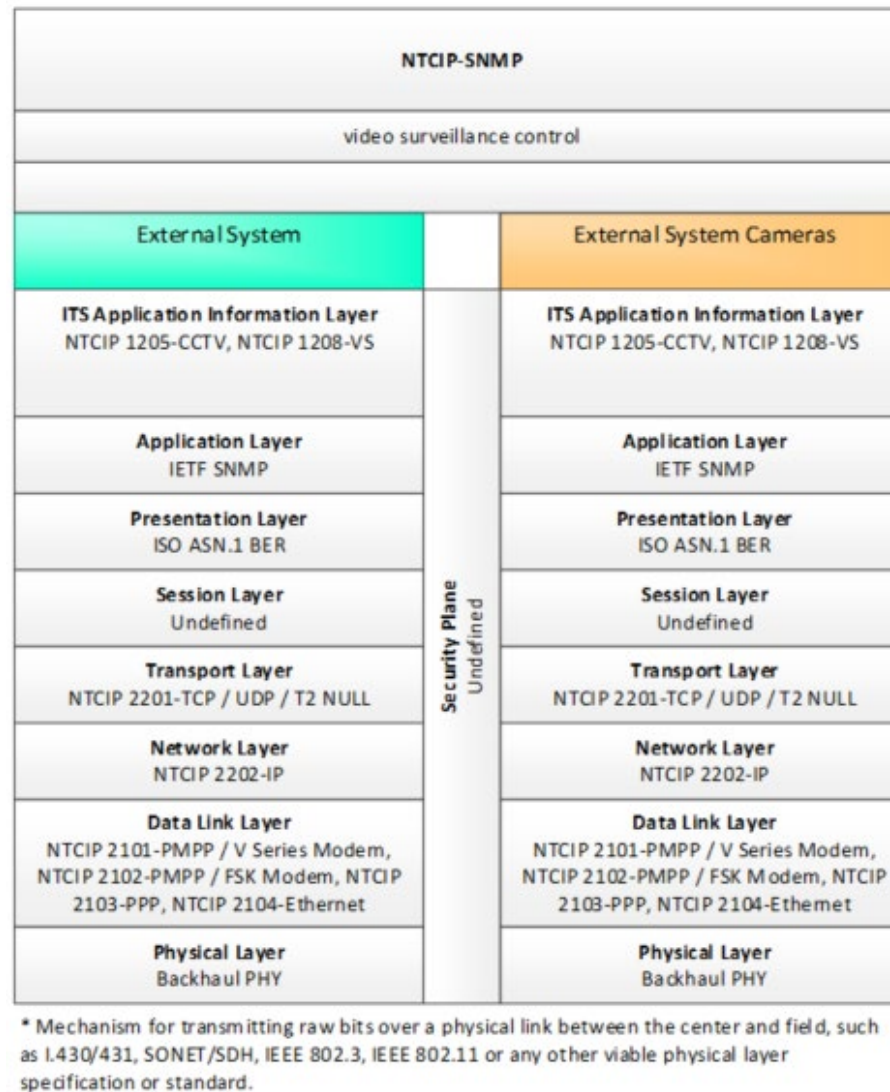
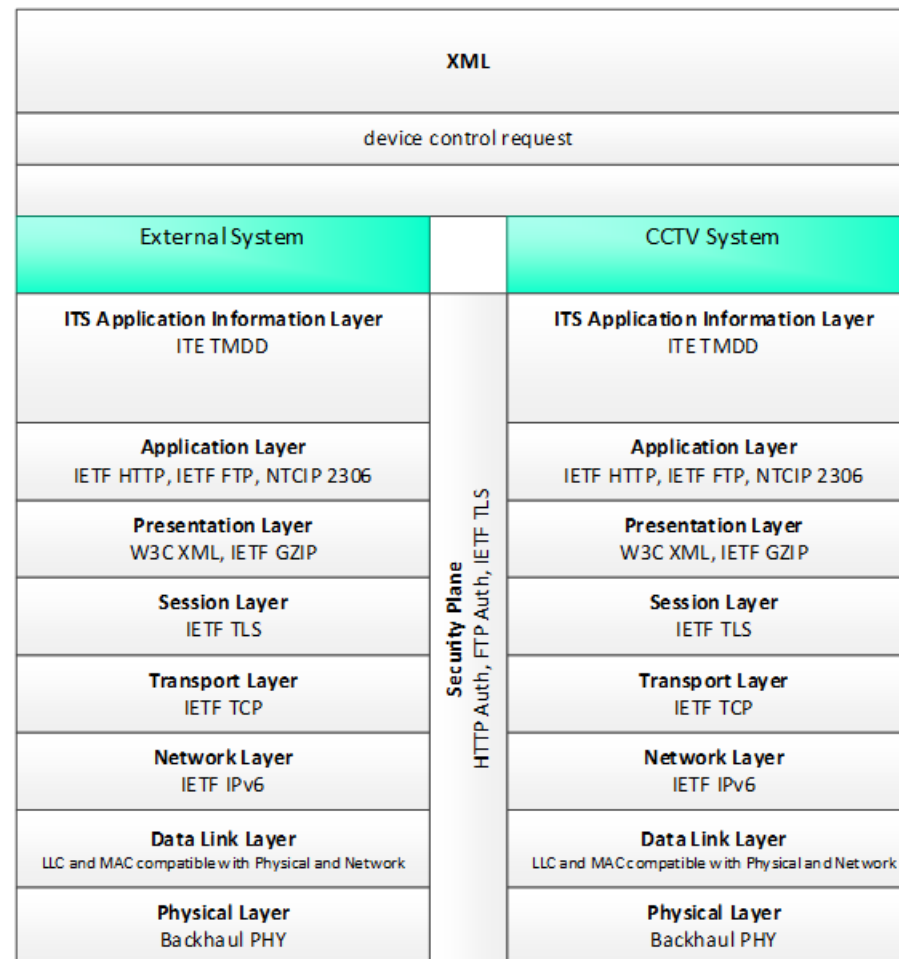


Figure 14: Communications Protocol Standards for the NTCIP-SNMP Triple of External System → video surveillance control → External System Cameras based on the CCTV System Project Architecture Diagram

NTCIP-SMTP		
video surveillance control		
External System		External System Cameras
ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS	Security Plane Undefined	ITS Application Information Layer NTCIP 1205-CCTV, NTCIP 1208-VS
Application Layer NTCIP 2301-STMP (OER) / SNMP, NTCIP 1103 SNMP Traps		Application Layer NTCIP 2301-STMP (OER) / SNMP, NTCIP 1103 SNMP Traps
Presentation Layer NTCIP 1102-OER		Presentation Layer NTCIP 1102-OER
Session Layer Undefined		Session Layer Undefined
Transport Layer NTCIP 2201-TCP / UDP / T2 NULL		Transport Layer NTCIP 2201-TCP / UDP / T2 NULL
Network Layer NTCIP 2202-IP		Network Layer NTCIP 2202-IP
Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet		Data Link Layer NTCIP 2101-PMPP / V Series Modem, NTCIP 2102-PMPP / FSK Modem, NTCIP 2103-PPP, NTCIP 2104-Ethernet
Physical Layer Backhaul PHY		Physical Layer Backhaul PHY

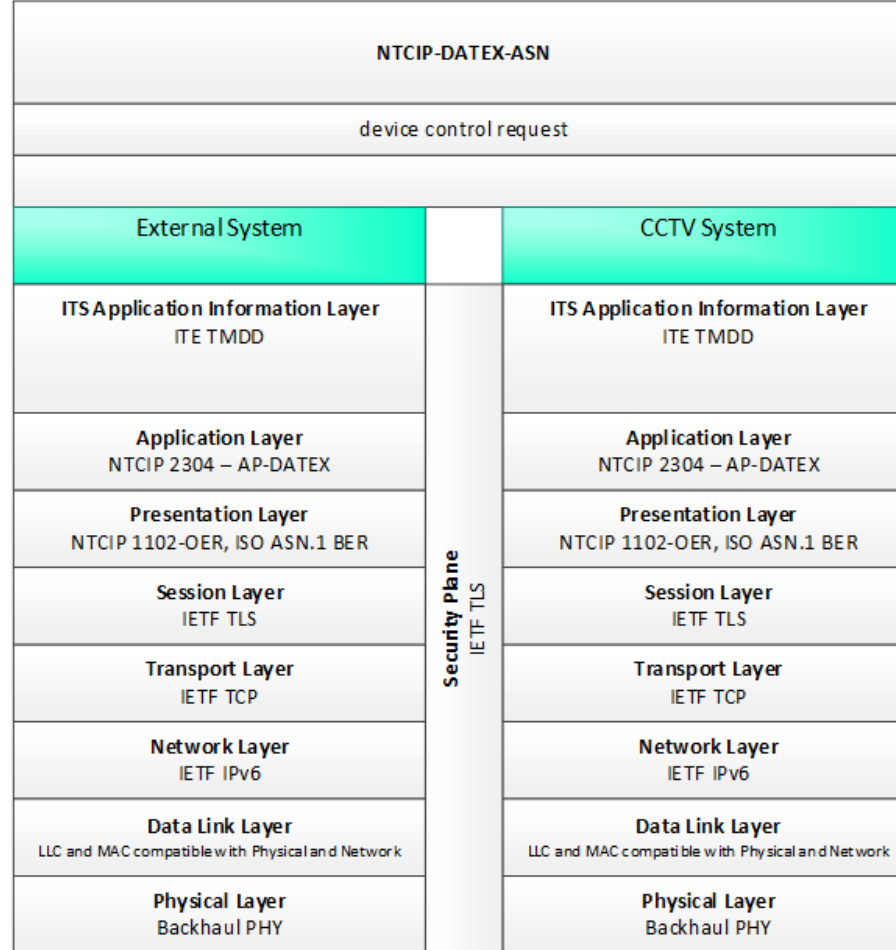
* Mechanism for transmitting raw bits over a physical link between the center and field, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 15: Communications Protocol Standards for the NTCIP-SMTP Triple of External System → video surveillance control → External System Cameras based on the CCTV System Project Architecture Diagram



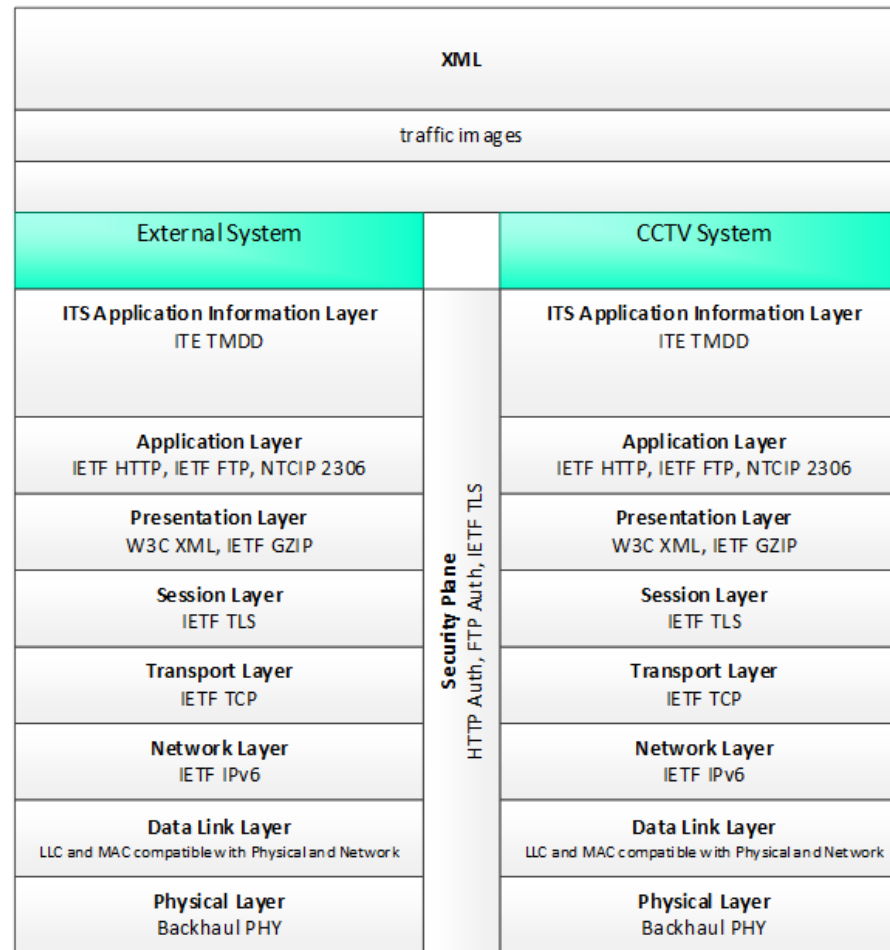
* Mechanism for transmitting raw bits over a physical link between centers, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 16: Communications Protocol Standards for the XML Triple of External System → device control request → CCTV System based on the CCTV System Project Architecture Diagram



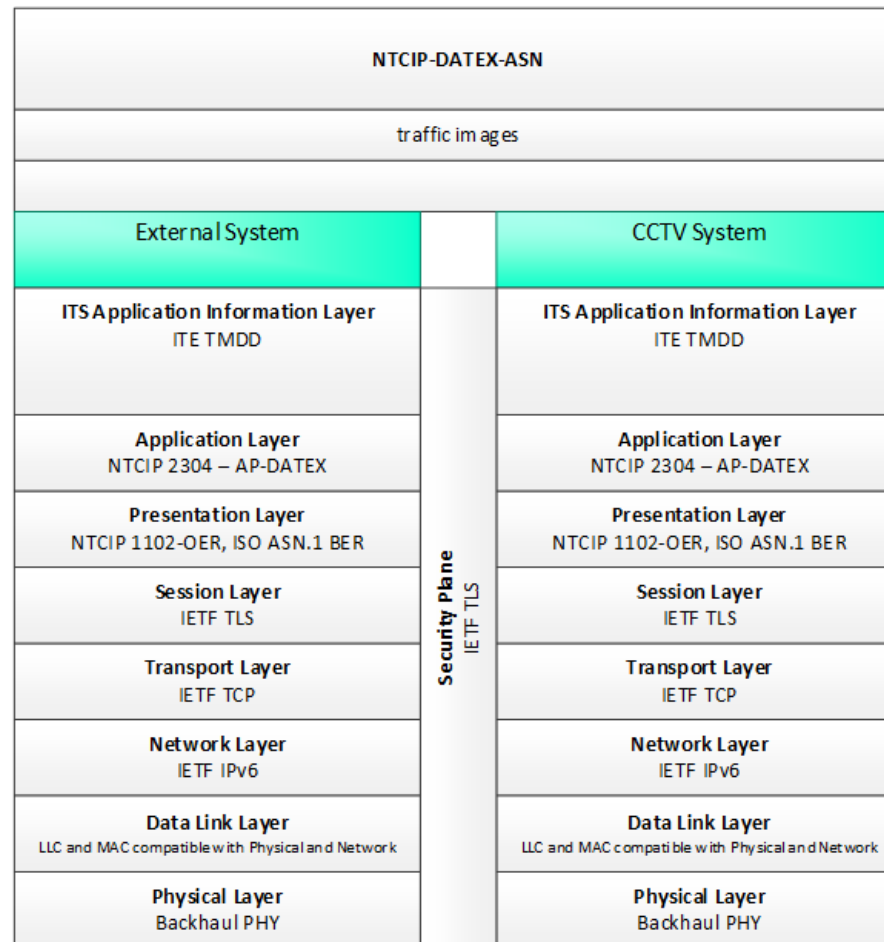
* Mechanism for transmitting raw bits over a physical link between centers, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 17: Communications Protocol Standards for the NTCIP-DATEX-ASN Triple of External System → device control request → CCTV System based on the CCTV System Project Architecture Diagram



* Mechanism for transmitting raw bits over a physical link between centers, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 18: Communications Protocol Standards for the XML Triple of External System → traffic images → CCTV System based on the CCTV System Project Architecture Diagram



* Mechanism for transmitting raw bits over a physical link between centers, such as I.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 19: Communications Protocol Standards for the NTCIP-DATEX-ASN Triple of External System → traffic images → CCTV System based on the CCTV System Project Architecture Diagram

APPENDIX G: ACKNOWLEDGMENTS

The Federal Highway Administration would like to express appreciation to the following State, regional and local transportation agencies for providing information used in developing this report.”

- Washington State Department of Transportation
- City of Anaheim, California

U.S. Department of Transportation
Federal Highway Administration
Office of Operations
1200 New Jersey Ave., SE
Washington, DC 20590
ops.fhwa.dot.gov
FHWA-HOP-18-060



U.S. Department of Transportation
Federal Highway Administration