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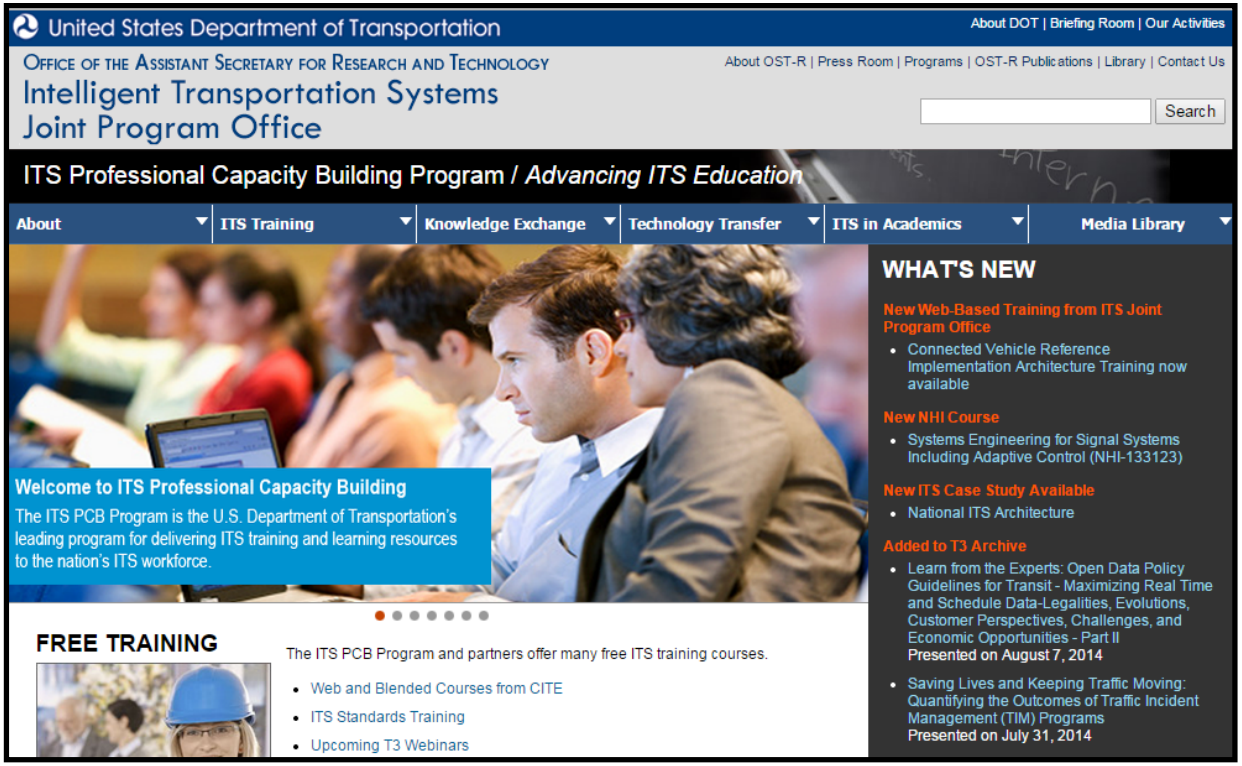
ITS Joint Program Office
Ken.Leonard@dot.gov



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ACTIVITY

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U.S. Department of Transportation
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A309a:
Understanding User Needs for Ramp Meter Control (RMC) Units Based on NTCIP 1207 v02 Standard

Instructor

Raman K. Patel, Ph.D., P.E.

President

RK Patel Associates, Inc.

New York City, NY, USA

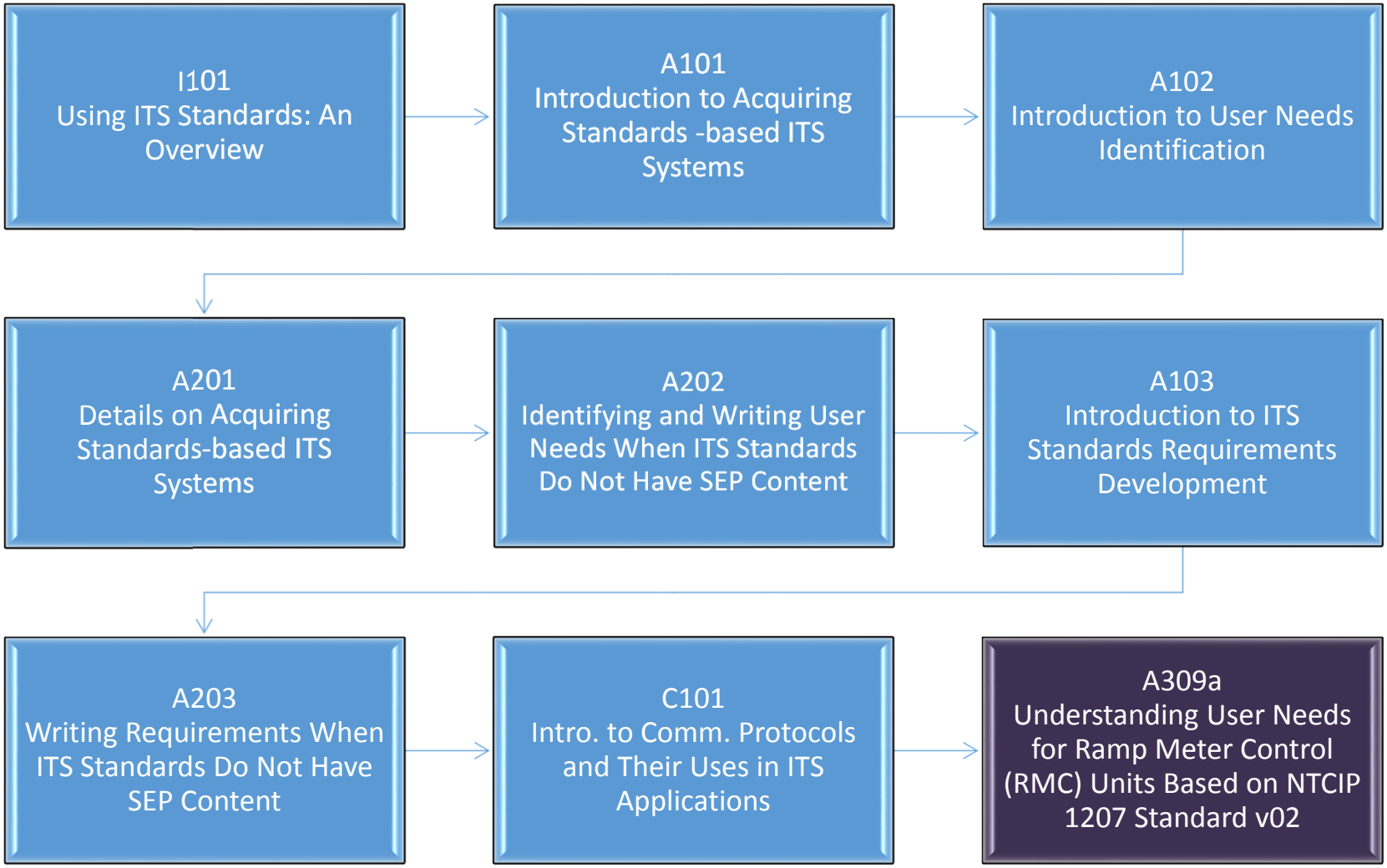
Target Audience

- Traffic management and engineering staff
- Traffic Management Center/operations staff
- Freeway and traffic signal maintenance staff
- System developers
- Private and public sectors users including manufacturers

Recommended Prerequisite(s)

- I101: Using ITS Standards: An Overview
- A101: Introduction to Acquiring Standards-based ITS Systems
- A102: Introduction to User Needs Identification
- A201: Details On Acquiring Standards-based ITS Systems
- A202: Identifying and Writing User Needs When ITS Standards Do Not Have SE Content
- A103: Introduction to ITS Standards Requirements Development
- A203: Writing Requirements When ITS Standards Do Not Have SE Content
- C101: Introduction to the Communications Protocols and Their Uses in ITS Applications

Curriculum Path



Learning Objectives

1. Review the structure of the NTCIP 1207 v02 Standard
2. Identify RMC-specific operational needs
3. Prepare well-written user needs for RMC units
4. Explain how to evaluate conformance to the RMC Standard

Learning Objective #1: Review the Structure of the NTCIP 1207 v02 Standard

- Definition of a ramp meter, reference layout, and architecture
- The NTCIP family of standards
- Purpose of the NTCIP 1207 v02 Standard
- Components of the NTCIP 1207 v02 Standard
- What is new in the v02 Standard?

Terminology

- **Ramp Meter** is a traffic controller (Type 170 or 2070 or ATC) equipped with software/firmware and algorithms specific to a freeway ramp to control (to meter) traffic flow entering freeway lanes

Source: Caltrans

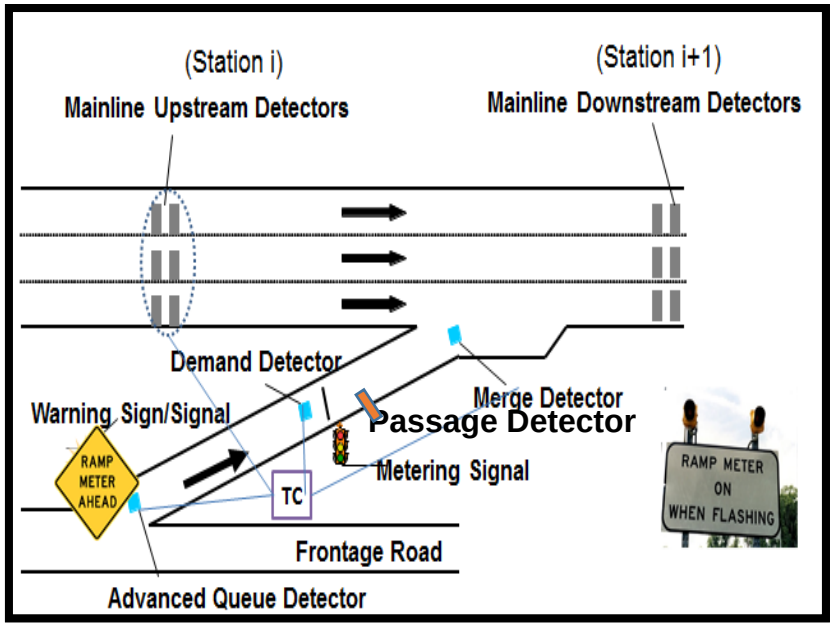
- **Ramp Metering** is a rate expressed in vehicle per hour per lane (vphpl), at which vehicles are allowed to proceed through the metered lane signal (release rate)

  Example: A ramp meter will allow 500 vph per lane (vphpl) release rate

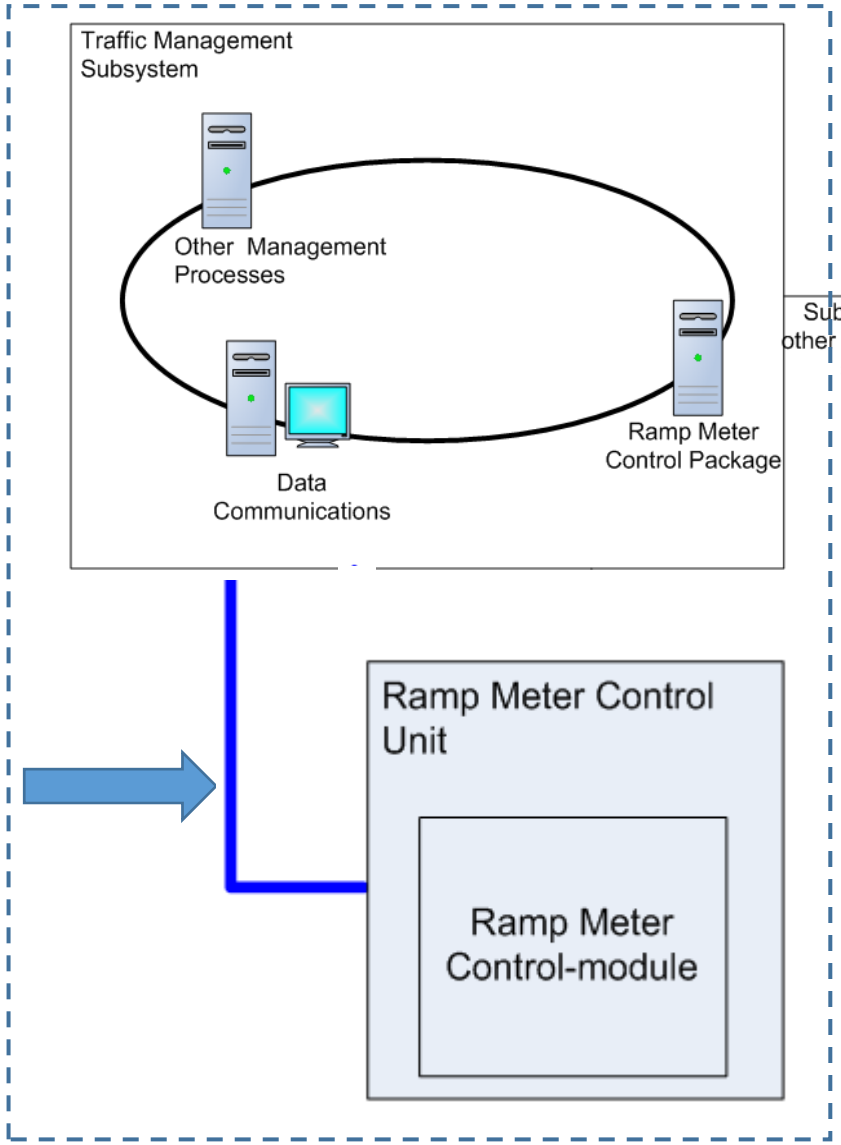
Ramp Metering Control (RMC) Unit

- **RMC** is a system in which the entry of vehicles onto a freeway from an on-ramp is controlled by a traffic signal, allowing a fixed number of vehicles to enter from each metered lane of the on-ramp during each cycle

- **RMC Unit** consists of the field **controller**, its suite of **sensors**, its warning **signs** and **signals**, and stop bar pavement marking



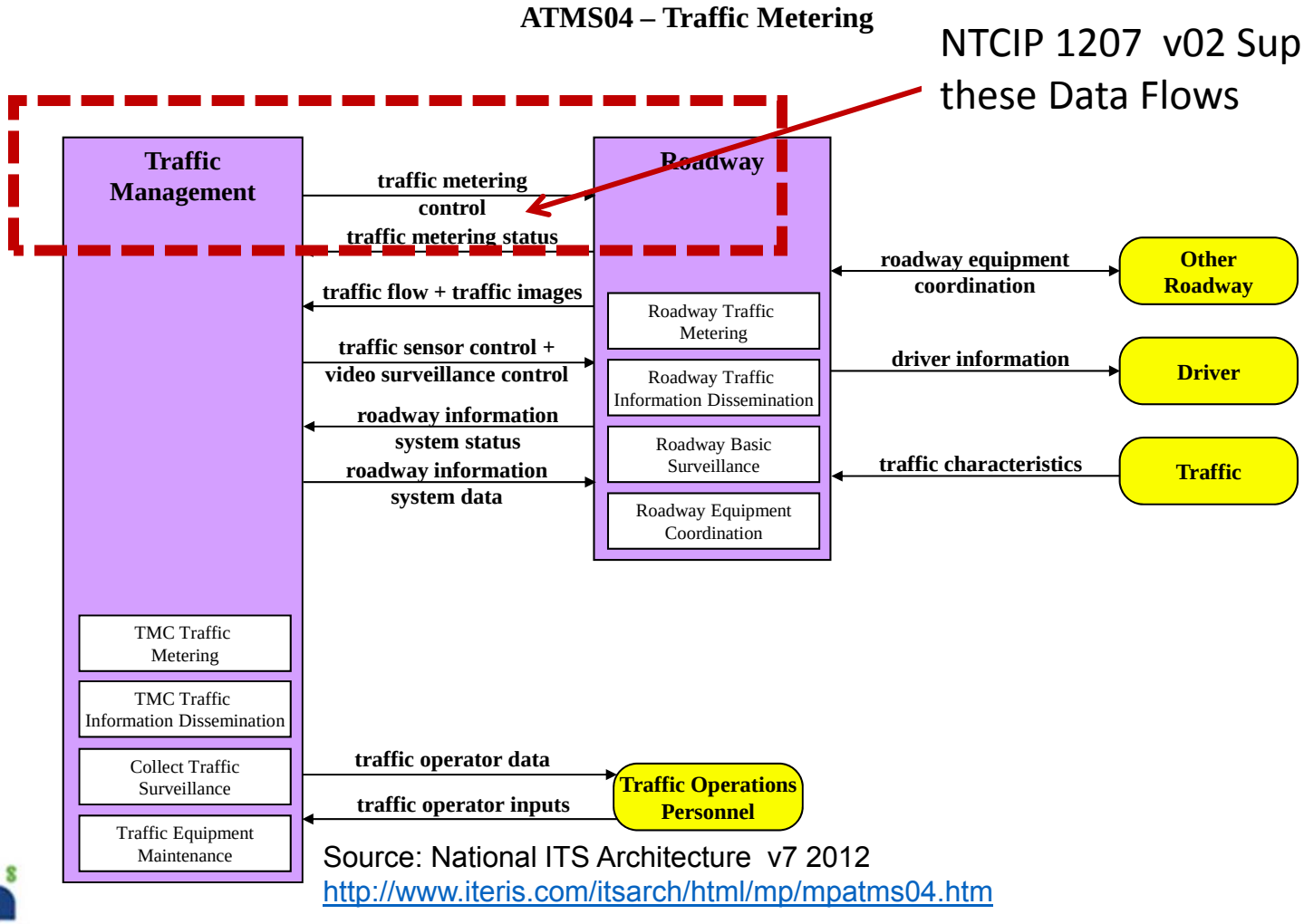
RMC Architecture Diagram



NTCIP
Subject matter of NTCIP 1207 – Ramp Meter Control Unit object definitions (THIS STANDARD)

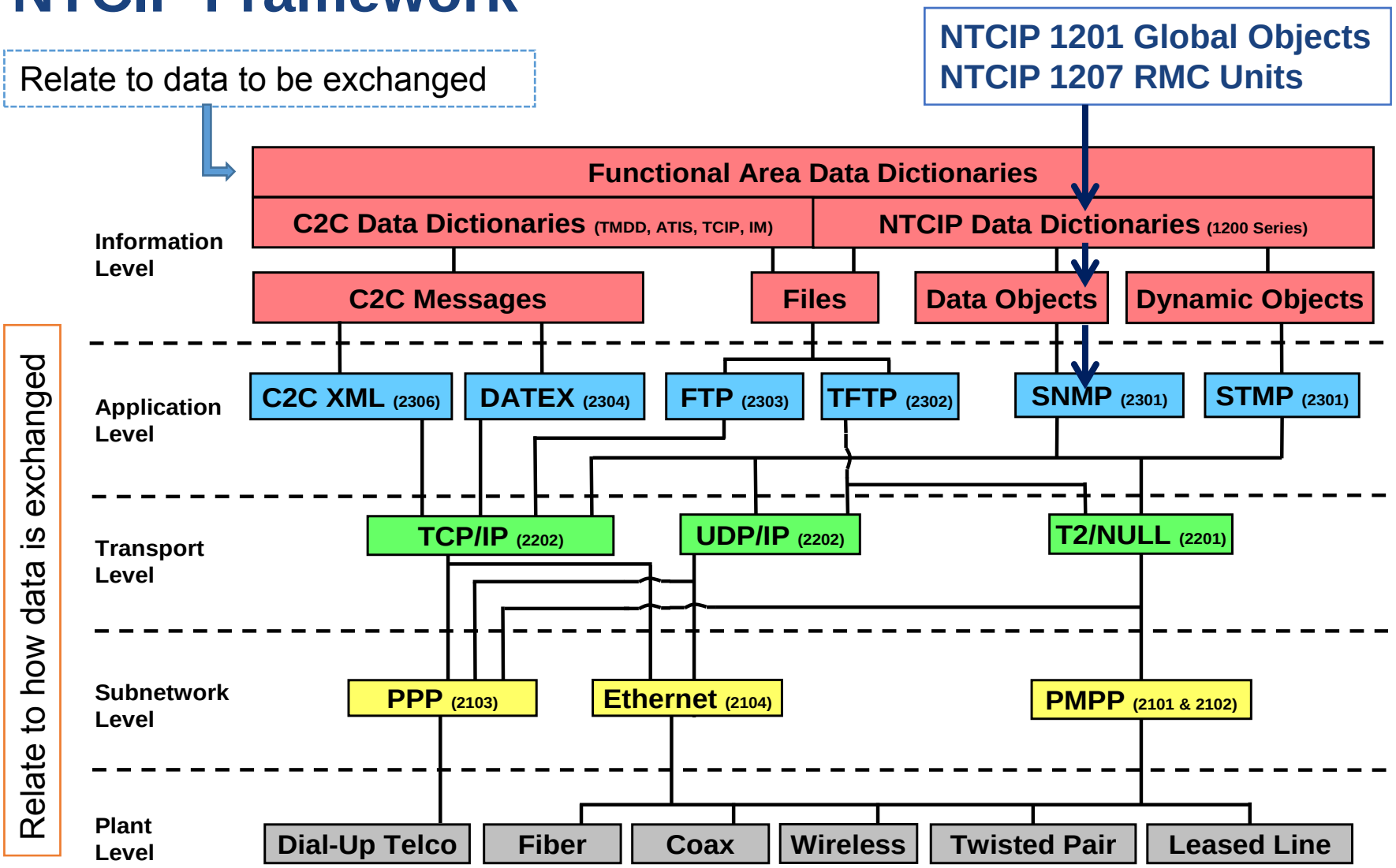
Traffic Management Data Dictionary (TMDD) and C2C Standards-NTCIP 2306 XML and NTCIP 2304 DATEX are deployed.

ITS Architecture
Traffic Metering Service Package (ATMS04)



Source: National ITS Architecture v7 2012
http://www.iteris.com/itsarch/html/mp/mpatms04.htm

NTCIP Framework



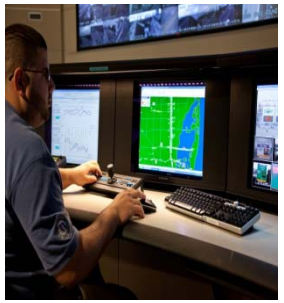
Source: NTCIP Guide

NTCIP 1207 v02 Standard Basics

- This standard assumes a mode of operation in which the RMC unit possesses intelligence, and data used for ramp management and data collection is **resident** at the RMC unit

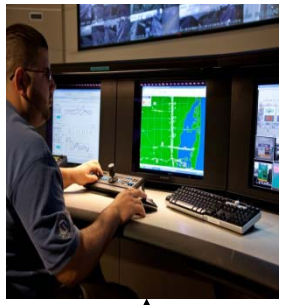
Source: Caltrans

- We refer to the RMC unit's status, control, and configuration data as the "controller database"; the standard specifies interfaces whereby this data can be manipulated by the central system



Source: FDOT

Benefits of ITS Standards



Source: FDOT

Interoperability

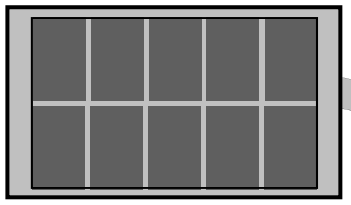
Interchangeability

NTCIP

Compatibility

New ATC

Source: NYCDOT



Source: ODOT

Older Type 170 or 2070 or ATC Controller

Components of the NTCIP 1207 v02 Standard

These sections provide general information about RMC units:

- SECTION 1 General
  - Scope, references, terms, definitions
- SECTION 2 Standard-Based RMC Systems
  - Benefits of standardization
- SECTION 3 Management Information Base (MIB)
  - RMC objects by functions
  - Abstract Syntax Notation 1 (ASN.1) Format

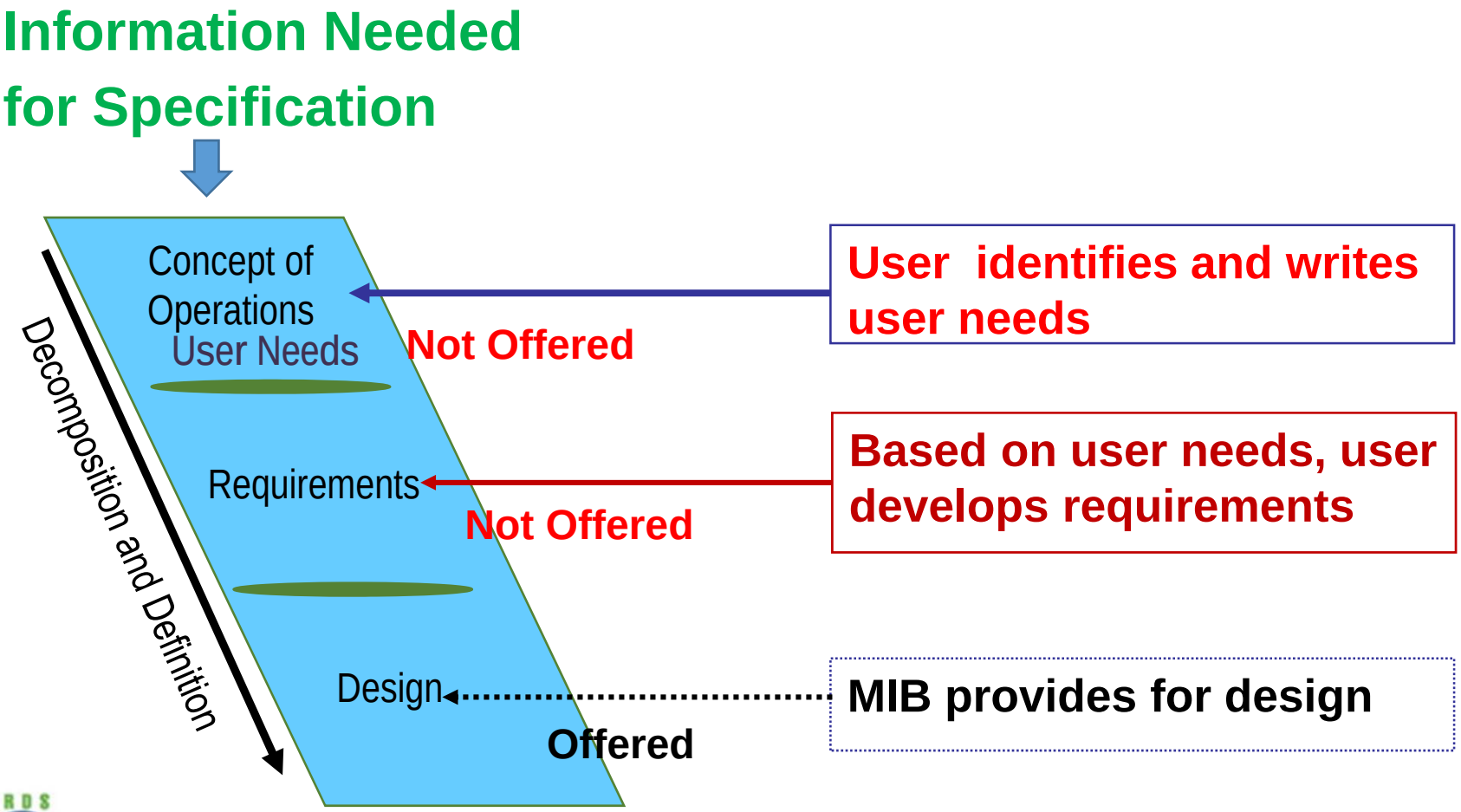
What is New in the NTCIP 1207 v02 Standard?

- New SECTION 4 RMC BLOCK OBJECT DEFINITIONS
  (Special objects to achieve transmission efficiency)

- New Annexes:

ANNEX A	RMC UNIT OPERATIONS DESCRIPTION
ANNEX B	PROTOCOL REQUIREMENTS LIST (PRL) Conformance Groups (CGs)
ANNEX C	OBJECT TREE
ANNEX D	(FUTURE TEST PROCEDURES)
ANNEX E	DOCUMENT REVISIONS

What is NOT offered by the NTCIP 1207 v02 Standard?



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Which of the following statements is FALSE as applied to the NTCIP 1207 v02 Standard?

Answer Choices

a) Standard is independent of the type of the ramp traffic controller

b) MIB provides design objects for RMC functions

c) RMC user needs are listed

d) Ramp metering module resides in the traffic controller

Review of Answers

a) Standard is independent of the type of the ramp traffic controller

Incorrect. The standard is independent of the type of controller used as a ramp meter.

b) MIB provides design objects for RMC functions

Incorrect. The MIB does provide design objects.

c) RMC user needs are listed

Correct! The statement is indeed a FALSE; RMC user needs are not listed.

d) Ramp metering module resides in the traffic controller

Incorrect. Each ramp meter has a metering module in it.

Summary of Learning Objective #1

Review the Structure of the NTCIP 1207 v02 Standard

- Defined an RMC unit and the components, and have reviewed layout and system architecture
- Reviewed the NTCIP family of standards and benefits
- Reviewed the purpose, structure of the standard, and key components
- Reviewed what is new in the v02 Standard

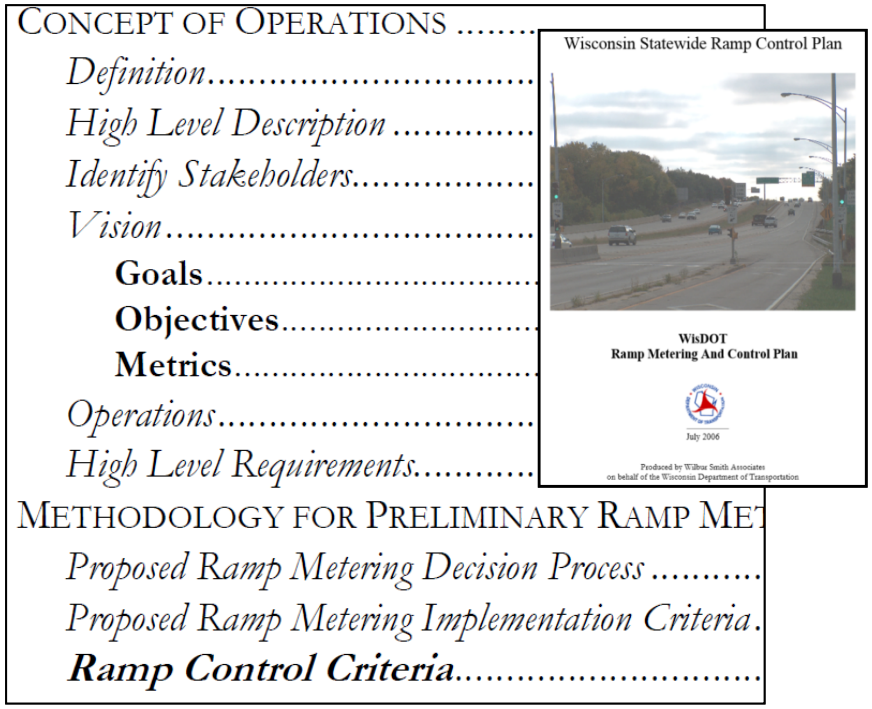
Learning Objective #2: Identify RMC-Specific Operational Needs

- What are your operational needs and why?
- How does the RMC Standard cover operational needs for freeway management applications?
  - Command sources (manual, communications, interconnect, default) and priorities
  - Communications actions (fixed rate, traffic responsive, corridor-wide coordinated)
- Identify key features from NTCIP 1207 v02 Standard Annex-A: RMC Operational Description

What are your Operational Needs and Why?

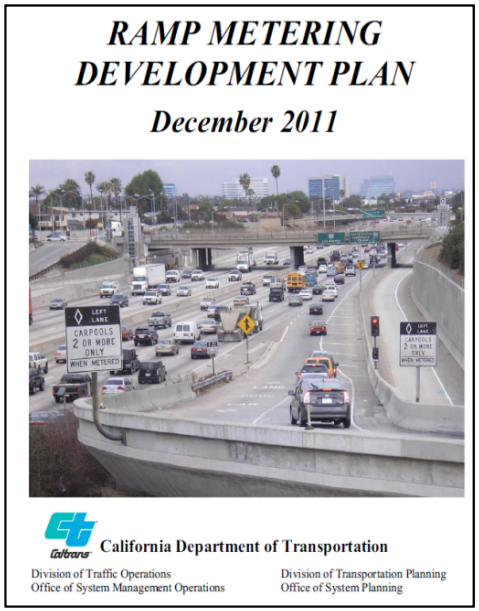
Analyzing Concept of Operations (ConOps) for Needs

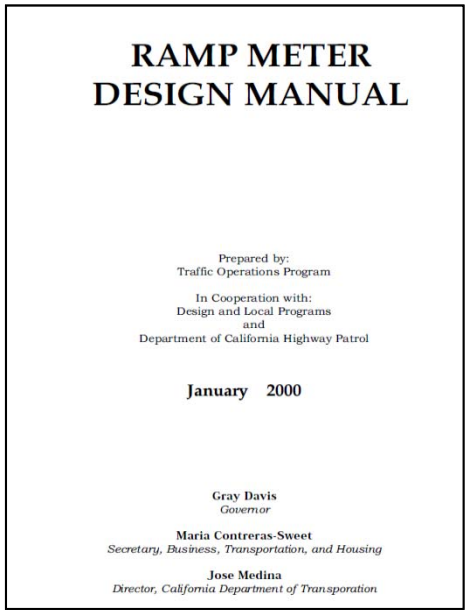
- ConOps document reveals a “big picture":
  - What is the current situation or problem?
  - Who are the users? Who is affected?
  - What are the operational scenarios?
  - Are there any corridor-wide or regional aspects?

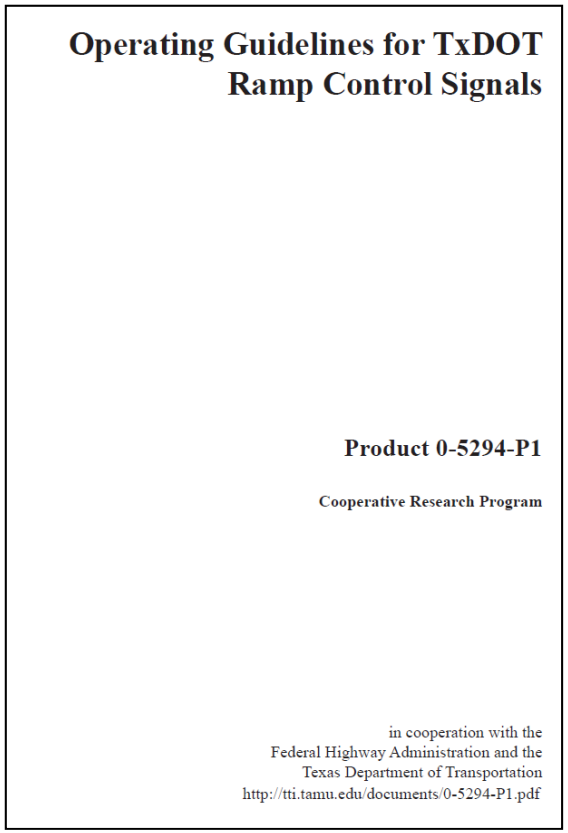


Sources of Operational Needs

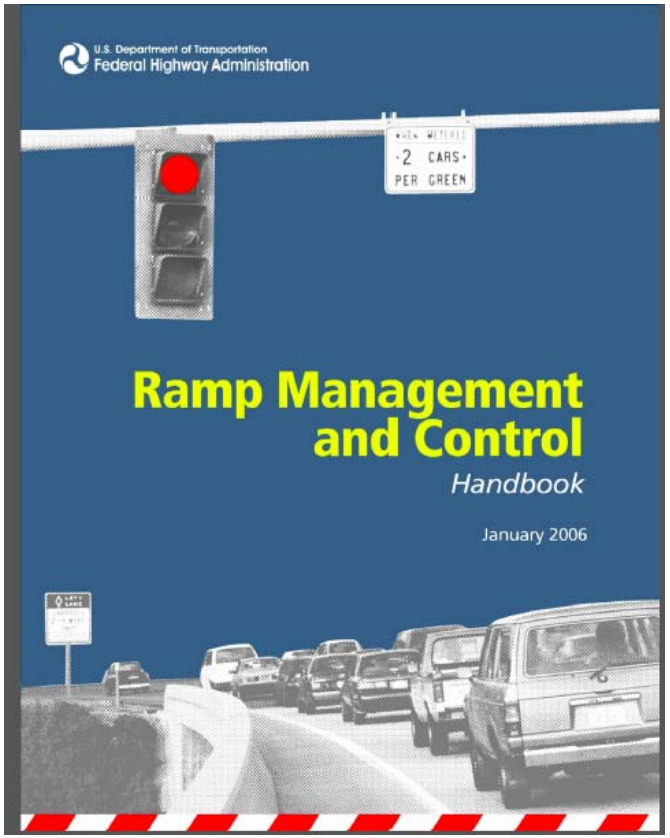
- Agency documentation:
  - Development plan
  - Design documents
  - Architecture and subsystem requirements

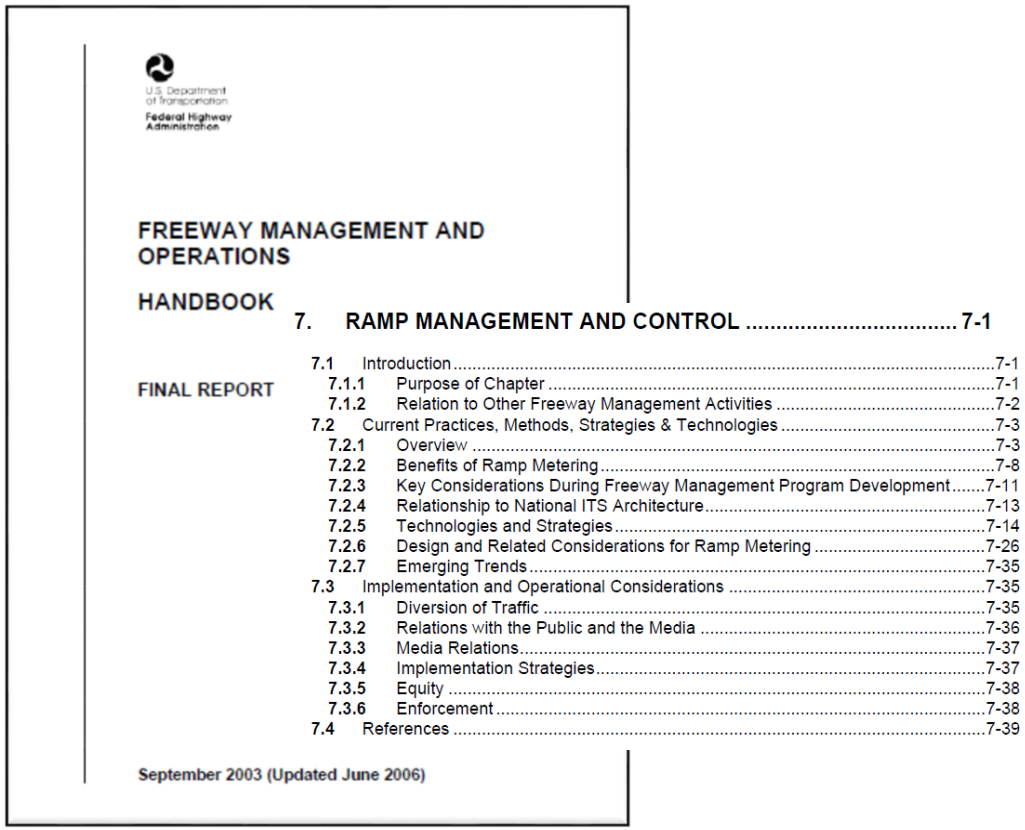






Additional Sources of RM Practice Information





U.S. Department of Transportation
Federal Highway Administration

FREEWAY MANAGEMENT AND OPERATIONS

HANDBOOK

FINAL REPORT

September 2003 (Updated June 2006)

http://ops.fhwa.dot.gov/publications/ramp_mgmt_handbook/manual/manual/pdf/rm_handbook.pdf

http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/report_info.htm

Operational Needs

Balance Freeway Capacity Demand by Controlling On-Ramp Traffic

- **Achieving greater efficiency with:**
  - Improved freeway flow
  - Increased freeway speed
  - Reduced overall travel time
- **Achieving safety improvements with:**
  - Reduction in overall freeway accidents
  - Providing smoother, safer merging

Source: WSDOT

Operational Needs (cont.)

- **Improving Traffic Incident Management (TIM) practice with:**
  - Reduced clearance time
  - Coordination within the corridor
  - Roadway closures and detours management

Source: FHWA

Summary of Operational Outcomes/Benefits

Efficiency Benefits

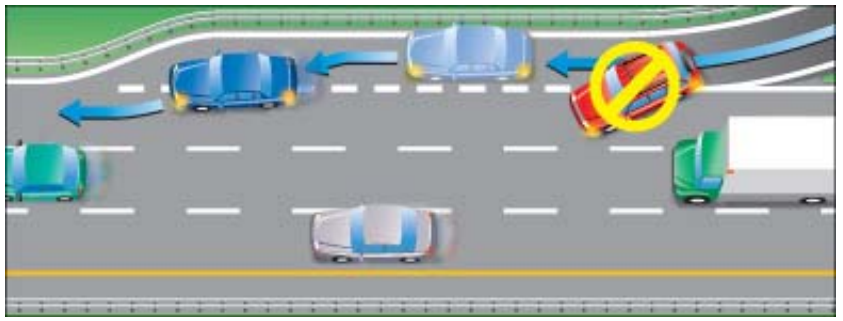
Operating Agency	Flow Volume Increase	Average Speed Increase	Travel Time Reduction
Detroit, MI	+14%	+8%	
Long Island, NY	+9%	+35%	-20%
Minneapolis, MN	+25%	+16%	-6 to -16%
Portland, OR		+173%	
Seattle, WA	+74%		-52%

Source: FHWA RM Handbook

Summary of Safety Outcomes/Benefits

	Safety Benefits
Operating Agency	Merging Accident Decrease
Detroit, MI	-50%
Long Island, NY	-15%
Minneapolis, MN	-24%
Portland, OR	-43%
Seattle, WA	-39%

Source: FHWA RM Handbook



Source: Ministry of Transportation, Canada

Operational Actions

Agencies Implement Metering Strategies to Influence Outcomes (Benefits)

- Balance demand (entering ramp traffic) and capacity (mainline flow)
- Implement metering actions:
  1. **Fixed rate** is a preplanned release rate determined using historical data or periodic field observations.
  2. **Traffic responsive** rate is calculated or selected based on the current measured conditions on the mainline
     - Local traffic responsive (one ramp)
  3. **System-wide traffic responsive** is a strategy to control ramps in a section-corridor using a central system algorithm (adaptive metering)

Fixed Rate Metering Action

Regulate **Traffic On-Ramp** Based on the Historical Data with
Fixed Rate Metering
(Time of Day or Pre-Timed)

Source: MTC-CA

ONE Metered Lane
240-**900** vph for single lane

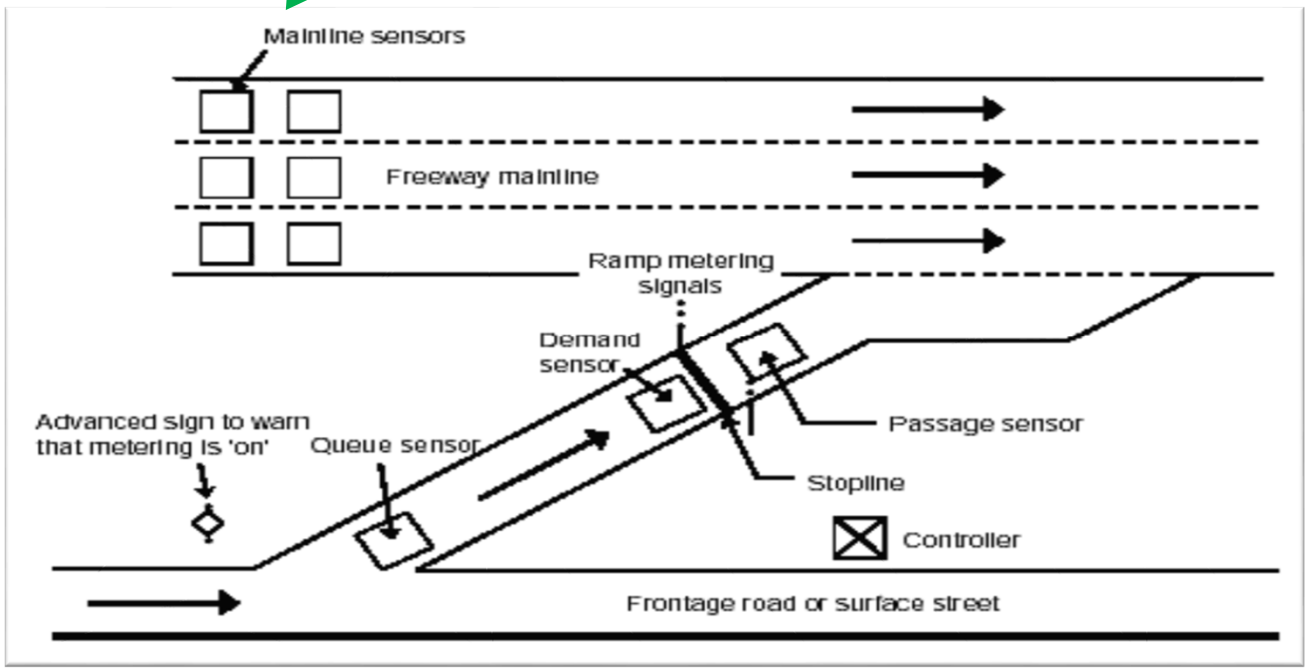
Source: MTC-CA

TWO Metered Lanes
400-**1700** vph for dual-lane

Data Source: Freeway M&O Handbook

Traffic Responsive Action

Regulate **Traffic On-Ramp** with a Traffic Responsive Metering Plan, Developed Based on **Real-Time Data** (***Occupancy, Flow Rate, Speed***)



Traffic Responsive Terminology

- A **metering plan** is a preconfigured look up table
- Each plan contains several **metering levels**
- Each level provides the suitable **metering rate** to *respond* to the current condition

- Mainline detectors report current **occupancy**
- Current occupancy is compared with the stored threshold data set for *occupancy*, *flow rate,* and *speed,* providing a **metering rate**

Illustration of Traffic Responsive Scenario

8 AM

Source : Minnesota DOT

Occupancy (%)	Metering Rate (Vehicles/Minute)
≤ 10	12
11 – 16	10
17 – 22	8
23 – 28	6
29 – 34	4
> 34	3

Source: FHWA Freeway M&O Handbook
Based on TRB NCHRP Report 232, 1981-Chicago

9 AM

Source: FHWA

Average occupancy = 20%

Metering Rate =8x60=480 vphl

Current occupancy = 31%

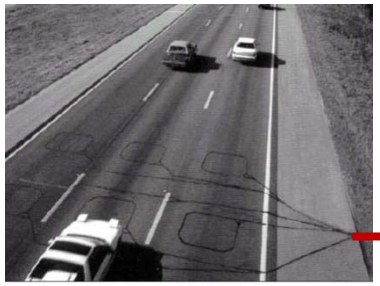
New metering rate = 4 x 60 = 240 vph

Summary: Example shows that RMC unit provided two metering levels. Levels are thus ***"Presets".***

How Does the RMC Standard Cover Operational Needs?

Provides for Management of Functions (Features)

Measure Current Condition



Source: FHWA

Source: NYSDOT

Request Action
Remote Command

Source: Caltrans

Store and Implement Plan
Compute Metering Rate
Using Module-Software

Display Intervals
Control Cycle
Metering

Source: Caltrans

Credit: MARK RIGHTMIRE
ORANGE COUNTY REGISTER

Sign
Control

Source: Caltrans

How Does the RMC Standard Cover Operational Needs? (cont.)

Provides for Mechanism to Request an Action from the RMC Unit though Command Sources

Source: Caltrans

3. Interconnect

2. Communication Command (NTCIP)

1. Manual (Highest Priority)

4. Time Base Control (Scheduled-Holidays Special Events)

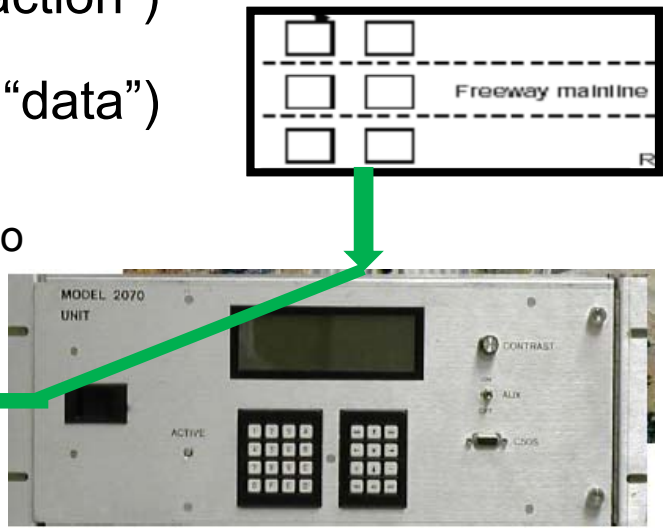
How Does the RMC Standard Cover Operational Needs? (cont.)

Using a Third Party Software, Communications Command Source Remotely Exchanges Data With the RMC Unit:

- To inquire about current **configuration** and change configuration
- To **control** functions-parameters (requests "action")
- To **monitor** operations-conditions (requests "data")

Source: NYSDOT

Accumulated data is available to the central software to further optimize operation



Source: Caltrans URMS User Manual

Identify Key Features (User Needs) from the NTCIP 1207 Annex A

1. **Freeway Segment:**
   - Number of lanes
   - Lane's ID number
   - Mainline detectors (volume, speed, occupancy)
   - Upstream station-Downstream station
2. **ON-Ramp Operation:**
   - Number of metered lanes
   - Lane's ID number
   - Detectors (demand, queue, passage)
   - Advanced warning signs and control
   - Traffic responsive plans-N
   - Metering levels-N
   - Signal service-green/yellow/red

Identify Key Features (User Needs) from the NTCIP 1207 Annex A (cont.)

3. **Command Sources:**
   - Manual
   - Communications
   - Interconnect
   - Time-base control
   - Default
4. **Command Actions:**
   - Fixed rate
   - Traffic responsive
   - Rest-in-dark
   - Rest-in-green

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Which of the following is a FALSE statement related to traffic responsive operation?

Answer Choices

a) A TMC operator can remotely retrieve traffic flow data

b) Communications command source has the highest priority

c) Metering levels are part of a metering plan table

d) RMC-module is located within the RMC unit

Review of Answers

a) A TMC operator can remotely retrieve traffic flow data

Incorrect. The statement is true.

b) Communications command source has the highest priority

Correct! The statement is FALSE. Manual command source has the highest priority, followed by the communications source command.

c) Metering levels are part of a metering plan table

Incorrect. The statement is true.

d) RMC-module is located within the RMC unit

Incorrect. The statement is true.

Summary of Learning Objective #2

Identify RMC-Specific Operational Needs

- We have reviewed the RMC-specific operational needs and why
- Reviewed how the standard covers priority-based mechanism for command sources such as manual or communications for controlling an RMC unit
- Discussed communications actions including fixed rate, traffic responsive, and corridor-wide
- Identified key RMC user needs from the Annex A operational descriptions

Learning Objective #3: Prepare Well-Written User Needs for RMC Units

- User needs do not exist for the RMC Standard and agencies must develop them for the acquisition process
- Explain how user needs are extracted and written for RMC procurement
- Discuss what to do if certain user needs are not met by the RMC Standard

What is a User Need?

- A user need is a description (a statement in a specification) of what the RMC system should do to support operations: Features/Functions
    - **Example**: A TMC operator needs to make a request to the RMC unit to change the current ramp metering rate…
- As a first step, users must first identify this user need and then write it for an RMC unit specification

Criteria for Writing a "Well-Written" User Need

When writing a user need, one must remember that it addresses an operational problem and describe it using the following recommended criteria:

1. Provide a structure by assigning a unique number and title to make it **uniquely identifiable**.

2. Identify (one or more) **major desired capability** (MDCs) by including a function(s) or feature(s) you desire from the device/system.

3. Capture the **rationale** by stating why it is needed by the user.

4. Keep it **solution-free**: Do not get into how to meet it (design).

Applying the Criteria: Example

UN #1 Change a Metering Rate **uniquely identifiable**

A TMC operator (management station) has a need to make a request to the RMC unit to change the current ramp metering rate to a new

Major Desired Capability

metering rate in order to meet current traffic flow conditions on a freeway

Rationale

segment.

~~*This should be done by providing …….*~~ **Solution-Free**

Where Do We Find RMC User Needs?

- **Explore** the following sources for user needs:
  - Operational needs: Agency metering policy and freeway traffic management ConOps
  - NTCIP 1207 v02 **Annex A** RMC unit operations description (provides functionality-key features details)
  - NTCIP 1207 v02 **Annex B** conformance groups (provides groupings of related objects)
  - Common (generic) architectural user needs from the SEP-based NTCIP 1204 v03 ESS Standard (Annex F)

Advice on How to Use Information Sources

Annex B CGs Cover RMC Functionality

- Read the annex to gain an insight into RMC **features** (**functions)**
- Understand how CGs act as a **traceability** tool for user needs and functionality
- Note how each CG lists design objects needed for a specification

Annex A Descriptions Explain RMC Operations

- Read the annex to gain better understanding of the RMC **operational parameters**
- Operations descriptions are inconsistent with SEP-based user needs, but they do discuss RMC parameters which we need for a specification

Suggestion for User Needs Organization

Types of RMC User Needs

- **Architectural** user needs for general communication capabilities
- **Features** (Functions) desired from the RMC unit
- **Special** local project needs not addressed above

RMC User Needs

2.0 Background Information

2.1 Architectural User Needs (generic)

2.1.1 Provide Live Data Exchange

2.1.2 Provide Off-Line Logged Data

2.1.3 Provide Retrieval Capability

2.2 Features (Functions)

2.2.1 Managing Configuration

2.2.2 RMC unit Control

2.2.3 Monitoring Status

2.3 Supplemental Needs

2.3.1 (if applicable)

Note: Section 2 and UN ID are shown as illustration

Approach to Architectural User Needs

Based on NTCIP 1204 v03 ESS Standard Annex F

UN 2.1.1: Provide Live Data Exchange

A management station (central software) has a need to conduct a **live data exchange** with the RMC unit to retrieve any set of data at any time.

UN 2.1.2: Provide Logged Data Exchange

A management station has a need to **log data** and to **retrieve data** at a later time from the RMC unit in a situation when communication is lost or is not always on communication (e.g. dial-up links).

UN 2.1.3: Provide Capability to Retrieve RMC Identity

A TMC Operator **desires to inquire** basic information about the RMC unit such as its location, make, model, and version of the device components.

MDCs are shown in green text

Approach to Finding User Needs from Annex A

Step1: Identify sections

- ✓ *A. 5.1 Fixed rate*
- ✓ *A. 8.3 Metering operation, signal intervals*
- ✓ *A. 9 Queue override*

- ✓ *A. 5.2 Traffic responsive metering*
- ✓ *A. 7.1 Metering plan*
- ✓ *A.7.2 Metering rate*
- ✓ *A.8.3 Metering operation-signal intervals*
- ✓ *A.2, A.4 Mainline Detectors*

Step 2: Use writing criteria: Provide ID, MDC, rationale, and solution-free

Finding User Needs from Annex A and Applying Writing Criteria

UN 2.4 Fixed Rate

*The agency desires to implement a **fixed metering** rate selected by the central system (or locally) based on a Time of Day Schedule to **control ramp traffic** for each metered lane. Currently, the agency intends to assign the left lane as priority (HOV) lane and the right lane as a common lane.*

Unique ID

Rationale

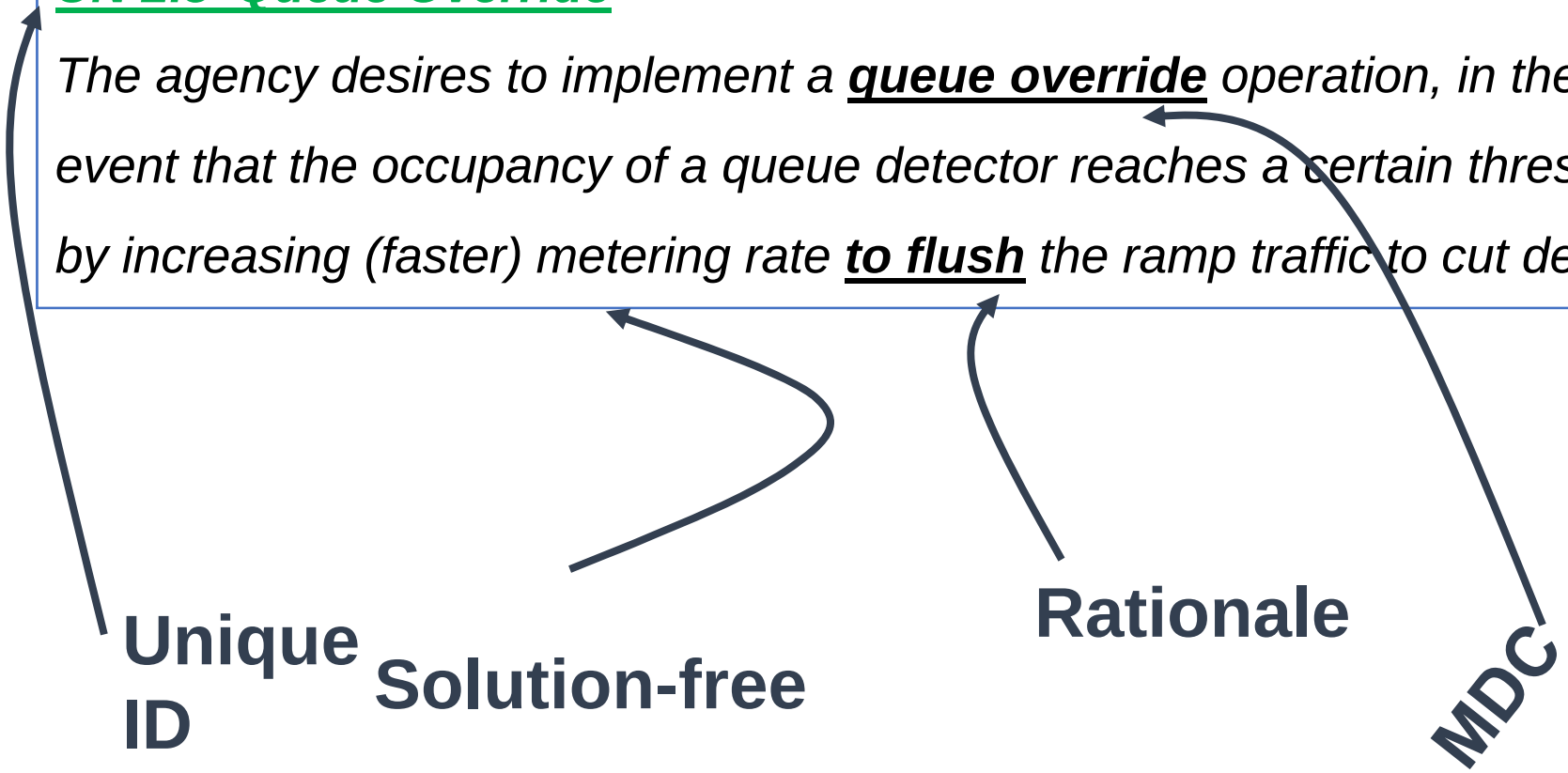
Solution-free

MDC

Finding User Needs from Annex A and Applying Writing Criteria (cont.)

UN 2.5 Queue Override

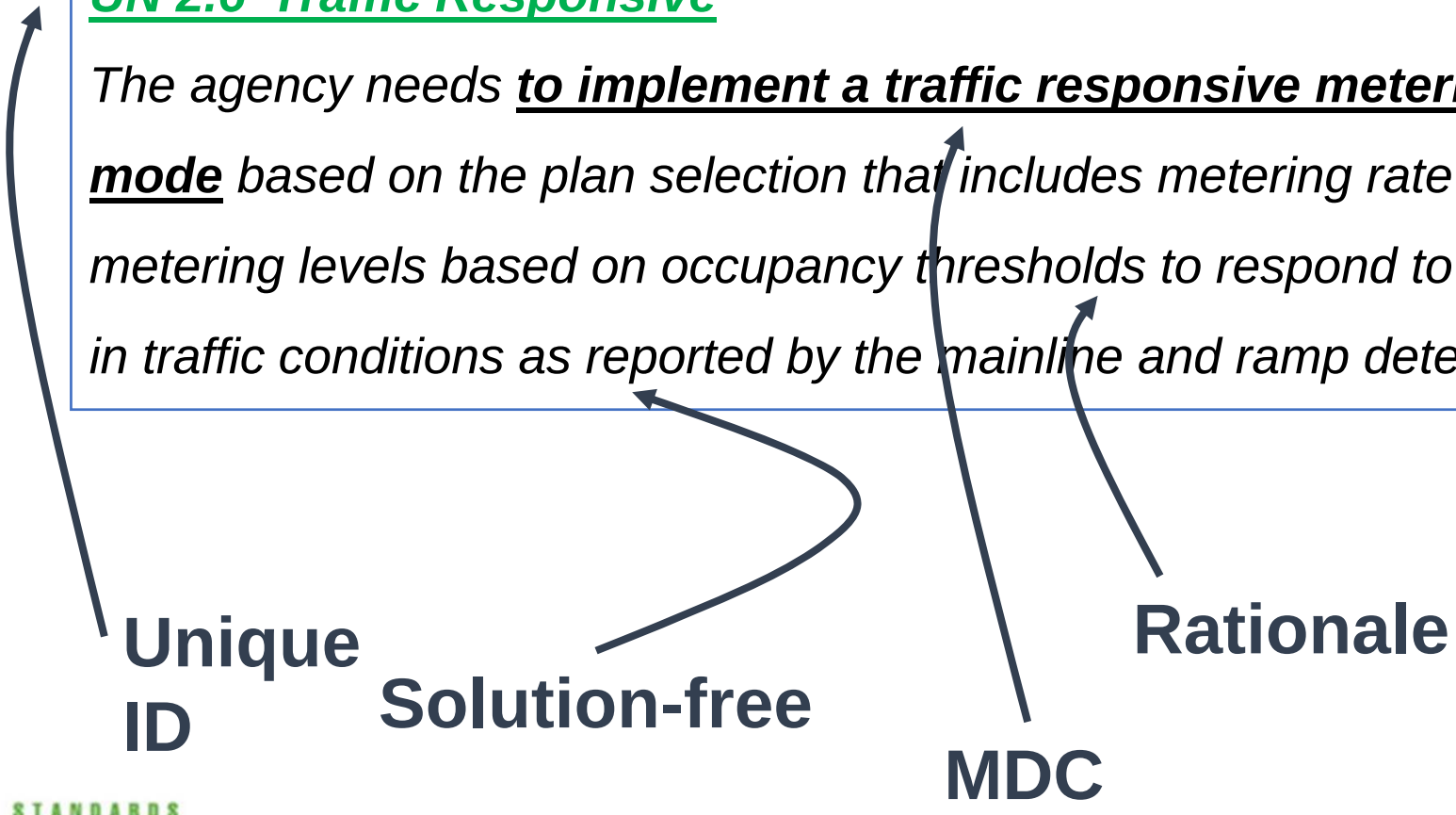
*The agency desires to implement a **queue override** operation, in the event that the occupancy of a queue detector reaches a certain threshold by increasing (faster) metering rate **to flush** the ramp traffic to cut delays.*



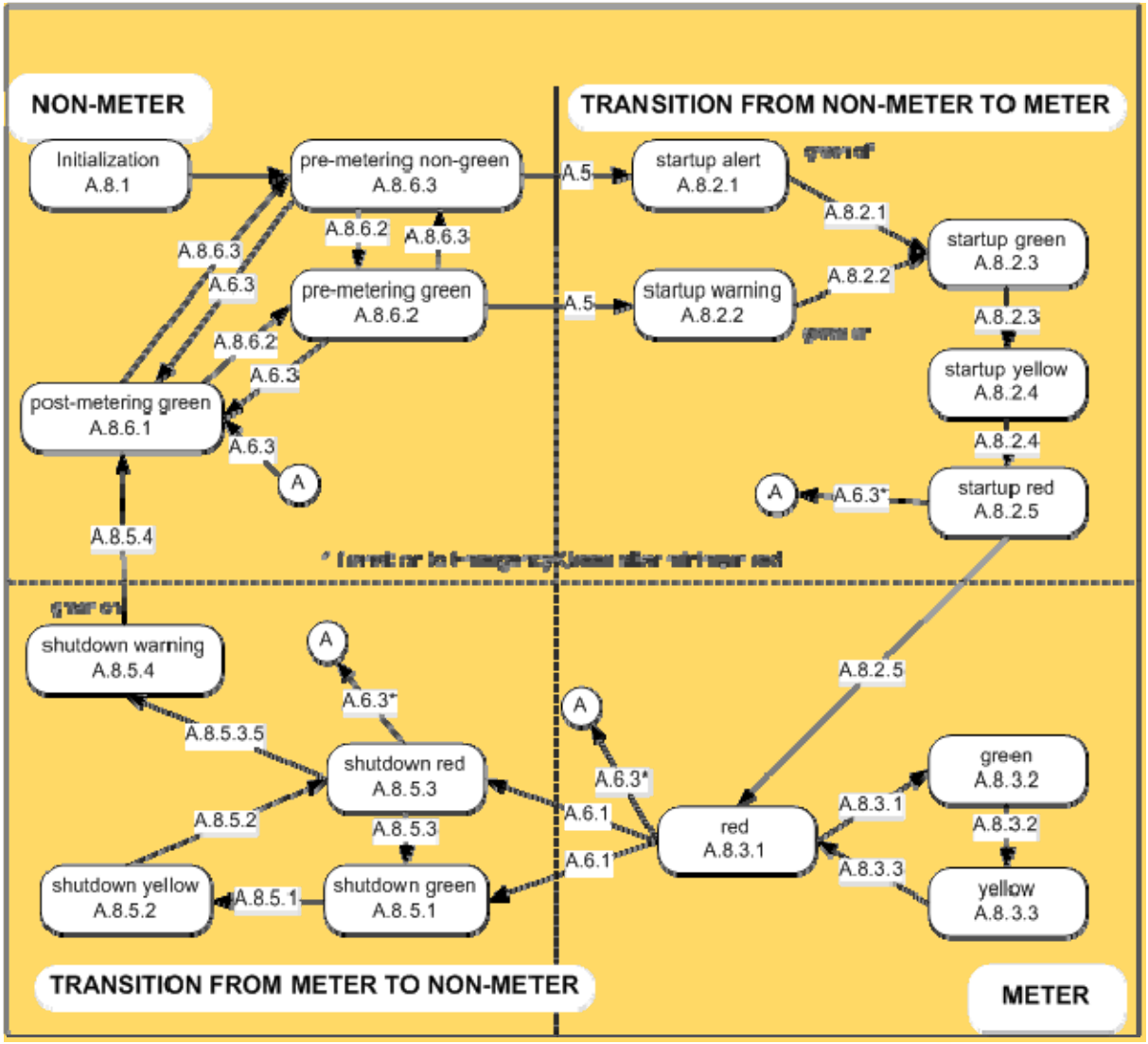
Finding User Needs from Annex A and Applying Writing Criteria (cont.)

UN 2.6 Traffic Responsive

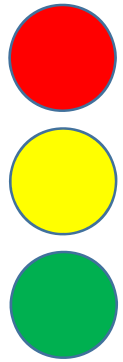
*The agency needs **to implement a traffic responsive metering mode** based on the plan selection that includes metering rate and metering levels based on occupancy thresholds to respond to change in traffic conditions as reported by the mainline and ramp detectors.*



Deriving User Needs from the State Diagram
(page 8)



METER ON



Source: NTCIP 1207 v02

Deriving User Needs from State Diagram and Applying Writing Criteria

UN 2.7 Signal Service

The agency needs to adhere to transitioning from a non-metering state to a metering state within the intervals of alert, warning, green-yellow-red intervals, and during a non-metering state control of an advanced warning sign.

Unique ID

Solution-free

MDC

Rationale

Deriving User Needs from State Diagram and Applying Writing Criteria (cont.)

UN ID 2.8 Transitioning

During a non-metering *state, the RMC unit* ***ceases all metering*** *and signalized control. Advanced warning signs and all signal lamps are to be dark while in this state. This mode is implemented at the* ***end of a*** *metering cycle green interval. Detector monitoring continues without interruption in processing while the controller is in the non-metering state.*

Unique ID

Solution-free

MDC

Rationale

Finding User Needs from the Conformance Groups (Annex B)

A CG is a Grouping of Related Objects that Supports a User Need(s)

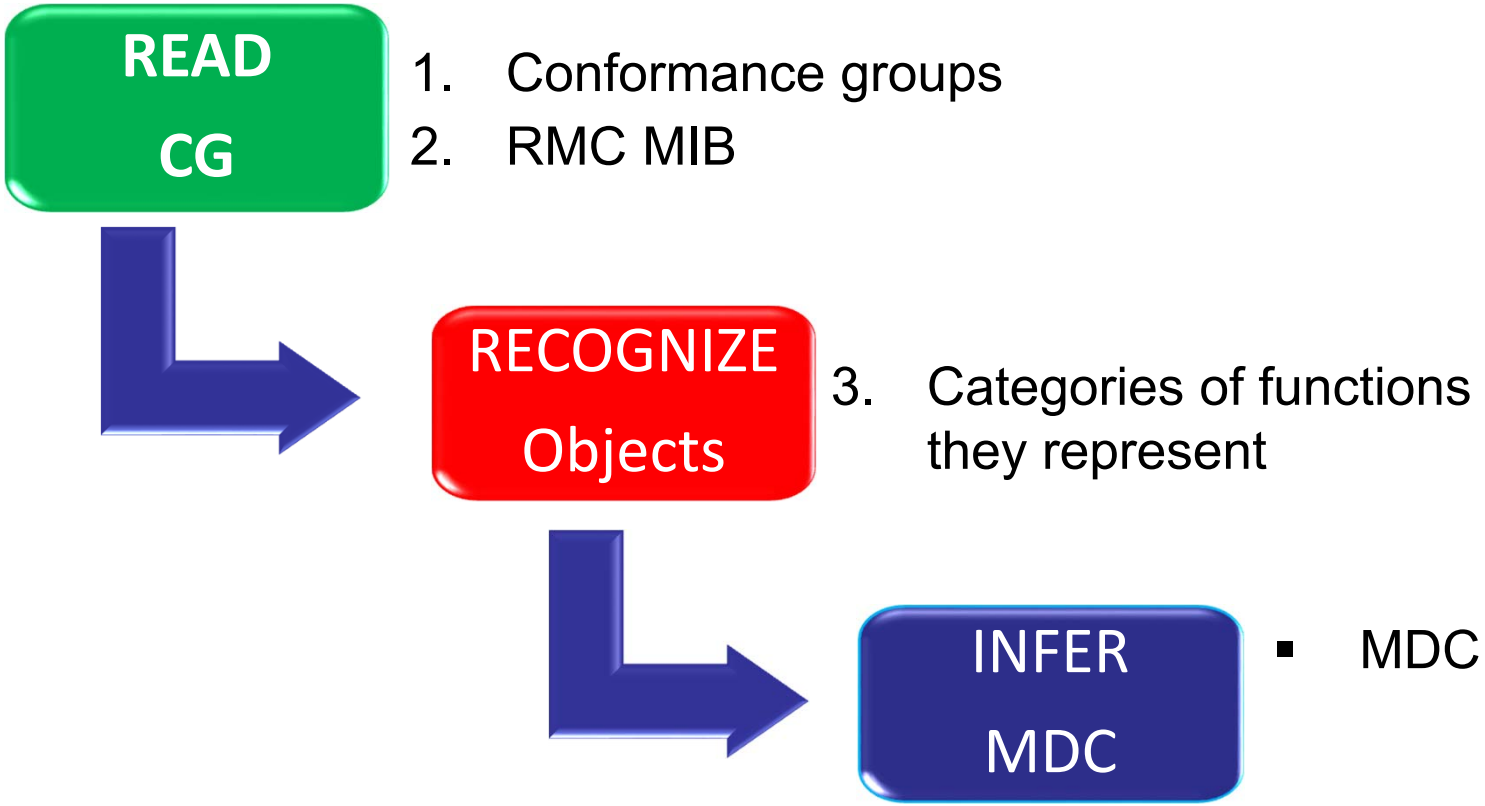
B.3	General Configuration	Basic Set Up of the Device
B.4	Traffic Responsive	Implement Metering Plan
B.5	Metered Lane-Demand Detector	Metering Operation (Action)
B.6	Dependency Group	Relationship to other Lanes
B.7	Queue Detection	Measure Ramp Volume
B.8	Passage Detection	Checkout-Vehicle has Passed
B.9	Time Base	Global Scheduling
B.10	Physical I/O	Assignments-Sign Control
B.11	Block Object	String of Objects to Move Data

Content of (B.5) Metered Lane Conformance Group (page 189)

This CG is Mandatory and Generates Minimum Set of User Needs

- Functions (actions) performed (as requested by a command source):
  - Fixed rate
  - Traffic responsive
  - Dark
  - Rest-in-green, rest-in-red
  - Emergency green
  - Vehicle per green
- Demand detection

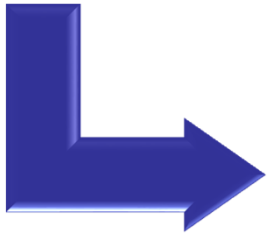
How to Apply a Generic Process for Extracting MDC from a CG



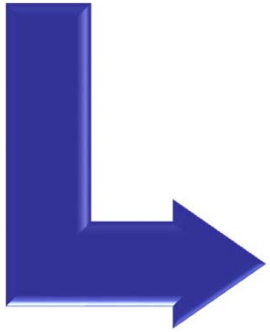
Example: Applying a Generic Process

B.4 Traffic Responsive CG listed on page 187

2. *On page15, find clause*

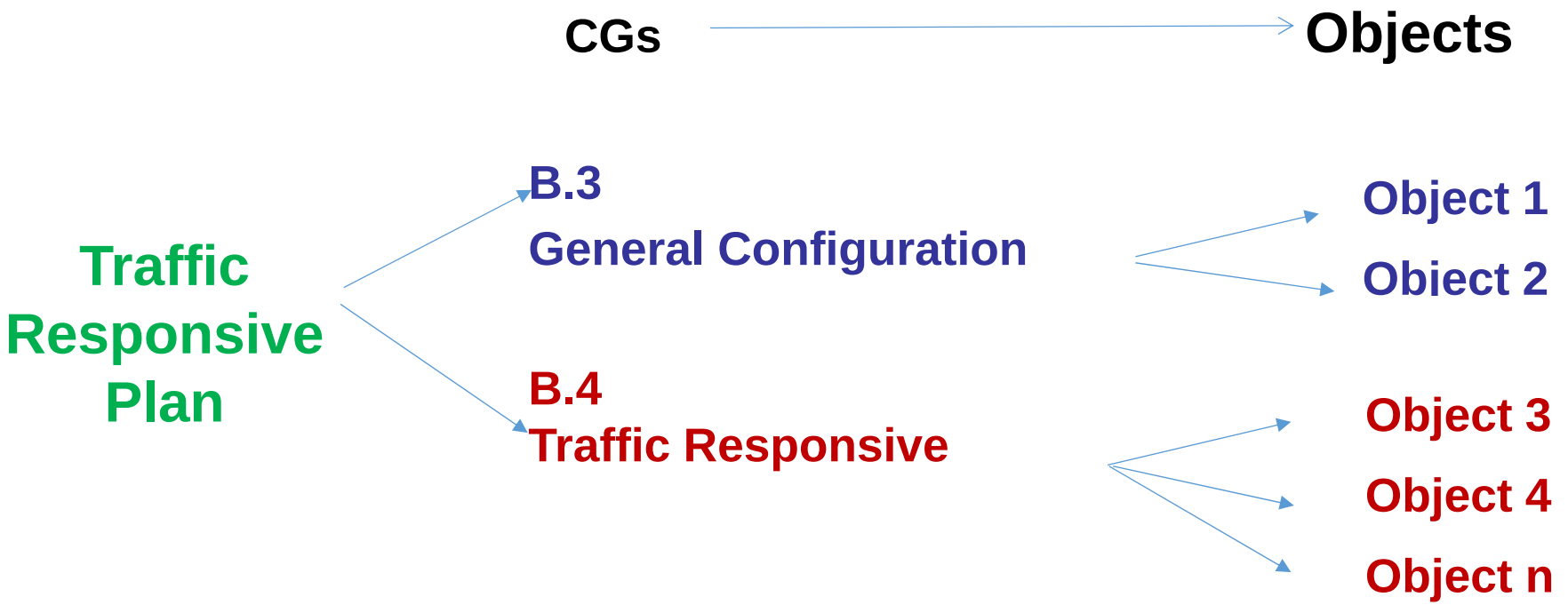


3.3.2 Maximum Number of Mainline Lanes
rmcMaxNumML OBJECT-TYPE
SYNTAX INTEGER **(1..255)**
ACCESS read-only
STATUS mandatory



3. Infer MDC, **N** lanes to be covered in the traffic responsive plan, for the direction of flow

Extracting MDCs from Multiple CGs

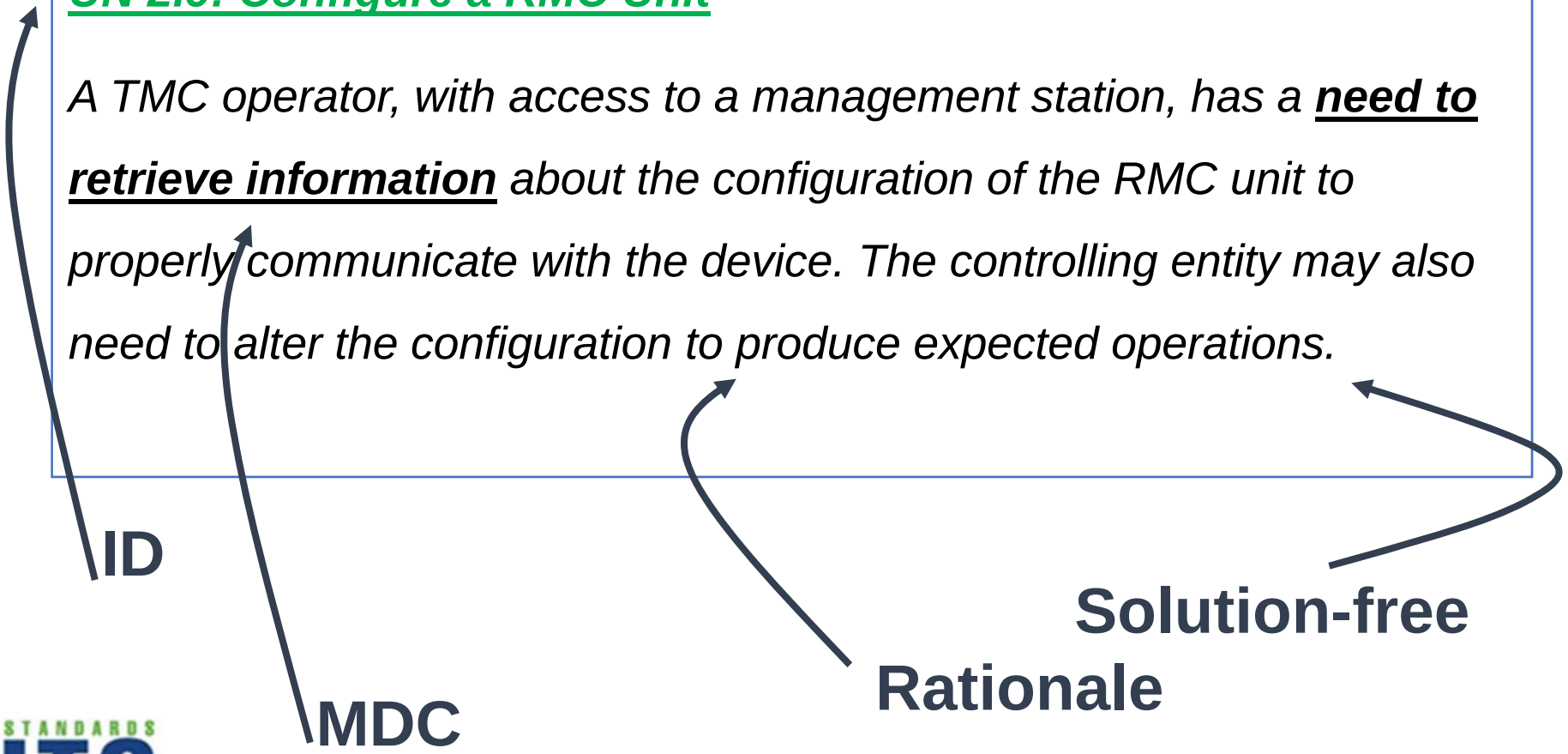


These two CGs offer several **objects** that will be examined for extracting MDCs to develop the user need.

Example: Applying User Needs Writing Criteria

UN 2.9: Configure a RMC Unit

*A TMC operator, with access to a management station, has a **need to retrieve information** about the configuration of the RMC unit to properly communicate with the device. The controlling entity may also need to alter the configuration to produce expected operations.*



Example: Applying User Needs Writing Criteria

UN 2.10: Command Source Priority

*The TMC operator, with access to the RMC system, has a need to allow for **five priority-based** mechanisms to control the RMC unit to **take metering** action(s). The sources desired in priority order are: manual (local at front panel), communications from a central location (TMC), interconnect (from peer to peer communications from a filed master controller), time base control (TBC for special events) and default. Default mode is placed in effect after skipping all other commands due to loss failures.*

ID **MDC** **Rationale** **Solution-free**

Example: Applying User Needs Writing Criteria (cont.)

UN 2.11: Command Source Parameters

*Each metering command source has **four parameters** to **complete** metering functions: **Action, metering rate, metering plan, and vehicle per green**.*

ID

Solution-free

MDC

Rationale

User Needs Translates to RMC Unit "Actions"

User Need

"TMC operator has a need to request an Action using a third party software on TOD or 24/7 basis"

Function

Functional Requirements

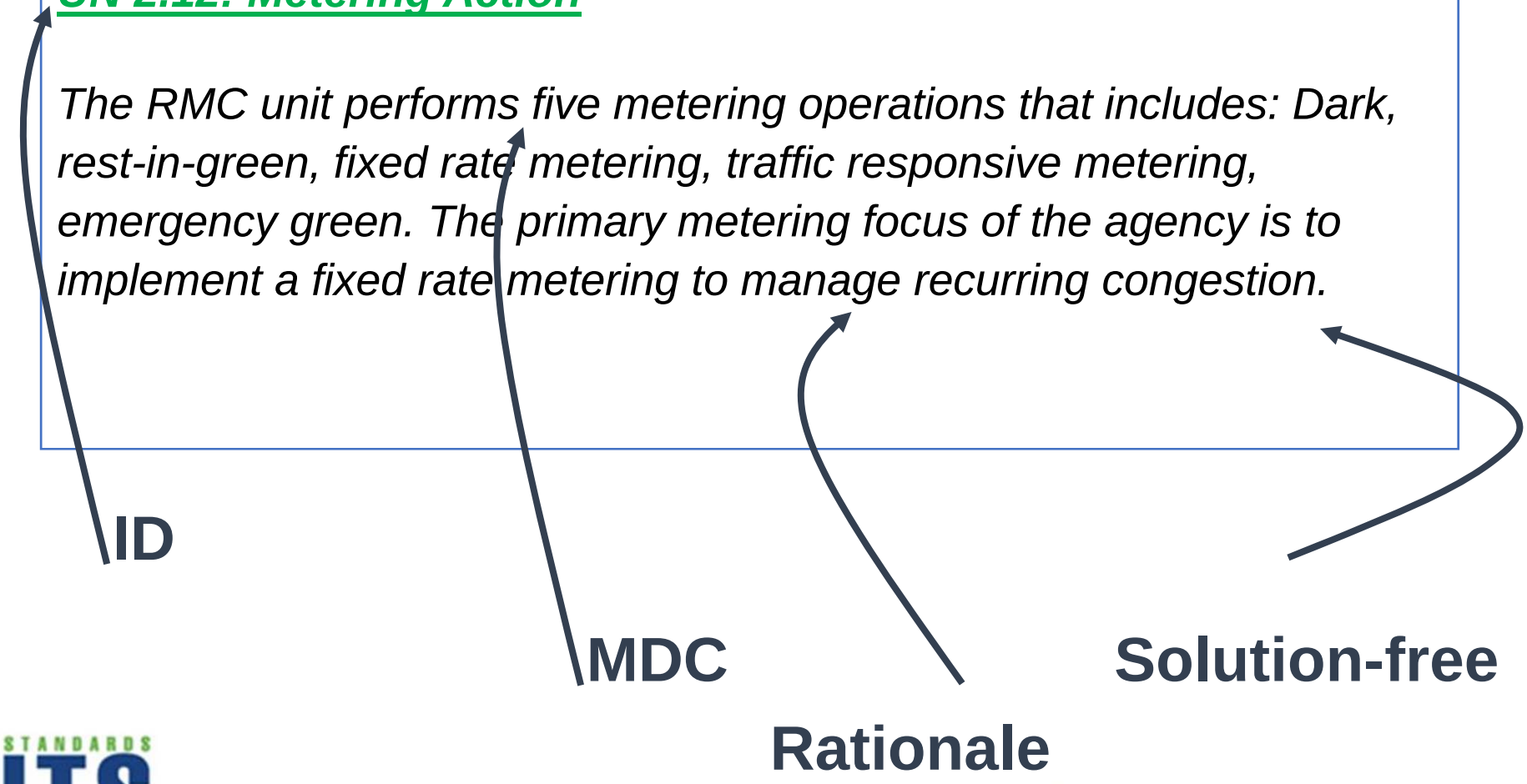
Action

- dark
- fixedRate
- restInGreen
- trafficResponsive
- emergencyGreen

Writing a User Need for the RMC Unit Action

UN 2.12: Metering Action

The RMC unit performs five metering operations that includes: Dark, rest-in-green, fixed rate metering, traffic responsive metering, emergency green. The primary metering focus of the agency is to implement a fixed rate metering to manage recurring congestion.



Summary of RMC User Needs Examples

Note: Titles of local user needs may change somewhat during specification preparation.

- UN 2.1 Provide Live Data Exchange
- UN 2.2 Provide Logged Data Exchange
- UN 2.3 Provide Capability to Retrieve RMC Identity
- UN 2.4 Fixed Rate
- UN 2.5 Queue Override
- UN 2.7 Signal Service
- UN 2.8 Transitioning
- UN 2.9 Configure a RMC Unit
- UN 2.10 Command Source Priority
- UN 2.11 Command Source Parameters
- UN 2.12 Metering Action

What to Do If Certain User Needs Are Not Met by the RMC Standard

- If an agency has a situation that translates to an unmet user need, consider the following:
  - Establish whether any non-standard capabilities are really needed
  - Are you expanding metering to other local ramp corridors using the same central control software?
  - Consider cost implications of extended features: specification, testing, and maintenance of a proprietary solution
- If a proprietary-custom solution is warranted due to additional needed functionality, the user needs driving the solution should be documented in the ConOps

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What is the best source of user needs?

Answer Choices

a) Freeway Traffic Management Concept of Operations (ConOps)

b) Regional ITS Architecture Ramp Metering Service Package

c) NTCIP 1207 v02 Standard Documentation

d) All of the above sources

Review of Answers

a) Freeway Traffic Management Concept of Operations

Incorrect. Exploring the ConOps is an important source but is only partially true.

b) Regional ITS Architecture Ramp Metering Service Package

Incorrect. Architecture is framework-only and is a partial source at best.

c) NTCIP 1207 v02 Standard Documentation

Incorrect. The standard offers design solutions—CGs and operational description, but it is not sufficient from users' operational needs perspective, which emerges from ConOps.

d) All of the above sources

Correct! All of the above sources have links to user needs. Assessment of each will ensure our purpose to identify user needs.

Summary of Learning Objective #3

Prepare Well-Written User Needs for RMC Units

- We have realized that RMC user needs are not available and we must develop them for the acquisition process
- Discussed how to extract user needs and write them for procurement using a criteria
- Discussed what to do if certain user needs are not met by the standard

Learning Objective #4: Explain How to Evaluate Conformance to the RMC Standard

- What are the minimum conformance requirements?
- Explain how to address backward compatibility issues

What are the Minimum Conformance Requirements?

- RMC Unit Standard Conformance Group (CG) Table Sates Requirements as:
  - **Mandatory (M) CGs** are very basic types and are required for conformance to the NTCIP 1207 v02 Standard (also include the Configuration CG from the NTCIP 1201 v02 Global Standard, which *is* required for conformance)
  - **Optional (O) CGs** are selected by the agency specification to meet local user needs

RMC Unit CG Table

Mandatory (M) CGs are Required

Optional (O) Agency Specifies

Ref	Areas	Clause of Profile	Status	Support
B.3	General Configuration Conformance Group	NTCIP 1207 – 3.2	O	Yes / No
B.4	Traffic Responsive Conformance Group	NTCIP 1207 – 3.3	O	Yes / No
B.5	Metered Lane Conformance Group	NTCIP 1207 – 3.3	M	Yes
B.6	Dependency Group Conformance Group	NTCIP 1207 – 3.4	O	Yes / No
B.7	Queue Detection Conformance Group	NTCIP 1207 – 3.4	O	Yes / No
	- Length Based Queue Detection		O	Yes / No
	- Occupancy Based Queue Detection		O	Yes / No
	- Quick Occupancy Based Queue Detection		O	Yes / No
	- Rate Adjusted Queue Adjustment		O	Yes / No
	- Level Adjusted Queue Adjustment		O	Yes / No
	- Fixed Rate Queue Adjustment		O	Yes / No
B.8	Passage Detection Conformance Group	NTCIP 1207 – 3.5	O	Yes / No
	- Long Stop	NTCIP 1207 – 3.5	O	Yes / No
B.9	Time Base Conformance Group	NTCIP 1207 – 3.6	O	Yes / No
	- Mainline Scheduling	NTCIP 1207 – 3.6	O	Yes / No
B.10	Physical I/O Conformance Group	NTCIP 1207 – 3.7	O	Yes / No
	- Metered Lane Output	NTCIP 1207 – 3.7	O	Yes / No
	- Dependency Group Output	NTCIP 1207 – 3.7	O	Yes / No
B.11	Block Object Conformance Group	NTCIP 1207 – 3.8	O	Yes / No
B.12	Configuration Conformance Group	NTCIP 1201 - 2.2	M	Yes

Example of Mandatory CG

- All ramp metering specification must select **YES**

B.5	Metered Lane Conformance Group	NTCIP 1207 – 3.3	M	Yes

- Implementation will include metering lane(s)

- For **CONFORMANCE** to the standard, this CG is required

Metered Lane
Metered Lane Main
rmcMaxNumMeteredLanes rmcNumMeteredLanes rmcMeterCfgTable
rmcMeterCfgEntry rmcMeterNumber rmcCmdSourcePriorityOrder
schemeCIT (1),
schemeICT (2), schemeTCI (3), schemeTIC (4),
schemeCTI (5), schemeITC (6)

Example of Optional CG

- If the traffic responsive metering is to be implemented, agency specification must select **YES**

B.4	Traffic Responsive Conformance Group	NTCIP 1207 – 3.3	O	Yes / No

- Implementation will include Metering Plan
- For **compliance** to the specification, this CG is required

Metering Plan
rmcMaxNumMeteringPlans
rmcNumMeteringPlans
rmcMaxNumLevelsPerPlan
rmcNumMeteringLevels
rmcMeteringPlanTable
rmcMeteringPlanEntry
rmcMeteringPlanNumber
rmcMeteringLevel
rmcMeteringRate
rmcFlowRateThreshold
rmcOccupancyThreshold
rmcSpeedThreshold

Traceability with Conformance Groups

Identified RMC user needs can ONLY be traced to the CGs in this standard.

User Need	Conformance Group	Requirement	Object Support
UN 1 Configure RMC Unit	B.3 General Configuration		
	B.5 Meter Lane		
UNs	B.4 Traffic Responsive		

NOTE: We will learn more on handling traceability in the next module, A309b.

Interoperability

- Interoperability issues:
  - RMC units are remotely accessed and may be controlled by management stations located at the TMC or other operation centers
  - To achieve interoperability, agencies must select the same user needs and design solutions, and must use common protocols (compatibility)
  - Ramp metering is a component of a freeway management system and may be shared by multiple agencies; use of common C2C Standards may be needed

Addressing Backward Compatibility

- NTCIP 1207 v02 is backwards compatible with NTCIP 1207 v01 and standard text advises readers where changes have been made:
  - Some objects have a 1-255 value range instead of a 0-255 range
  - Dialogs (a mechanism to communicate messages with the device) have NOT been defined in RMC; consistency may be an issue
  - Although technically RMC can mix ATC and 2070-170 in the same corridor, local interface constraints may remain; a check may be needed on firmware

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Which of the following is a FALSE statement related to the NTCIP 1207 RMC v02 Standard?

Answer Choices

a) Only Metered Lane CG is required to conform to the standard

b) Traffic Responsive CG is optional

c) V02 Standard is NOT compatible with the previous version

d) A CG represents one or more RMC unit function

Review of Answers

a) Only Metered Lane CG is required to conform to the standard

Incorrect. The statement is true. It is a mandatory CG.

b) Traffic Responsive CG is optional

Incorrect. The statement is true. It is required only when an agency desires to implement metering based on real-time traffic data.

c) v02 Standard is NOT compatible with the previous version

Correct! The statement is FALSE. V02 is compatible with the previous version.

d) A CG represents one or more RMC unit function

Incorrect. A CG is a grouping of objects that represent a function.

Summary of Learning Objective #4

Explain How to Evaluate Conformance to the RMC Standard

- We have reviewed the RMC Standard conformance requirements as stipulated in Table B.2, including mandatory CGs
- We also reviewed interoperability and backwards compatibility issues

What We Have Learned

1) NTCIP 1207 v02 Non-SEP Standard does not have user needs and we must identify and write them using a criteria.

2) RMC unit user needs can be found in ConOps, conformance groups and operation descriptions.

3) A user need must be uniquely identifiable, and defines major desired capability, provides a rationale and is solution-free.

What We Have Learned (cont.)

4) Types of metering include fixed rate metering ,
traffic responsive, and corridor-wide metering adaptive.

5) Highest priory command source in RMC is manual, followed by
communications.

6) All mandatory CGs must be included in the specification for conformance to the standard.

Next Course Module

A309b:

Understanding Requirements for Ramp Meter Control (RMC) Units Based on

NTCIP 1207 v02 Standard

Resources

- NTCIP Standards available at www.ntcip.org:
  - NTCIP 1201 v03 Global Object Definitions
  - NTCIP 1207 v02 Ramp Meter Control (RMC) Units
  - NTCIP 9001: Information report Guide available at www.ntcip.org
- A202: Identifying and Writing User Needs When ITS Standards Do Not Have SEP Content (www.pcb.its.dot.gov/stds_training.aspx)
- Participant Student Supplement
  - Overview of RMC Practice
  - List of RMC User Needs
  - References on Ramp Metering Practice
- Kansas City SCOUT-Video on Ramp Metering (4 min.)

  http://www.kcscout.net/RMWatchTheVideo.aspx

QUESTIONS?

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