

SOFTWARE REQUIREMENTS SPECIFICATION (SRS) FOR THE DALLAS / FT. WORTH REGIONAL CENTER-TO-CENTER COMMUNICATIONS NETWORK

Version 3.0

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Prepared for:

Software Task Force

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REVISION HISTORY

Revision	Date	Changes
1.0	September 4, 1999	Initial release
2.0	February 24, 2000	<ul style="list-style-type: none">• Significantly modified the structure of the SRS• Requirements from version 1.0 were reformatted to utilize the new structure• Expanded the requirements for device status• Added requirements for device command/control• Added requirements for remote control user interface
3.0	December 5, 2001	<p>Added EO-22 to identification table. Revised to reflect changes from SICD and CICD version 2.3. Incorporated input from DFW Regional Software Task Force into document. Major new additions included:</p> <ul style="list-style-type: none">• Ramp Meters• Highway Advisory Radio (HAR)• Traffic Signals• Environmental Sensor Stations (ESS)• High Occupancy Vehicle (HOV) Lanes• Parking Lots• School Zones• Railroad Crossings• Reversible Lanes• Dynamic Lanes• Transit

1.0 SCOPE

This Software Requirements Specification (SRS) provides the requirements for the Center-to-Center Communications (C2C) Communications project.

1.1 Identification

Project Title:	Center-To-Center Communications
Project Number:	04594, EO 17 04594, EO 22
Abbreviation:	C2C
Version Number:	3.0
Release Number:	1

1.2 System Overview

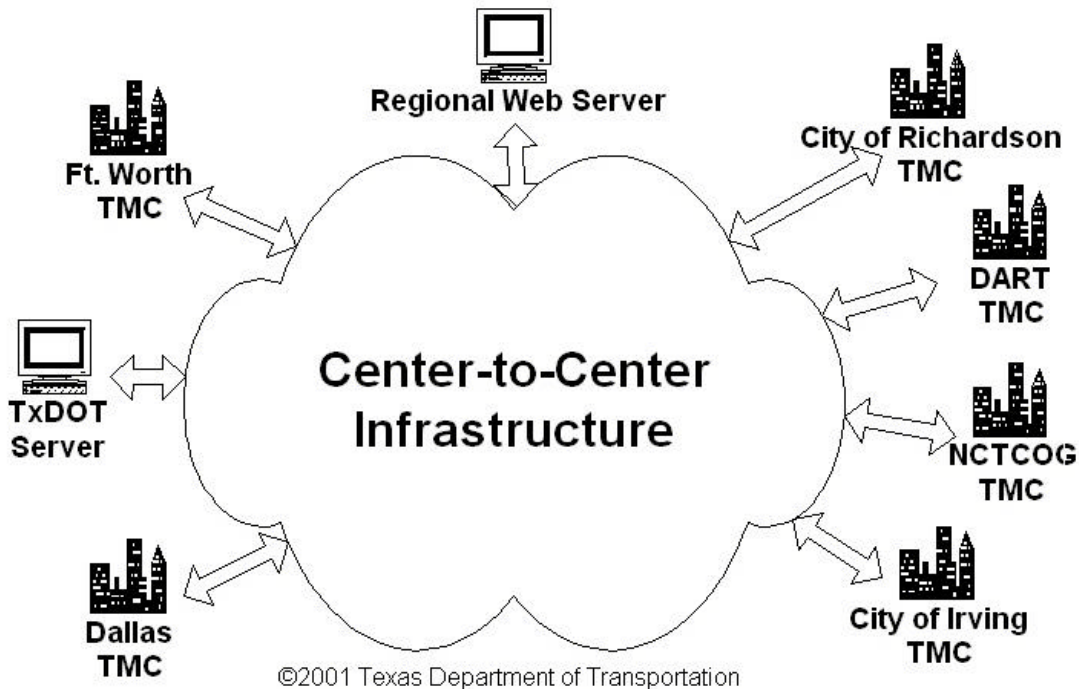
This document describes the requirements for the Dallas/Ft. Worth (DFW) Regional “Center-to-Center (C2C) Communications Network” that is based on a Texas Department of Transportation (TxDOT) C2C project. The TxDOT C2c project initially connected the DFW TxDOT Traffic Management Centers (TMCs). This C2C infrastructure implements a repository for traffic data and provides a mechanism to exchange device control information between TMCs.

The C2C project will be implemented using the evolving ITS Traffic Management Data Dictionary (TMDD) standard, the message sets associated with TMDD, other ITS Data Elements and Message Sets. The use of ITS standards will create a system that is reusable for other ITS application areas and will provide the State of Texas with a baseline system that can be cost effectively extended in the future.

1.3 Operational Concept

The C2C infrastructure must interconnect several dissimilar traffic management systems. In order to create the C2C infrastructure, interfaces to the existing systems will be created. The data from these interfaces will communicate with the existing system in a “system specific” format. The data being deposited into the C2C infrastructure will be converted to a standard format (based on the ITS standards). The C2C infrastructure is being created using a series of building blocks. These building blocks allow the software to be utilized in a number of configurations (by simply altering the configuration parameters of the software).

In a region such as Dallas/Ft. Worth, multiple instances of the building blocks will be utilized. The software is being designed so that multiple instances of a building block can be deployed by simply “configuring” the building block of operation within a specific agency. Conceptually, the C2C infrastructure would be deployed as depicted in the following diagram:



Any data that is passed into the “cloud” in the above figure will be based on the ITS standards. Systems will interface to the “cloud” using a project defined protocol. New systems that are deployed (based on the ITS standards) will not utilize the project defined protocol but will be moved “into” the cloud (because they themselves would be based on the ITS standards).

1.4 Goals and Objectives

The C2C project has the following goals:

- To provide a common repository for traffic information for the DFW Metroplex.
- To provide a World Wide Web based graphical map to display traffic conditions in the DFW Metroplex.
- To provide a Microsoft Windows application that will allow agencies without a formal Traffic Management Center (TMC) to participate in the C2C infrastructure and information sharing.
- To provide a system which supports ITS center-to-center communications for command/control/status of various ITS field devices including: Dynamic Message Signs, Lane Control Signals and Closed Circuit Television Cameras (CCTVs), Ramp Meters, and Highway Advisory Radios (HARs).
- To utilize National ITS standards to implement the project.
- To provide a software system that is extensible all local or regional partners. This would allow a “local” common repository to be created by “linking” individual partners, a “regional” common repository to be created by “linking” local common repositories and a “statewide” common repository to be created by “linking” regional common repositories.

1.5 Constraints

None.

1.6 Document Overview

Section 2 defines the requirements of the system. Acronyms are defined in Appendix A.

1.7 Related Documents

- *Concept Of Operations Framework For The Dallas/Ft. Worth Regional Center-to-Center Communications Network*, Version 1.0, Southwest Research Institute, November 2001.

2.0 REQUIREMENTS

The following sections define the requirements for the C2C project. Requirements are listed in separate sections and in table format for each functional area. The C2C project mnemonic uniquely identifies the C2C project to distinguish its requirements from the requirements of other ITS systems. The mnemonic for the C2C project is *C2C*. The Requirement Category Mnemonic is a two-letter mnemonic for each functional area. The Requirement Numbers are a combination of target Advanced Traffic Management System (ATMS) and sequential within a given functional area.

The columns of the tables are structured as follows:

- The first column of the table contains the requirement identifier. The requirement identifier is a three-part number that is used to uniquely identify each requirement. The number consists of the following fields: <C2C Project Mnemonic>-<Requirement Category Mnemonic>-<Requirement Number>.
- The second column of each table contains a description of the requirement.
- The third column contains a rationale for the requirements. If the rationale is left blank for a particular requirement, the requirement rationale is assumed obvious from the description.

2.1 Interfaces

The following tables list the interfaces that shall be developed.

2.1.1 Roadway Network Interface Requirements

Table 1 lists the interface requirements for supporting the roadway network data transmission.

Table 1. Roadway Network Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS01	For each roadway network it maintains, the Center shall provide the following information. <ol style="list-style-type: none">1. Network identifier2. Network name3. Number of links in the network4. Number of nodes in the network5. List of link data6. List of node data	
C2C-IF-IS02	The Center shall provide the following link information: <ol style="list-style-type: none">1. Link identifier2. Link name3. Road number4. Link type5. Link type description6. Start node (see below for node information)7. End node (see below for node information)8. Direction9. Length10. Capacity11. Speed limit12. Speed limit truck13. Number of lanes	
C2C-IF-IS03	The Center shall provide the following node information: <ol style="list-style-type: none">1. Node identifier2. Node name3. Node jurisdiction4. Owner5. Latitude/longitude6. Type of node (i.e., intersection or bridge)7. Node type description8. Number of links	

2.1.2 Traffic Conditions Interface Requirements

Table 2 lists the interface requirements for supporting the traffic conditions data transmission.

Table 2. Traffic Conditions Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS04	For each link defined within the Center: <ol style="list-style-type: none"> 1. Network identifier 2. Link identifier 3. Data type 4. Data type description 5. Delay 6. Travel time 7. Volume 8. Speed 9. Density 10. Occupancy 	

2.1.3 Incident Data Interface Requirements

Table 3 lists the interface requirements for supporting the incident data transmission.

Table 3. Incident Data Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS05	The Center shall support the following information about each incident: <ol style="list-style-type: none"> 1. Network identifier 2. Incident ID 3. Incident description 4. Roadway 5. Cross street 6. Latitude/longitude 7. Link identifier 8. Direction 9. Status 10. Update Type 11. Affected lanes 12. Classification 13. Severity 14. Incident type 15. Incident type description 16. Road conditions 17. Weather 18. Confirmed date & time 19. Cleared date & time 	

2.1.4 Lane Closure Interface Requirements

Table 4 lists the interface requirements for supporting the lane closure data transmission.

Table 4. Lane Closure Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS06	The Center shall support the following information about each lane closure: <ol style="list-style-type: none"> 1. Network identifier 2. Lane closure ID 3. Closure description 4. Starting roadway 5. Starting cross street 6. Latitude/longitude of starting location 7. Ending roadway 8. Ending cross street 9. Latitude/longitude of ending location 10. Direction of roadway 11. Link identifier 12. Current status 13. Update type 14. Affected lanes 15. Lane closure source 16. Contact 17. Days closed 18. Start time of day 19. End time of day 20. Start date of series 21. End date of series 	

2.1.5 Dynamic Message Sign Interface Requirements

Table 5 lists the interface requirements for supporting the Dynamic Message Sign (DMS) data transmission.

Table 5. DMS Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS07	The Center shall provide the following status information about each DMS: <ol style="list-style-type: none"> 1. Network Identifier 2. DMS Identifier 3. DMS Name 4. Location (latitude/longitude) 5. Sign Geometry (row/column) 6. Status (online/offline) 7. Current message (MULTI string) 8. Beacons (on/off) 	
C2C-IF-IS08	To support DMS control in other centers, the Center shall be able to support the following device control command for a DMS: <ol style="list-style-type: none"> 1. Network identifier 2. DMS Identifier 3. Username 4. Password 5. Beacons (on/off) 6. Immediate message (MULTI string) 	

2.1.6 Lane Control Signal Interface Requirements

Table 6 lists the interface requirements for supporting the Lane Control Signal (LCS) data transmission.

Table 6. LCS Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS09	The Center shall support the following status information about each LCS: 1. Network identifier 2. LCS identifier 3. LCS name 4. Location (latitude/longitude) 5. Geometry (number of heads) 6. Head capabilities 7. Status 8. Current pattern	
C2C-IF-IS10	To support LCS control in other centers, the Center shall be able to support the following device control command for a LCS: 1. Network Identifier 2. LCS Identifier 3. Username 4. Password 5. Signal Pattern	

2.1.7 Closed Circuit Television Interface Requirements

Table 7 lists the interface requirements for supporting the Closed Circuit Television (CCTV) data transmission.

Table 7. CCTV Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS11	<p>The Center shall provide the following information status information about each CCTV:</p> <ol style="list-style-type: none"> 1. Network identifier 2. CCTV identifier 3. CCTV name 4. Location (latitude/longitude) 5. Status (online/offline) 6. Locked/unlocked 7. Lock holder (if locked) 8. Supported directions 9. Current direction 10. Current preset position 11. Current pan 12. Current tilt 13. Current zoom 14. Current focus 15. Current iris 	
C2C-IF-IS12	<p>To support CCTV control in other centers, the Center shall be able to support the following CCTV control request:</p> <ol style="list-style-type: none"> 1. Network identifier 2. CCTV Identifier 3. Username 4. Password 5. CCTV request (one of the following): <ul style="list-style-type: none"> ▪ Lock camera ▪ Set direction ▪ Set preset ▪ Set absolute (pan/tilt/zoom/focus/iris) ▪ Stop offset (pan/tilt/zoom/focus/iris) 	Ft. Worth will not support Momentary Pan/Tilt/Zoom/Iris/Focus command
C2C-IF-IS13	<p>To support video snapshots, the Center shall be able to support the following status information:</p> <ol style="list-style-type: none"> 1. Network identifier 2. CCTV Identifier 3. CCTV Name 4. Status 5. Current camera direction 6. Size of snapshot 7. Video snapshot (in JPEG format) 	
C2C-IF-IS14	<p>To support CCTV switching in other centers, the Center shall be able to support the following CCTV switching command:</p> <ol style="list-style-type: none"> 1. Network identifier (owner of CCTV) 2. Username 3. Password 4. Video channel input identifier 5. Video channel output identifier 	Dallas will not support the Tour video switch command

2.1.8 Ramp Meter Requirements

Table 8 lists the interface requirements for supporting the ramp meter data transmission.

Table 8. Ramp Meter Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS15	The Center shall support the following status information about each ramp meter: <ol style="list-style-type: none">1. Network identifier (owner of ramp meter)2. Ramp Meter Identifier3. Ramp Meter Name4. Location (latitude/longitude)5. Status6. Status Source7. Plan8. Cycle Time	
C2C-IF-IS16	To support Ramp Meter control in other centers, the Center shall be able to support the following device control command for a ramp meter: <ol style="list-style-type: none">1. Network identifier (owner of ramp meter)2. Ramp Meter Identifier3. Username4. Password5. Plan6. Duration	

2.1.9 Highway Advisory Radio Requirements

Table 9 lists the interface requirements for supporting the Highway Advisory Radio (HAR) data transmission.

Table 9. HAR Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS17	The Center shall support the following status information about each HAR: <ol style="list-style-type: none">1. Network identifier (owner of HAR)2. HAR Identifier3. HAR Name4. Location (latitude/longitude)5. Status6. Current Message7. Current Message Text	
C2C-IF-IS18	To support HAR control in other centers, the Center shall be able to support the following device control command for a HAR: <ol style="list-style-type: none">1. Network identifier (owner of HAR)2. HAR Identifier3. Username4. Password5. Message6. Message Text7. Duration	

2.1.10 Traffic Signals Requirements

Table 10 lists the interface requirements for supporting the Traffic Signals data transmission.

Table 10. Traffic Signals Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS19	The Center shall support the following status information about each Traffic Signal: <ol style="list-style-type: none"> 1. Network identifier (owner of traffic signal) 2. Traffic Signal Identifier 3. Traffic Signal Name 4. Location (latitude/longitude) 5. Status 6. Status Source 7. State 8. Failure State 9. Plan 10. Plan Expiration 11. Signal Preemption 	
C2C-IF-IS20	To support Traffic Signal control in other centers, the Center shall be able to support the following device control command for a Traffic Signal: <ol style="list-style-type: none"> 1. Network identifier (owner of traffic signal) 2. Traffic Signal Identifier 3. Username 4. Password 5. Traffic Signal Plan Identifier 6. Duration 	

2.1.11 Environment Sensor Station Requirements

Table 11 lists the interface requirements for supporting the Environmental Sensor Station (ESS) data transmission.

Table 11. ESS Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS21	The Center shall support the following status information about each ESS: <ol style="list-style-type: none"> 1. Network identifier (owner of sensor) 2. Environmental Sensor Identifier 3. Environmental Sensor Name 4. Type 5. Location (latitude/longitude) 6. Status 7. Type 8. Reading 9. Units 10. Alarm status 	

2.1.12 High Occupany Vehicle Requirements

Table 12 lists the interface requirements for supporting the High Occupancy Vehicle (HOV) data transmission.

Table 12. HOV Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS22	The Center shall support the following status information about each HOV: 1. Network identifier (owner of HOV) 2. HOV Identifier 3. HOV Name 4. Link Identifier 5. Status 6. Failure State 7. Plan 8. State 9. Status Source 10. Occupants 11. Next Transition Time	
C2C-IF-IS22.1	To support HOV Lane control in other centers, the Center shall be able to support the following device control command for a HOV Lane: 1. Network identifier (owner of HOV) 2. HOV Lane Identifier 3. Username 4. Password 5. Lane Plan 6. Duration	

2.1.13 Parking Lot Requirements

Table 13 lists the interface requirements for supporting the Parking Lot data transmission.

Table 13. Parking Lot Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS23	The Center shall support the following status information about each Parking Lot: 1. Network identifier (owner of parking lot) 2. Parking Lot Identifier 3. Parking Lot Name 4. Location (latitude/longitude) 5. Status 6. Capacity 7. Utilization 8. Entrance 9. Restrictions 10. Special Capabilities	

2.1.14 School Zone Requirements

Table 14 lists the interface requirements for supporting the School Zone data transmission.

Table 14. School Zone Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS24	The Center shall support the following status information about each School Zone: <ol style="list-style-type: none"> 1. Network identifier (owner of school zone) 2. Link Identifier 3. School Zone Identifier 4. School Zone Name 5. Location (latitude/longitude) 6. Status 7. Failure Status 8. State Plan 9. State Source 	
C2C-IF-IS25	To support School Zone control in other centers, the Center shall be able to support the following device control command for a School Zone: <ol style="list-style-type: none"> 1. Network identifier (owner of school zone) 2. School Zone Identifier 3. Username 4. Password 5. Plan 	

2.1.15 Railroad Crossing Requirements

Table 15 lists the interface requirements for supporting the Railroad Crossing data transmission.

Table 15. Railroad Crossing Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS26	The Center shall support the following status information about each Railroad Crossing: <ol style="list-style-type: none"> 1. Network identifier (owner of railroad Crossing) 2. Link Identifier 3. Rail Crossing Identifier 4. Rail Crossing Name 5. Location (latitude/longitude) 6. Status 7. Rail Type 8. Estimated Time for Train to Clear of Intersection 9. Estimated Minutes to Train Arrival 10. Rail closing signal type 	

2.1.16 Reversible Lanes Requirements

Table 16 lists the interface requirements for supporting the Reversible Lanes data transmission.

Table 16. Reversible Lanes Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS27	The Center shall support the following status information about each Reversible Lane: <ol style="list-style-type: none"> 1. Network identifier (owner of reversible lane) 2. Reversible Lane Identifier 3. Reversible Lane Name 4. Link Identifier 5. Indicator Status 6. Indicator Failure State 7. Plan 8. Direction 9. Direction Transition Time 10. Status Source 	
C2C-IF-IS28	To support Reversible Lane control in other centers, the Center shall be able to support the following device control command for a Reversible Lane: <ol style="list-style-type: none"> 1. Network identifier (owner of reversible lane) 2. Reversible Lane Identifier 3. Username 4. Password 5. Plan 6. Duration 	

2.1.17 Dynamic Lane Assignments Requirements

Table 17 lists the interface requirements for supporting the Dynamic Lane Assignment data transmission.

Table 17. Dynamic Lane Assignments Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS29	The Center shall support the following status information about each Dynamic Lane: <ol style="list-style-type: none"> 1. Network identifier (owner of dynamic lane) 2. Link Identifier 3. Dynamic Lane Identifier 4. Dynamic Lane Name 5. Indicator Status 6. Failure State 7. Plan 8. Type 9. Transition Time 	
C2C-IF-IS30	To support Dynamic Lane control in other centers, the Center shall be able to support the following device control command for a Dynamic Lane: <ol style="list-style-type: none"> 1. Network identifier (owner of dynamic lane) 2. Dynamic Lane Identifier 3. Username 4. Password 5. Lane Plan 6. Duration 	

2.1.18 Transit Requirements

Table 18 lists the interface requirements for supporting the Transit data transmission.

Table 18. Transit Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS30	The Center shall support the following status information about each Bus Stop: <ol style="list-style-type: none"> 1. Network identifier (owner of bus stop) 2. Link Identifier¹ 3. Relative Link Location 4. Identifier 5. Name 6. Location (Node) 7. Bus Routes 8. Frequency 	
C2C-IF-IS31	The Center shall support the following status information about each Bus Location: <ol style="list-style-type: none"> 1. Network identifier (owner of bus) 2. Link Identifier 3. Bus Identifier 4. Bus Name 5. Location (latitude/longitude) 6. Schedule Adherence 7. Vehicle Attributes 8. Capacity 	
C2C-IF-IS32	The Center shall support the following status information about each Light/Commuter Stop: <ol style="list-style-type: none"> 1. Network identifier (owner of stop) 2. Link Identifier 3. Commuter / Light Rail Stop Identifier 4. Commuter / Light Rail Stop Name 5. Location 6. Routes 7. Frequency 	
C2C-IF-IS33	The Center shall support the following status information about each Light/Commuter Location: <ol style="list-style-type: none"> 1. Network identifier (owner of train) 2. Link Identifier 3. Commuter / Light Rail Identifier 4. Commuter / Light Rail Name 5. Location (latitude/location) 6. Schedule Adherence 7. Vehicle Attributes 8. Capacity 	

¹ Associating a bus stop, commuter / light rail stop, bus location, etc. with a link within a roadway network may be an inherently difficult problem from a configuration management perspective. The roadway network and transit information may be managed by separate centers, i.e. City of Dallas vs. DART. Updates to the roadway network, i.e. renaming links, may cause the associated link information within the transit data to become outdated and inconsistent with the location data.

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS34	The Center shall support the following status information about each Park and Ride Lot: <ol style="list-style-type: none"> 1. Network identifier (owner of lot) 2. Park and Ride Lot Identifier 3. Park and Ride Lot Name 4. Location (latitude/location) 5. Status 6. Capacity 7. Utilization 8. Entrance 9. Restrictions 10. Special Capabilities 	
C2C-IF-IS35	The Center shall support the following status information about each Vehicle Priority: <ol style="list-style-type: none"> 1. Vehicle Identifier 2. Network identifier (owner of signal) 3. Link Identifier 4. Intersection Identifier 5. Priority Request Status 6. Departure Time 7. Desired Arrival Time 8. Priority 9. Vehicle Classification 10. Service Strategy 	

2.1.19 Network Device Status Interface Requirements

Table 19 lists the interface requirements for supporting network device status data transmission.

Table 19. Network Device Status Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS36	The Center shall support the following information about network device status: <ol style="list-style-type: none"> 1. Network identifier 2. Number of DMSs 3. Number of LCSs 4. Number of CCTVs 5. Number of CCTV video inputs 6. Number of CCTV video outputs 7. Number of Ramp Meters 8. Number of HARs 9. Number of Traffic Signals 10. Number of ESSs 11. Number of HOVs 12. Number of Parking Lots 13. Number of School Zones 14. Number of Railroad Crossings 15. Number of Reversible Lanes 16. Number of Dynamic Lanes 17. DMS status data 18. LCS status data 19. CCTV status data 20. Video input channel identifiers 21. Video output channel identifiers 22. Ramp Meter status data 23. HAR status data 24. Traffic Signal status data 25. ESS status data 26. HOV status data 27. Parking Lot status data 28. School Zone status data 29. Railroad Crossing status data 30. Reversible Lane status data 31. Dynamic Lane status data 	

2.1.20 Command Timeframe Request / Response Interface Requirements

Table 20 lists the interface requirements supporting command timeframe requests and responses.

Table 20. Command Timeframe Request / Response Interface Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-IF-IS37	The device status requestor and Center shall support the following information for command timeframe request: 1. Network identifier 2. Device Type	This is used to determine when a center will accept a command from a remote user. These are device type dependent.
C2C-IF-IS38	The device status requestor and Center shall support the following information for command timeframe request: 1. Network identifier 2. Device Type 3. Days Commands Accepted 4. Times Commands Accepted	This is the response to a command timeframe request.

2.2 Functional

The follow sections detail the functional requirements of the C2C project.

2.2.1 Data Collector Requirements

The Data Collector Requirements define what must be stored on the Data Collector. The requirements are listed in Table 21.

Table 21. Data Collector Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-DS-01	The Data Collector shall be designed to support the storage of TMDD data elements and message set information.	

2.2.2 Data Transmission Requirements

The Data Transmission Requirements define the messaging protocols and message sets to be used for C2C communications and are listed in Table 22.

Table 22. Data Transmission Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-DT-01	The C2C Project shall utilize the TMDD standard (including message sets) to transmit information.	
C2C-DT-02	DATEX/ASN shall be used to transmit the TMDD message sets.	
C2C-DT-03	TCP/IP shall be used to transmit the DATEX/ASN data.	Derived from this requirement is the necessary TCP/IP connection management.

2.2.3 Web Map Requirements

The Web Map application generates a map that can be displayed on an Internet WWW server. The map provides a graphical depiction of the traffic conditions. The requirements for the WWW map are listed in Table 23.

Table 23. WWW Map Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-MP-01	The map shall display interstates and state highways on the graphical map.	
C2C-MP-03	The basemap data shall be derived from the North Central Texas Council of Governments (NCTCOG) Geo-Data warehouse.	
C2C-MP-03	The map user shall be able to alter the current magnification (zoom level) of the map.	
C2C-MP-04	The map user shall be able to pan the map in each of the following directions: North, South, East or West.	
C2C-MP-05	Each link displayed on the map shall be color coded to provide a graphical depiction of speeds. A configuration file shall be provided to specify specific speed values. The color coding shall be as follows: <ul style="list-style-type: none"> • Green - speeds > TBD MPH • Yellow - speeds between TBD and TBD MPH • Red – speeds below TBD MPH 	
C2C-MP-06	The map shall display the current incidents (as icons) known to the C2C Project.	
C2C-MP-07	The user shall be able to click on an incident icon to obtain further information about the incident.	
C2C-MP-08	All current incidents shall be displayed in tabular format with the following information contained in the table: <ul style="list-style-type: none"> • Location • Type of incident (e.g., accident, lane closure) • Severity of incident • Incident status • Travel direction • Effected lanes 	
C2C-MP-09	The map shall be capable of displaying the following for a DMS: <ol style="list-style-type: none"> 1. Location 2. Current Message 	
C2C-MP-10	The map shall be capable of displaying the following for a LCS: <ol style="list-style-type: none"> 1. Location 2. Current Signals 	
C2C-MP-11	The map shall be capable of displaying the following for a CCTV: <ol style="list-style-type: none"> 1. Location 2. Status 	

2.2.4 Incident GUI Requirements

The Incident GUI must provide data to the C2C Infrastructure. The GUI requirements are listed in Table 24.

Table 24. Incident GUI Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-GI-01	The Incident GUI shall allow the user to enter incident or lane closure information without the use of an Center.	
C2C-GI-02	The Incident GUI shall allow the user to input the following information for each incident: <ul style="list-style-type: none">• Location (latitude/longitude)• Description• Status• Effectuated lanes• Detection time• Response time• Estimated time to clear queue• Queue length	
C2C-GI-03	The Incident GUI shall allow the user to input the following information for each lane closure: <ul style="list-style-type: none">• Location (latitude/longitude)• Description• Effectuated lanes• Date• Start time• End time	
C2C-GI-04	The GUI shall provide a list of previously entered incidents.	
C2C-GI-05	The GUI shall allow the data about an incident to be modified.	
C2C-GI-06	The GUI shall allow a user to delete a previously entered incident.	
C2C-GI-07	The GUI shall provide a list of previously entered lane closures.	
C2C-GI-08	The GUI shall allow a user to delete a previously entered lane closure.	
C2C-GI-09	The GUI shall allow a user to delete a previously entered lane closure.	

2.2.5 Remote Control GUI

Table 25 contains the requirements for the Remote Control GUI.

Table 25. Remote Control GUI

Requirement Number	Requirement Description	Rationale or Comments
C2C-CG-01	The remote Center Control GUI shall be designed to execute on a public network (e.g., Internet) and transmit equipment requests to the C-2-C software system.	The Remote Control GUI will execute as a local application on a PC. The application will generate TMDD device control messages that will be sent to a Center for processing. Connectivity through the various firewalls and gateways is not addressed by this requirement.
C2C-CG-02	When the GUI application is initiated, the user shall be prompted for the following information: <ul style="list-style-type: none"> • User name • Password 	
C2C-CG-03	The user shall be provided with the capability to select a network identifier for a device command/control request.	
C2C-CG-04	Once an Center is selected, the user shall be able to select a DMS from a list and provide the following information: <ul style="list-style-type: none"> • Target DMS • Message to be displayed • Beacons On/Off 	
C2C-CG-05	Once an Center is selected, the user shall be able to select a LCS from a list and provide the following information: <ul style="list-style-type: none"> • Target LCS • Assignment of lane arrows 	
C2C-CG-06	Once an Center is selected, the user shall be able to issue a CCTV switching command: <ul style="list-style-type: none"> • Source (input) • Destination port (output) 	
C2C-CG-07	Once an Center is selected, the user shall be able to select a CCTV from a list and provide the following information: <ul style="list-style-type: none"> • Target CCTV • Device control including: <ul style="list-style-type: none"> • Pan • Tilt • Zoom 	
C2C-CG-08	Once an Center is selected, the user shall be able to select a Ramp Meter from a list and provide the following information: <ul style="list-style-type: none"> • Target Ramp Meter • Plan 	
C2C-CG-09	Once an Center is selected, the user shall be able to select a HAR from a list and provide the following information: <ul style="list-style-type: none"> • Target HAR • Text to be sent to the HAR 	
C2C-CG-10	Once an Center is selected, the user shall be able to select a Traffic Signal from a list and provide the following information: <ul style="list-style-type: none"> • Target Traffic Signal • Plan 	
C2C-CG-11	Once an Center is selected, the user shall be able to select	

Requirement Number	Requirement Description	Rationale or Comments
	a HOV from a list and provide the following information: <ul style="list-style-type: none"> • Target HOV • Plan 	
C2C-CG-12	Once an Center is selected, the user shall be able to select a School Zone from a list and provide the following information: <ul style="list-style-type: none"> • Target School Zone • Plan 	
C2C-CG-13	Once an Center is selected, the user shall be able to select a Reversible Lane from a list and provide the following information: <ul style="list-style-type: none"> • Target Reversible Lane • Plan 	
C2C-CG-14	Once an Center is selected, the user shall be able to select a Dynamic Lane from a list and provide the following information: <ul style="list-style-type: none"> • Target Dynamic Lane • Plan 	
C2C-CG-15	For each device command/control status request sent by the Remote GUI, the status returned from the network identifier will be displayed in a scrollable list on the GUI.	

2.3 Design and Construction Standards

The computer resource requirements are listed in Table 26.

Table 26. Computer Resource Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-DC-01	The C2C Server shall execute in a Microsoft Windows NT environment.	
C2C-DC-02	A DATEX/ASN runtime library shall be available on any computer communicating to the C2C project.	
C2C-DC-03	The web server application shall use ESRI's ARC Internet Map Server (ARC IMS) product for creating of map images.	

The Design and implementation requirements are listed in the in Table 27.

Table 27. Design and Implementation Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-DC-04	The C2C shall execute in a Microsoft Windows NT environment.	
C2C-DC-05	The C2C shall be implemented in the C/C++ programming language.	
C2C-DC-06	The C2C web interface shall be implemented using C/C++ and ESRI ARC IMS.	
C2C-DC-07	The Incident GUI shall be implemented using C/C++ and ESRI Map Objects.	
C2C-DC-08	The Remote Control GUI shall be implemented using C/C++ and ESRI Map Objects.	

2.4 Operational

The C2C Project shall be capable of operating in one of two modes: normal mode for normal operations or in test mode for development and testing. The requirements for these modes are listed in Table 28.

Table 28. Required States and Modes Requirements

Requirement Number	Requirement Description	Rationale or Comments
C2C-OP-01	The C2C shall be able to operate in normal mode. In this mode the C2C receives data from all connected systems, including the Incident GUI, and combines the data into a single data store (database).	
C2C-OP-02	The C2C shall be able to operate in test mode. In this mode, the C2C performs normal mode operations and also logs activities.	To provide additional information for development and testing.

APPENDIX A

ACRONYMS

ACRONYMS

ASN.1	Abstract Syntax Notation One
ATIS	Advance Traveler Information System
ATMS	Advanced Traffic Management System
CCTV	Closed Circuit Television
DATEX/ASN	DATEX/Abstract Syntax Notation
DFW	Dallas/Ft. Worth
DMS	Dynamic Message Sign
DT	Data Transmission
ESS	Environmental Sensor Stations
GI	Incident GUI
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicle
ICD	Interface Control Document
IMS	Internet Map Server
ISP	Information System Provider
ITS	Intelligent Transportation Systems
LCS	Lane Control Signal
MPH	Miles Per Hour
MULTI	Mark-Up Language for Transportation Information
NCTCOG	North Central Texas Council of Governments
NTCIP	National Transportation Communications for ITS Protocol
SRS	Software Requirements Specification
TBD	To Be Determined
TCP/IP	Transmission Control Protocol/Internet Protocol
TMC	Traffic Management Center
TMDD	Traffic Management Data Dictionary
TxDOT	Texas Department of Transportation
WWW	World Wide Web