Module A313b Specifying Requirements for ESS Systems Based on NTCIP 1210 v04 Standard

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1. Module Description

This module is based on the recently released NTCIP 1204 v04 (May 2016) standard that covers Environmental Sensor Stations (ESS) and Road Weather Information System (RWIS).

The purpose of this updated module (the previous module was based on v03 of the standard) is to incorporate necessary changes such as new ESS user needs/requirements and ESS test procedures provided in recently completed work on NTCIP 1204 Standard v04 and reorganized documentation from the previous v03. The module provides participants with information on how to identify the appropriate use of the latest NTCIP 1204 Standard v04 and acquire an ESS system based on what the user is seeking to accomplish; it also provides participants with information on how to specify requirements.

ESS-Related Training Modules and Prerequisites

Agencies preparing a project specification for Environmental Sensor Stations (ESS) based on NTCIP 1204 v04 will need to consult the following three updated sequential modules:

1. A313a: Understanding **User Needs** for ESS Systems Based on NTCIP 1204 Standard v04
2. A313b: Specifying **Requirements** for ESS Systems Based on NTCIP 1204 Standard v04
3. T313: Applying Your **Test Plan** to the Environmental Sensor Stations Based on NTCIP 1204 Standard v04

This module will be placed in the context of the systems engineering process as well in the acquisition curriculum path, with I101, A101, A102, and A201 being the prerequisites. This completes the acquisition lifecycle leading to the user being able to write specifications with a focus on ESS user needs in the previous module, followed by ESS requirements in this module. The logical next step for the participant is to consider modules in the testing lifecycle, which begins with modules T101, T201, and T202, and T203 and T204, which lead up to the T313 module: Applying Your Test Plan to the Environmental Sensor Stations Based on NTCIP 1204 Standard v04.

2. Introduction to ESS and NTCIP 1204 ESS Standard

Environmental Sensor Stations (ESS) are ground -based or pole-mounted sensors that collect base-level raw weather data from roadways sections or regions and transmit data to a central or field location, where they are used as part of a Road Weather Information System (RWIS). The module provides a brief background on RWIS/ESS and shows how agencies use weather information to make decisions and issue advisories to motorists and stakeholders.

NTCIP 1204 v04, an NTCIP standards publication, identifies and defines how a management station interfaces with a field device to control and monitor pavement sensors, weather stations, air quality sensors, and other equipment related to the monitoring of and response to environmental conditions in an NTCIP-conformant fashion. NTCIP 1204 v04 uses only metric units. NTCIP 1204 v04 provides definitions of data elements for environmental sensor data, including weather data, pavement condition data, water level data, and air quality data. NTCIP 1204 v04 defines

requirements that are applicable to all NTCIP environments and it also contains optional and conditional sections that are applicable to specific environments for which they are intended.

Types of ESS Requirements

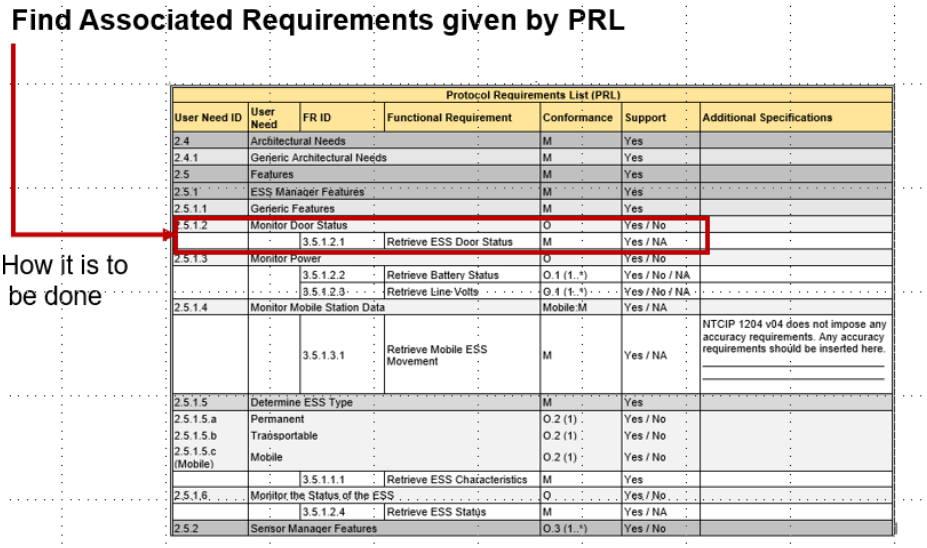
As shown below, the ESS standard supports three types of ESS requirements to fulfill user needs.

3. Case Study: Understanding How to Use the Protocol Requirements List (PRL) and Requirements Traceability Matrix (RTM)

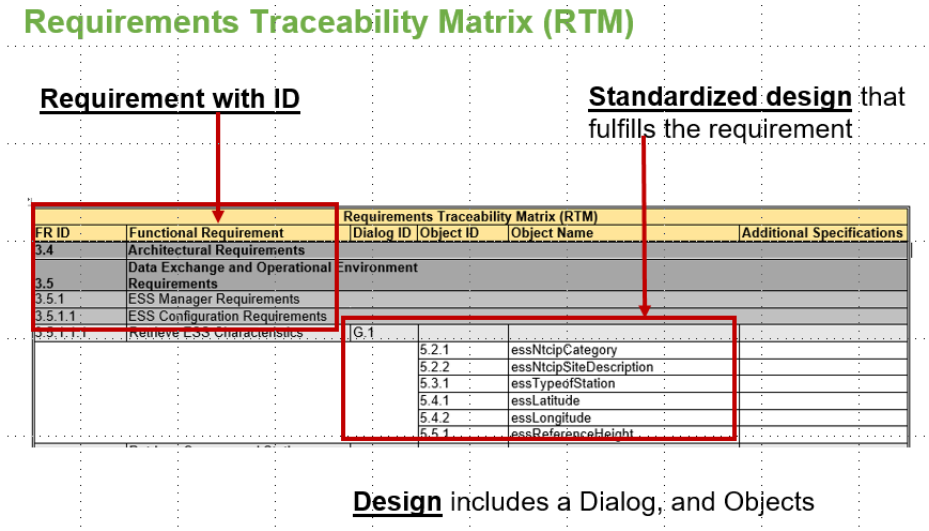
Both PRL and RTM are required for a project specification and later for testing ESS systems.

PRL is a first step toward achieving a successful ESS system that is conformant to the ESS standard and ensuring an interoperable system that works as desired. Every ESS procurement specification must incorporate a PRL that meets project user needs and associated requirements. Readers are directed to familiarize themselves with the structure of the ESS PRL and learn how to prepare a project-level PRL.

The PRL provided under Section 3.3.3 maps the user needs defined in Section 2 to the requirements defined in Section 3. The following examples illustrate how a project-level PRL can be developed that includes user needs/requirements as a tailored version of what the standard provides, and how an RTM provides dialogs and objects necessary to fulfil a requirement.



Using Requirements Traceability Matrix (RTM) to Specify Dialogs and Objects



4. Example of RTM Use

Requirement: 3.5.2.1.9 Configure Snapshot Camera

Upon request, the ESS shall store a textual description of the location and direction to which the camera points and the filename to be used when storing new snapshots.

a. Retrieve Snapshot

Upon request, the ESS shall return a copy of the specified snapshot image.

4.1.1. The following RTM entry shows how this requirement is managed with dialog and additional notes, if needed.

Using RTM to Specify Design for Retrieving Snapshot

- Standardized dialog 4.2.2 will utilize two objects: 5.17.1 and 5.17.2

Requirements Traceability Matrix (RTM)					
FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specifications
3.5.2.3.8	Retrieve Snapshot	4.2.2			Upon ESS delivery the FTP username shall be _____. Upon ESS delivery, the FTP password shall be _____. Note: For agencies that restrict the use of FTP, see Annex E.3 for additional information.
			5.17.1		<not an SNMP Object> Snapshot.filename:text
			5.17.2		<not an SNMP object> Snapshot.image:frame

5.17.1 Filename
Definition> The name of the file in which the snapshot image is stored.
<Descriptive Name> Snapshot.filename:text
<Data Concept Type> Data Element

4.2. Image
<Definition> The graphic snapshot image. The storage format is not defined by this standard.
<DescriptiveName>Snapshot.image:frame
<Data Concept Type> Data Element

Summary of Key Steps to Achieve Conformance to Standard

1. Secure user need **support** with selecting **YES** in PRL, making those requirements Mandatory
2. RTM-identified **dialogs**, in proper sequence-order
3. RTM-identified **objects** as allocated by standard
4. Both PRL and RTM are required for **Conformance** to the standard

Implementations seeking to achieve interoperability must have selected same user needs-requirements-dialogs-objects.

5. References to Standards

- NTCIP Joint Committee: *NTCIP 1204 v04 Object Definitions for Environmental Sensor Stations* – www.ntcip.org (NEMA NTCIP Coordinator approval for public Draft release pending)
- *NTCIP 1201 Version v03.13a, National Transportation Communications for ITS Protocol, Global Object Definitions* (www.ntcip.org)
- *IEEE 830-2008 - IEEE Recommended Practice for Software Requirements Specification*

6. Glossary

Term	Definition
C2C	Center to Center
C2F	Center to Field
DMS	Dynamic Message Signs
ESS	Environmental Sensor Station
FMS	Freeway Management System
MIB	Management Information Base
NTCIP	National Transportation Communications for ITS Protocols
PRL	Protocol Requirements List
PTS	Pavement Treatment Systems
RPU	Remote Processor Unit
RTM	Requirements Traceability Matrix
RWIS	Road Weather Information System
SEP	Systems Engineering Process
SNMP	Simple Network Management Protocol
TMC	Traffic Management Center
Agency Specification	A document that has been prepared by an agency to define requirements for a subject item or process when procured by the agency.
Compliance	A condition that exists when an item meets all of the requirements of an agency specification.
Concept of Operations	A document that describes the purpose of a system project, including a description of the current and proposed system, as well as key user needs that the new system is required to address.
Conformance	A condition that exists when an item meets all of the mandatory requirements as defined by a standard. It can be measured on the standard as a whole, which means that it meets all mandatory (and applicable conditional) requirements of the standard or on a feature level (i.e., it conforms to feature X as defined in section X.X.X), which means that it meets all mandatory (and applicable conditional) requirements of the feature.
Dialogs	A sequence of information or message exchanges.
Environmental Sensor Station (ESS)	A location that includes a remote processor unit (RPU) connected to one or more sensors for the collection of environmental or meteorological data. It may also include a pavement treatment system (PTS). Note: The acronym ESS may also be used as a plural.
Feature	A service provided by/behavior of the device.
Protocol Requirements List (PRL)	A table mapping user needs with their associated requirements. This table allows procurement personnel to specify the desired features of a DMS or can be used by a manufacturer to document the features supported by their implementation.

Term	Definition
	Requirement is a condition or capability needed by a user to solve a problem or achieve an objective.
Specification	The project-specific detailed requirements for a DMS to be purchased by an agency or a statement by a manufacturer defining the detailed features provided by the DMS. Within NTCIP 1203 v03, "specification" often refers to the text contained in the "Additional Project Requirements" column of the PRL.
Transportable	In the context of an ESS, an ESS capable of being relocated, but its environmental sensors and pavement treatment devices do not operate while moving.
User Need	The business or operational problem (opportunity) that must be fulfilled to justify purchase or use. While this is termed a "user need" within the NTCIP community, it reflects needs of all stakeholders.
Requirements Traceability Matrix (RTM)	A table that links the requirements to the corresponding dialogs and objects.

7. References

- Federal Highway Administration, *Best Practices for Road Weather Management, v3,* FHWA-HOP-12-046, June 2012. https://ops.fhwa.dot.gov/publications/fhwahop12046/fhwahop12046.pdf
- Federal Highway Administration, *Weather-Responsive Traffic Management – Concept of Operations, 2003* https://ops.fhwa.dot.gov/weather/best_practices/WeatherConOps0103.pdf
- Michigan DOT, *Road Weather Information System Concept of Operations*, June 2007. https://www.michigan.gov/documents/mdot/RWIS_Concept_of_Operations_-_Superior_Region_427446_7.pdf
- NTCIP Joint Committee, *NTCIP 9001 NTCIP Guide Version 04,* July 2009. http://www.ntcip.org/library/documents/
- United States Department of Transportation, *Systems Engineering Guidebook for Intelligent Transportation Systems Version 3.0*, November 2009. http://www.fhwa.dot.gov/cadiv/segb/

8. Study Questions

1. **Which of the following is a <u>FALSE</u> statement?**
   a) ESS requirements are standardized by the standard
   b) RTM provides benefits to vendors only
   c) PRL provides standardized design
   d) NTCIP 1204 v04 is backward compatible to previous versions

2. **Which of the following is a <u>FALSE</u> statement as applied to ESS?**
   a) Remote Processing Unit (RPU) contains ESS Manager
   b) Sensor Manager collects data supplied by each sensor
   c) PRL allows users to select user needs and associated requirements
   d) Backward compatibility is not addressed by the PRL

3. **Which of the following is <u>NOT</u> a correct statement as applied to communications interface specification?**
   a) Project PRL lists standardized user needs
   b) Only PRL is necessary for conformance to standard
   c) PRL lists optional user needs
   d) RTM provides complete design

4. **Which of the following is a <u>CORRECT</u> statement related to ESS extension?**
   a) Extension will be conformant to the ESS standard
   b) Extension will break regional RWIS interoperability
   c) ESS implementation with extensions is manageable
   d) Extension may enable a remote operation of ESS field devices

5. **Which is NOT a correct statement as applied to ESS Testing?**
   a) Test procedures connect requirements to testing steps
   b) NTCIP 1204 v04 standard provides test procedures
   c) Test plan documentation includes test procedures
   d) Test planning is done at the testing stage

9. Icon Guide

The following icons are used throughout the module to visually indicate the corresponding learning concept listed below, and/or to highlight a specific point in the training material.

1) **Background information:** General knowledge that is available elsewhere and is outside the module being presented. This will be used primarily in the beginning of the slide set when reviewing information readers are expected to already know.

2) **Tools/Applications:** An industry-specific item a person would use to accomplish a specific task, and applying that tool to fit your need.

3) **Remember:** Used when referencing something already discussed in the module that is necessary to recount.

4) **Refer to Student Supplement:** Items or information that are further explained/detailed in the Student Supplement.

5) **Example:** Can be real-world (case study), hypothetical, a sample of a table, etc.

6) **Checklist:** Used to indicate a process that is being laid out sequentially.