Welcome

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A313a:
Understanding User Needs for ESS Systems based on NTCIP 1204 v04 Standard
Instructor

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Learning Objectives

- Review the **structure** of the standard
- Identify specific ESS operational needs
- Use the **PRL** to select the user needs and traceability to requirements
- Discuss how to prepare a project level PRL for ESS specification
Learning Objective 1

Review the structure of the standard
Terminology

Sensor

Sensor is a device that responds to a physical stimulus and transmits a resulting impulse to a remote processing unit.
Terminology

Environmental Sensor Station (ESS)

**Location** on the Roadway/Bridge

ESS collects weather data using range of sensors

Source: MDOT

Source: FDOT Bridge Wind Speed Monitor Installation. FHWA
Remote Processing Unit (RPU) is a Part of a Controller

- As part of a field controller, RPU collects and transmit data to the management station
- RPU is located close to sensors
Road Weather Information System (RWIS)

RWIS is a network of ESS that relay road and weather conditions to a computer system.

Source: National Conference of State Legislatures

Source: Iowa DOT RWIS Camera Images

Source: Iowa DOT RWIS Camera Images

Source: National Conference of State Legislatures
**Terminology**

**Types of RWIS**

**Permanent:** Fixed Locations-based ESS
- Management Station
- RPU
- Air Quality Sensor

**Portable:** Mobile Data Collection-MDC
- Management Station
- RPU
- Pavement Sensor
- Maintenance Vehicle

**Transportable:** Vehicle-based
- Management Station
- RPU
- Sprayer
Flashing Beacons are used to warn public on current and anticipated flooding conditions.

Example: Flashing Beacon with optional video monitoring.
Terminology

Example: IOWA DOT RWIS

1. Wind speed and direction sensor
2. Antenna for communications
3. Traffic speed and traffic count sensor
4. Pan-tilt-zoom color camera
5. Precipitation and visibility sensor
6. Air temperature and Relative Humidity sensor
7. Road surface temperature sensor and sub surface temperature sensor below pavement

Source: Iowa DOT RWIS

http://www.iowadot.gov/maintenance/weather.html
Reference Architecture for ESS

Major Components of ESS System

Central System
- Management Station
- Subject of NTCIP

Field ESS System
- Sensor Manager
- ESS Manager
- PTS Manager
- Environmental Sensor
- Pavement Treatment
  - Sprayer
  - Chemical Tank

NTCIP 1204
History of NTCIP 1204 Standard

ESS Standard has Evolved to v04 in 2016

NTCIP 1204 v01 (1998), Non-SEP
(2001), Amendment-1, Reflected Actual Implementations.

NTCIP 1204 v02 (2007), SEP-based
Added new Features, e.g. de-icing.

NTCIP 1204 v03 (2009), Updated SEP content
Added test procedures, issued Errata for Annex C.

NTCIP 1204 v04 (2015), Supports newly identified user needs, such as Connected Vehicles (CV), reflects lessons learned from deployments.
Standard Organization

Structure of the Standard (NTCIP 1204 v04)

Section 1  General
Section 2  Concept of Operations (**Features-User Needs**)
Section 3  Functional Requirements
Section 3.3  Protocol Requirements List (**PRL**)
Section 4  **Dialogs**
Section 5  Object Definitions (**Management Information Base-MIB**)
Standard Organization

Structure of the Standard (NTCIP 1204 v04)

Annex A  Requirements Traceability Matrix (RTM)
Annex B  Object Tree
Annex C  Test Procedures
Annex D  Documentation of Revisions
Annex E  User Requests
Annex F  Generic Clauses
Annex G  Encoding of Sample Block Objects
Annex H  Controller Configuration Objects
Standard Organization

How Does the Structure Relate to the Agency ESS/RWIS Specification?

- Features-User Needs (Section 2)
- Requirements (Section 3)
- Design Details (Section 5)
- PRL (Section 3)
- RTM (Annex A)
- Test Procedures (Annex C)
Standard Organization

Standard Structure Supports
Road Weather Data Collection Service Package

MC03 – Road Weather Data Collection

Maintenance and Construction Vehicle
- MCV Environmental Monitoring
- Environmental sensor data
- Environmental conditions

Weather Service
- Environmental sensors control
- Environmental sensor data
- Environmental conditions

Roadway Environment
- Environmental sensors control
- Environmental sensor data
- Environmental conditions

Surface Transportation Weather Service
- Environmental conditions data
- Environmental conditions

Traffic Management
- Environmental sensors control
- Environmental sensor data
- Environmental conditions data

NTCIP 1204 Interface

20
User Needs (Features) NOT Covered by v04 Standard

- Configuration details about how a device calculates the current reading **sampling periods**
- File Transfer Protocol (FTP) to transfer files such as camera snapshots across their **agency's network**
Learning Objectives

- Review the **structure** of the standard
- Identify **specific ESS operational needs**
Learning Objective 2

Identify Specific ESS Operational Needs
What are Your Operational Objectives?

“Weather or Not?”
Roadway Environment

Who is affected?
Roadways
Motorists
Vehicles
Assets

Source: Caltrans District 4
What are Your Operational Objectives?

Roadway Operational Environment Weather Variables

- Air temperature/Humidity
- Precipitation
- Wind speed
- Fog
- Water level
- Pavement temperature
- Pavement condition
- Snow/slit

Source: NJTPK
What are Your Operational Objectives?

Weather Events Adversely Impact Roadway Operations

- Rain and Flooding
- Snow and Ice
- Low Visibility
- Hurricanes
- High Winds

Source: Iowa DOT

Source: TX DOT

Source: FHWA

Source: Iowa DOT
What are Your Operational Objectives?

Loss of Access Routes
What are Your Operational Objectives?

Loss of Access Routes

Courtesy: Michael Martinez and Ben Brumfield, CNN
What are Your Operational Objectives?

Operational Concerns for Roads-Driver-Vehicles

**Adverse Impacts**
- Reduced Capacity/Access-Throughput-Speed

**Roadway Conditions**

**Visibility Impairment**

**Traction, Stability Maneuverability**

**Driver Behavior-Reactions-Safety**

**Vehicle Performance, Skidding-Crash Potential**
What are Your Operational Objectives?

Measuring Adverse Impacts on Safety

- 1.5 million (23%) of annual vehicle crashes in 2015
- Resulting in 800,000 Injuries
- 7,000 fatalities (20% of total 35,092) attributed to weather related vehicle crashes

(Based on NHTSA and FHWA 2015 Data)

Source: NOAA, National Weather Service
What are Your Operational Objectives?

Measuring Adverse Impacts on Mobility

- Road closures reduce Capacity/Speed/ Volume
- Motorists, Traffic Signals, Vehicles-Trucks
What are Your Operational Objectives?

Measuring Adverse Impacts on Productivity

- 20% spent on winter maintenance by State DOTs
- Motorists’ delays, Maintenance workers safety
- Trucking Loss-$3.5 billion, Roadway damage (potholes, erosions)

“The Pennsylvania Department of Transportation, which had $189.2 million budgeted for the 2013-14 winter, spent $284 million.”-PennDOT
What are Your Operational Objectives?

Operational Need

Assess Roadway Condition with Sensors-Supplied Data

Central System Management Station RWIS

Sensors Detect Roadway Conditions
- Visibility impairments
- Precipitation
- High winds
- Temperature extremes
- Pavement friction-condition
- Snow-Ice-Rain....

Source: FHWA

Note: Wyoming DOT has 62 RWIS Operational
What are Your Operational Objectives?

User Needs are Translations of Operational Needs

2.5.2.1 Monitor Weather Conditions
   (affect the transportation system)

2.5.2.1.2 Monitor Atmospheric Pressure

2.5.2.1.3 Monitor Winds

2.5.2.1.4 Monitor Air Temperature
What are Your Operational Objectives?

Operational Need

Deploy RWIS as a Decision Support System to Take Action

Source: FHWA: WY TMC

RWIS Decision Support Tool

Action

- Advisory
- Control
- Treatment
What are Your Operational Objectives?

Weather Related Advisory Actions

- Display Messages on Variable Message Signs
  (Covered by NTCIP 1203 Standard)
- 511
- Text Message-E Mails
- Web-services
- Media

Source: NJTPA-Daktronics
Source: Caltrans
Source: Manual Joshi, NYCDOT TMC
What are Your Operational Objectives?

Weather Related Control Actions

Source: National Conference of State Legislatures

Source: Tennessee Ramp Gate-FHWA
What are Your Operational Objectives?

Roadway Treatment Actions

Figure 17A – City of New York, NY Bridge Section Treated with Anti-Icing System

Figure 17B – City of New York, NY Bridge Section Treated with Truck-Mounted Sprayer

Source: FHWA
How Does ESS Standard Support Operational Needs-Features?

Annex F.1.1: Architectural Needs Supports Operational Environment

F.1.1.1. Provide Live Data: When we always have **ON** connection

F.1.1.2 Provide Compressed Data

F.1.1.3 Provide Off-line Log Data

F.1.2 Generic Features

Communications to RPU in ESS Controller

Source: City of Overland Park, KS

Source: WYDOT TMC
How Does ESS Standard Support Operational Needs-Features?

Categories of Features Supported

ESS Manager Features
- Section 2.5.1

Sensor Manager Features
- Section 2.5.2

PTS Manager Features
- Section 2.5.3

PTS-Pavement Treatment System
How Does ESS Standard Support Operational Needs-Features?

ESS Manager Features Supported by Standard

- ESS Manager manages both a Sensor Manager and a PTS Manager

- ESS Features (2.5.1):
  - Generic Features (2.5.1.1)
  - Monitor Door Status (2.5.1.2)
  - Monitor Power (2.5.1.3)
  - Monitor Mobile Station Data (2.5.1.4)
  - Determine ESS Type (2.5.1.5)
How Does ESS Standard Support Operational Needs-Features?

Example: 2.5.1.2 Monitor Door Status

“A transportation system operator may wish to inquire if any doors on the ESS equipment are open...”

Source: WYDOT TMC

Source: UDOT
Deployment Examples

Idaho DOT Statewide Deployments of Weather Stations

US 95: Whitebird Hill
6 miles north of the White Bird area

78 °F

<table>
<thead>
<tr>
<th>Precip (Yes/No)</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Status</td>
<td>Dry</td>
</tr>
<tr>
<td>Surface Friction</td>
<td>Good</td>
</tr>
<tr>
<td>Visibility</td>
<td>1.24 miles</td>
</tr>
<tr>
<td>Wind Speed (avg)</td>
<td>3.4 mph</td>
</tr>
<tr>
<td>Wind Speed (gust)</td>
<td>5.1 mph</td>
</tr>
</tbody>
</table>
Deployment Examples

Source: FHWA
Deployment Examples

- Ultrasonic Wind Sensor
- Road Weather Camera
- Precipitation Identifier (rate & accumulation) and Road Visibility
- Remote Processor Unit (RPU) Cabinet
- I-10 FDOT

Source: FHWA
Deployment Examples

Purpose of ESS Deployments by Transportation Agencies

- Collect timely, accurate, and relevant road weather conditions data
- Manage roadways and provide roadway weather information to motorists
- Motorists make travel decisions and adjust to roadway conditions

2.5.1.3 Monitor Power

A transportation system operator may wish to monitor the power for the ESS to ensure proper operation.

2.5.1.4 Monitor Mobile Station Data

A transportation system operator may wish to monitor the movements of a mobile ESS and, if it is part of a mobile pavement treatment system, monitor the chemicals being dispersed.

2.5.1.1 Generic Features (Device ID...)
Deployment Examples: Sensor Manager

2.5.2 Sensor Manager Features

- Monitor weather conditions
- Monitor pavement
- Monitor subsurface conditions
- Monitor human readings
- Monitor water levels
- Monitor air quality and biohazards
- Monitor mobile weather profile
2.5.3.2 Manage Mobile Spray System

A transportation system operator may need to manage the application of anti-icing or de-icing chemicals from a mobile pavement treatment system (e.g., a salt truck).

Source: FHWA
Learning Objectives

Review the **structure** of the standard

**Identify** specific ESS operational needs

Use the **PRL** to select the user needs and traceability to requirements
**What is a PRL?**

**Protocol Requirements List (PRL) is a Table, a Matrix**

- Provides the standardized **relationship** between user needs and their requirements

- As a **template** with fixed columns and multiple rows it guides users and DMS manufacturers/suppliers

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.2</td>
<td>Sensor Manager Features</td>
<td></td>
<td></td>
<td>0.3 (1..*)</td>
<td>Yes / No</td>
<td></td>
</tr>
</tbody>
</table>
What is a PRL?

Standardized Relationship Provided by the Standard

Agency selects

<table>
<thead>
<tr>
<th>One User Need</th>
<th>Requirement 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>One User Need</td>
<td>Requirement 1</td>
</tr>
<tr>
<td></td>
<td>Requirement n</td>
</tr>
</tbody>
</table>

Templates Links to Associated Requirements

| Many User Needs | Requirement 1 |
What is a PRL?

Provides Guidance

- PRL template **guides agency** to select project user needs
- PRL then presents associated requirements to fulfill user needs

Agency completes the rows with text from the PRL provided by the standard object PRL
**Parts of PRL Provided in the Standard (Section 3.3)**

**User Need Columns**

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.1.2</td>
<td>Monitor Door Status</td>
<td>0</td>
<td></td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1.2.1</td>
<td>Retrieve ESS Door Status</td>
<td>M</td>
<td></td>
<td>Yes / NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1st line is the headings of the PRL Table (*users cannot modify columns*).

2nd line, an example of a user need, with section number-2.5.1.2 and its title.

Section number 2.5.1.2, (page 16), find the **optional user need**; and you must decide if it is desired for your project implementation.
Part of PRL Provided in the Standard (Section 3.3)

Conformance Column

- Identifies if the user need (or requirement) is Mandatory (M) or Optional (O), plus some from group

- Some basic user needs are considered Mandatory

**Example**: *Determine ESS Type, is it permanent, transportable or mobile?*
### Parts of PRL Provided in the Standard (Section 3.3)

#### Support/Project Requirement Column

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.2.1.2</td>
<td>Monitor Winds</td>
<td></td>
<td></td>
<td>0.5 (1.∗)</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

- **What should Agency do?**
  - Circle **Yes** to indicate support for project user need; No for not needed
  - If the **Conformance** shows selected User Need Mandatory, then you must circle Yes regardless.
### Additional Project Requirements - Last Column

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need Description</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
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</thead>
<tbody>
<tr>
<td>2.5.1.4</td>
<td>Monitor Mobile Station Data</td>
<td></td>
<td>Mobile: M</td>
<td>Yes / NA</td>
<td></td>
<td>NTCIP 1204 v.2 does not impose any accuracy requirements. Any accuracy requirements should be inserted here.</td>
</tr>
<tr>
<td>3.5.1.3.1</td>
<td>Retrieve Mobile ESS Movement</td>
<td></td>
<td>M</td>
<td>Yes / NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provides any additional details about the specific implementation.
Parts of PRL Provided in the Standard (Section 3.3)

Agency Determines if an Optional ESS User Need is Required

2.5.2.1.2 Monitor Winds

A transportation system operator may need to monitor the current wind conditions in the vicinity of the ESS and to configure and retrieve the metadata for the wind measurements. This feature allows an operator to determine if vehicle restrictions on a given roadway or bridge span should be issued or to restrict roadway maintenance (e.g., fire alerts).

If the agency selects **YES**, then certain requirements will be allocated in the project PRL.

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.2.1.2</td>
<td>Monitor Winds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.2</td>
<td></td>
<td>(Wind)</td>
<td>Retrieve Metadata for Each Wind Sensor - Text Description</td>
</tr>
<tr>
<td>3.5.2.1.11.1</td>
<td></td>
<td>(WindLoc)</td>
<td>Retrieve Metadata for Each Wind Sensor - Location</td>
</tr>
<tr>
<td>3.5.2.1.11.2</td>
<td></td>
<td></td>
<td>Retrieve Metadata for Each Wind Sensor - Sensor Information</td>
</tr>
<tr>
<td>3.5.2.1.11.3</td>
<td></td>
<td></td>
<td>Configure Wind Sensor Metadata - Location</td>
</tr>
<tr>
<td>3.5.2.3.2.2</td>
<td></td>
<td></td>
<td>Retrieve Wind Data</td>
</tr>
<tr>
<td>3.6.2</td>
<td></td>
<td></td>
<td>Required Number of Wind Sensors</td>
</tr>
</tbody>
</table>

Courtesy: WSDOT
### Parts of PRL Provided in the Standard

#### Completing a Project PRL: Functional Requirements

**Section number and the Functional Requirement**

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
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</thead>
<tbody>
<tr>
<td>2.5.2.1.2</td>
<td>Monitor</td>
<td>Winds</td>
<td>Retrieve Metadata for Each Wind Sensor - Text Description</td>
<td>O.5 (1..*)</td>
<td>Yes/No/NA</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.2</td>
<td>(Wind)</td>
<td></td>
<td>Retrieve Metadata for Each Wind Sensor - Location</td>
<td>O</td>
<td>Yes/No/NA</td>
<td></td>
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<tr>
<td>3.5.2.1.11.1</td>
<td>(WindLoc)</td>
<td></td>
<td>Retrieve Metadata for Each Wind Sensor - Sensor Information</td>
<td>O</td>
<td>Yes/No/NA</td>
<td></td>
</tr>
<tr>
<td>3.5.2.1.11.2</td>
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<td></td>
<td>Configure Wind Sensor Metadata - Location</td>
<td>Wind:O; WindLoc:O</td>
<td>Yes/No/NA</td>
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<tr>
<td>3.5.2.3.2.2</td>
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<td>Retrieve Wind Data</td>
<td></td>
<td>M</td>
<td>Yes/NA</td>
<td></td>
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</tbody>
</table>
Partially Filled-in PRL that Provides Standardized Requirement(s) Allocated to Each User Need

<table>
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<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
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<tr>
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<td>2.4.1</td>
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<td>Features</td>
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<tr>
<td>2.5.1.2</td>
<td>Monitor Door Status</td>
<td>O</td>
<td>Retrieve ESS Door Status</td>
<td>M</td>
<td>Yes / NA</td>
<td></td>
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<tr>
<td>3.5.1.2.1</td>
<td>Retrieve ESS Door Status</td>
<td>M</td>
<td></td>
<td>M</td>
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<tr>
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<td>O</td>
<td>Retrieve Battery Status</td>
<td>O.1 (1..*)</td>
<td>Yes / No / NA</td>
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<tr>
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<td>Retrieve Battery Status</td>
<td>O.1 (1..*)</td>
<td></td>
<td>Yes / No / NA</td>
<td></td>
<td></td>
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<tr>
<td>3.5.1.2.3</td>
<td>Retrieve Line Volts</td>
<td>O.1 (1..*)</td>
<td></td>
<td>Yes / No / NA</td>
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<tr>
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<td>Monitor Mobile Station Data</td>
<td>Mobile:M</td>
<td></td>
<td>Yes / NA</td>
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<td>NTCP 1204 v04 does not impose any accuracy requirements. Any accuracy requirements should be inserted here.</td>
</tr>
<tr>
<td>2.5.1.5</td>
<td>Determine ESS Type</td>
<td>M</td>
<td></td>
<td>M</td>
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<td></td>
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<tr>
<td>2.5.1.5.a</td>
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<td>O.2 (1)</td>
<td></td>
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<td></td>
</tr>
<tr>
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<td>O.2 (1)</td>
<td></td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5.1.5.c</td>
<td>Mobile</td>
<td>O.2 (1)</td>
<td></td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Mobile)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
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<td>Retrieve ESS Characteristics</td>
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<tr>
<td>2.5.1.6</td>
<td>Monitor the Status of the ESS</td>
<td>O</td>
<td></td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1.2.4</td>
<td>Retrieve ESS Status</td>
<td>M</td>
<td></td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5.2</td>
<td>Sensor Manager Features</td>
<td>O.3 (1..*)</td>
<td></td>
<td>Yes / No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Agency prepares a customized project PRL by selecting YES
Benefits of PRL to Stakeholders

Agency Perspective (Project PRL)

- “Communicates” the scope of the desired ESS interface
- Makes it easier to specify what the interface is to do (customize)
- “Spells out” Conformance requirements; what is needed
- A “Checklist” to validity the built system
- Aid in achieving interoperability

Did they build **RIGHT** system?
Benefits of PRL to Stakeholders

Vendors/System Developers Perspective

- Everyone is “connected” on the same page
- Eliminates “guessing” to reduce risks
- Vendors “confirms” ESS functionality + offer optional features
Learning Objectives

- Review the structure of the standard
- Identify specific ESS operational needs
- Use the **PRL** to select the user needs and traceability to requirements
- Discuss how to prepare a project level PRL for ESS specification
Learning Objective 4

Discuss How to Prepare a Project Level PRL for ESS Specification
Steps to Select User Needs and Associated Requirements

Brief Review

- ESS gathers weather data and sends it to the central system management station for further processing.
- Central management station “monitors” ESS as part of RWIS.
- ESS specification begins with identifying user needs and specifying requirements.
# How PRL Fits into the ESS Specification

## Procurement Contract Specifications

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>
| **Hardware Specifications**  
Functional Req.  
Performance Req.  
Structural Req.  
Mechanical Req.  
Electrical Req.  
Environmental Req. | **Software Specifications**  
Functional Req.  
Performance Req. | **Communications Interface Specifications**  
User Needs  
Functional Req.  
Project PRL, RTM  
Testing Documentation |

## Contractual requirements during:  
- System development  
- Testing  
- Deployment/integration  
- Operations/maintenance  
- Project management

*Note: Remember!*
Complete Project PRL with Entries (Populating Table)

Key Points to Remember While Completing a Project PRL

1. PRL must be consistent with the hardware specification
2. ESS specification should have project level PRL
3. PRL must be based on the NTCIP 1204 v04 with SNMP interface
4. Include only need-based specific ESS parameters- NOT All YOU Can GET
Conformance and Compliance Issues

- **Conformance:** Meets a specified standard
  - To claim "Conformance" to NTCIP 1204 v04, the vendor shall minimally satisfy the mandatory requirements selected (YES)
  - Vendors that provide additional features beyond the completed PRL are still conformant as long as they conform with the requirements of NTCIP 1204 v04 and its normative references

- **Compliance:** Meets a specification
Complete Project PRL with Entries (Populating Table)

**Fill-in PRL with User Needs/Requirements; YES**

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
<th>Support</th>
<th>Additional Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.2.1.2</td>
<td>Monitor Winds</td>
<td>3.5.2.1.2</td>
<td>Retrieve Metadata for Each Wind Sensor - Text Description</td>
<td>0.5 (1..*)</td>
<td>Yes / No / NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wind</td>
<td>3.5.2.1.11.1</td>
<td>Retrieve Metadata for Each Wind Sensor - Location</td>
<td>0</td>
<td>Yes / No / NA</td>
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<tr>
<td></td>
<td>WindLoc</td>
<td>3.5.2.1.11.2</td>
<td>Retrieve Metadata for Each Wind Sensor - Sensor Information</td>
<td>0</td>
<td>Yes / No / NA</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3.5.2.1.11.3</td>
<td>Configure Wind Sensor Metadata - Location</td>
<td>Wind:O; WindLoc:O</td>
<td>Yes / No / NA</td>
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<tr>
<td></td>
<td></td>
<td>3.5.2.3.2.2</td>
<td>Retrieve Wind Data</td>
<td>M</td>
<td>Yes / NA</td>
<td>The ESS shall support at least ____ (1..255:Default=1) wind sensors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.6.2</td>
<td>Required Number of Wind Sensors</td>
<td>M</td>
<td>Yes / NA</td>
<td></td>
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</tbody>
</table>

- Use the Support/Project Requirement column to indicate if the user need is required for the implementation
- If the YES is selected, the PRL identifies the requirements associated with that user need
- Add notes to the last column if required
### Addressing Mandatory Needs for Conformity

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
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<th>Support</th>
<th>Additional Specifications</th>
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<td>2.4.1</td>
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<td>2.5</td>
<td>Features</td>
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<td>2.5.1</td>
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<td>2.5.1.1</td>
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<td>2.5.1.2</td>
<td>Monitor Door Status</td>
<td>O</td>
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<td>2.5.1.2.1</td>
<td>Retrieve ESS Door Status</td>
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<td>Yes / NA</td>
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<tr>
<td>2.5.1.3</td>
<td>Monitor Power</td>
<td>O</td>
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<td>Yes / No</td>
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<td>2.5.1.2.2</td>
<td>Retrieve Battery Status</td>
<td>O.1 (1.*)</td>
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<td>Yes / No / NA</td>
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<td>Retrieve Line Volts</td>
<td>O.1 (1.*)</td>
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<td>Yes / No / NA</td>
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<tr>
<td>2.5.1.4</td>
<td>Monitor Mobile Station Data</td>
<td>Mobile</td>
<td></td>
<td>Yes / NA</td>
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<td>2.5.1.3.1</td>
<td>Retrieve Mobile ESS Movement</td>
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<td></td>
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<td>Determine ESS Type</td>
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<td>2.5.1.5.a</td>
<td>Permanent</td>
<td>O.2 (1)</td>
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<td>2.5.1.5.b</td>
<td>Transportable</td>
<td>O.2 (1)</td>
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<td>Yes / No</td>
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<td>2.5.1.5.c</td>
<td>Mobile</td>
<td>O.2 (1)</td>
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<td>2.5.1.6</td>
<td>Monitor the Status of the ESS</td>
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<td>Retrieve ESS Characteristics</td>
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<td>2.5.2</td>
<td>Sensor Manager Features</td>
<td>O.3 (1.*)</td>
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<td>Yes / No</td>
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</tbody>
</table>

**Selected YES**

- For a project
- YES for Permanent
- NO for Mobile
- NO for Transportable

*NTCIP 1204 v04 does not impose any accuracy requirements. Any accuracy requirements should be inserted here.*
### Addressing Generic Architectural (Communications) Needs

<table>
<thead>
<tr>
<th>User Need ID</th>
<th>User Need</th>
<th>FR ID</th>
<th>Functional Requirement</th>
<th>Conformance</th>
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<td>Provide Live Data</td>
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<td>F.1.1.2</td>
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<td>Provide Off-line Log Data</td>
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<td>3.6.21</td>
<td>Maximum Response Time for</td>
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<td>The Response Time for all requests shall be (r) milliseconds (25-500: Default=100)</td>
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<td></td>
<td>of Logging Service</td>
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<tr>
<td>F.2.1.2.6</td>
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<td></td>
<td>Logged Events</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Selected YES**

**Selected NO**

If not needed in a project

**YES for Dial-up ESS**

**EXAMPLE**
Backward Compatibility

NTCIP 1204 v04 Compatibility to Earlier Versions

- v04 is updated for newer user needs and generally backward compatible with v03, v02 and v01

- Previous ESS implementations that used v01 and v02 data objects may not be able to add newer sensor technologies

- v04 PRL and RTM tables headings have been revised
Module Summary

- Review the structure of the standard

- Identify specific ESS operational needs

- Use the PRL to select the user needs and traceability to requirements

- Discuss how to prepare a project level PRL for ESS specification
We Have Now Completed A313a in the ESS Curriculum

**Module A313a**: Understanding User Needs for ESS Systems Based on NTCIP 1204 v04 Standard

**Module A313b**: Specifying Requirements for NTCIP 1204 v04 ESS Standard

**Module T313**: Applying Your Test Plan to the Environmental Sensor Stations based on the NTCIP 1204 ESS Standard v04
Next Course Module

Module A313b: Specifying Requirements for NTCIP 1204 v04 ESS Standard

Concepts taught in next module (Learning Objectives):

1) Review the structure of the standard
2) Use the PRL and RTM to specify the standardized structure of requirements
3) Use the RTM to specify the standardized design
4) How to specify requirements not covered by the standard
5) Infer the relationship between selecting requirements and testing
Thank you for completing this module.

Feedback
Please use the Feedback link below to provide us with your thoughts and comments about the value of the training.

Thank you!