STANDARDS ITS TRAINING

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U.S. Department of Transportation

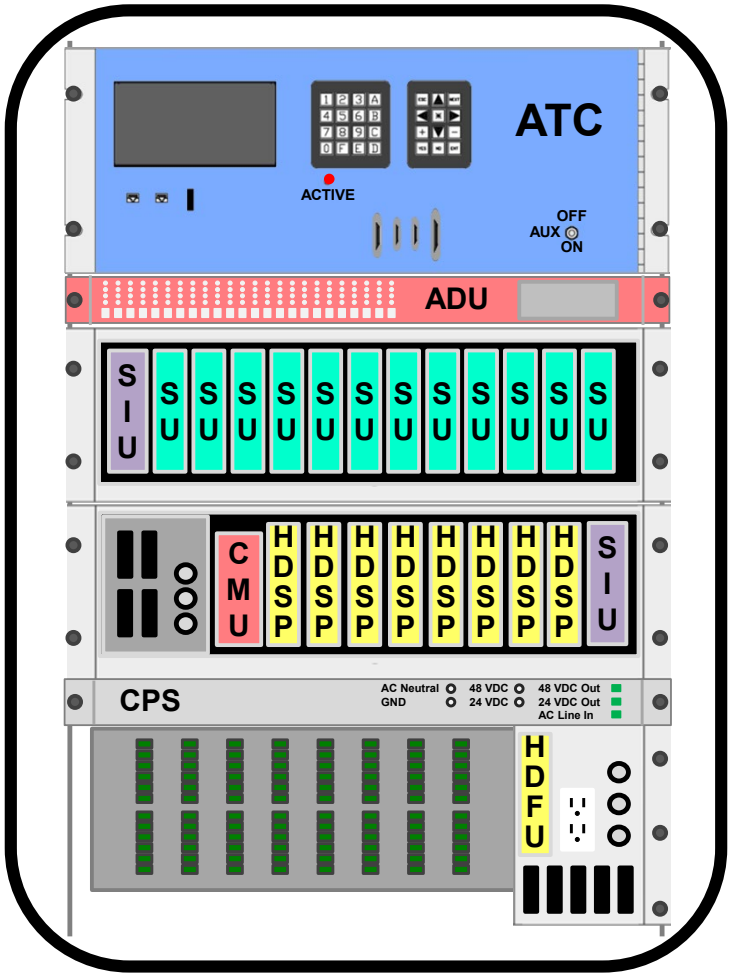
Office of the Assistant Secretary for
Research and Technology

Welcome

Ken Leonard, Director
ITS Joint Program Office
Ken.Leonard@dot.gov

www.pcb.its.dot.gov

Module A322b:
Understanding Requirements for Transportation Field Cabinet Systems Using ATC 5301 v02



Instructor

Ralph W. Boaz

President

Pillar Consulting, Inc.

Learning Objectives

Describe the features of ATC 5301 Standard v02 transportation field cabinet systems

Write requirements for ATC Cabinet systems

Create a procurement specification for ATC Cabinets

Verify the ATC Cabinet specification

Learning Objective 1

Describe the features of ATC 5301 Standard v02 transportation field cabinet systems

Benefits of ATC 5301 v02

- **Functional standard** except where component interchangeability is desired
- **Double** the number of **detector channels** in the same space
- **Double** the number of **channels per switch pack** and the switch pack is **physically smaller**
- Most **assemblies replaceable** while intersection **in flash**
- Load **current monitoring** for **detecting dark approaches**

Benefits of ATC 5301 v02 (cont.)

- **Eliminate arc flash hazard** per National Fire Protection Association (NFPA) 70E
- **Touch safe** design
- **Low voltage option** for 48 VDC on field wires
  - Electrically **safe for humans**
  - **Alternative power sources**
- **Better LED compatibility** – potential power conservation

ATC Cabinet v02 Assemblies

- **Assembly**
  - Any subordinate element to the cabinet system that is made up of multiple parts or components
  - Major and minor Assemblies
- Major assemblies are:
  - **Controller** – Defined by ATC 5201 and ATC 5401 Standards
  - **Input Assembly**
  - **Output Assembly**
  - **Field Termination Assembly**
  - **Service Assembly**

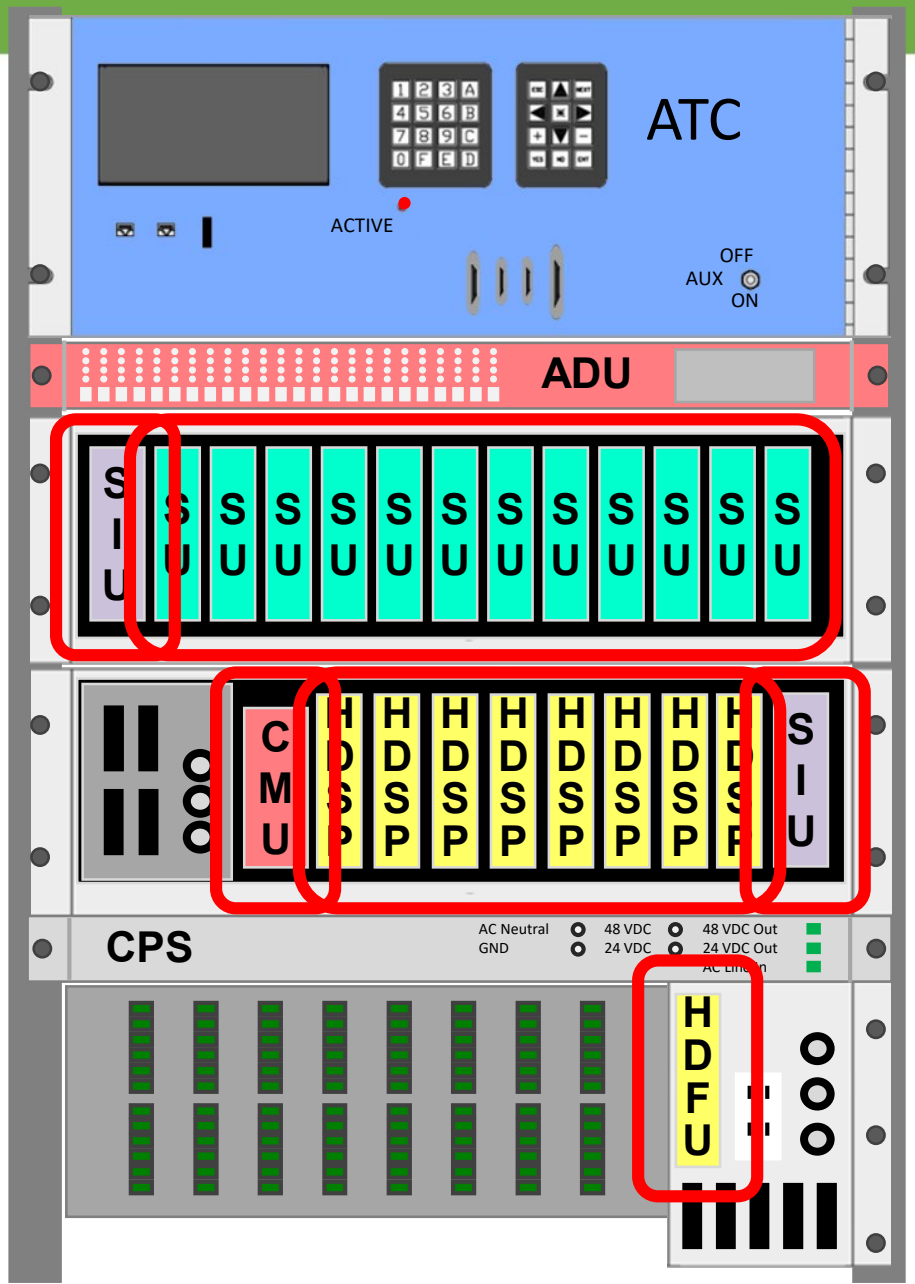
ATC Cabinet v02 Components

- **Component**
  - An electronic assembly with major functional attributes of the TFCS where some level of functional and/or physical interchangeability is desired
- Components are the following:
  - **Serial Interface Unit (SIU)**
  - **High-Density Switch Pack / Flasher Unit (HDSP/FU)**
  - **Cabinet Monitor Unit (CMU)**
  - **Cabinet Power Supply (CPS)**
  - **Auxiliary Display Unit (ADU)**
  - **Sensor Unit (SU)**

Manufacturer-specific designs also allowed

ATC Cabinet v02 Generic Representation

ADU	Auxiliary Display Unit
ATC	Advanced Transportation Controller
CMU	Cabinet Monitor Unit
CPS	Cabinet Power Supply
HDFU	High Density Flasher Unit
HDSP	High Density Switch Pack
SA	Service Assembly
SIU	Serial Interface Unit
SU	Sensor Unit



(Option)

Graphics: Ralph W. Boaz

Options Within ATC 5301 v02

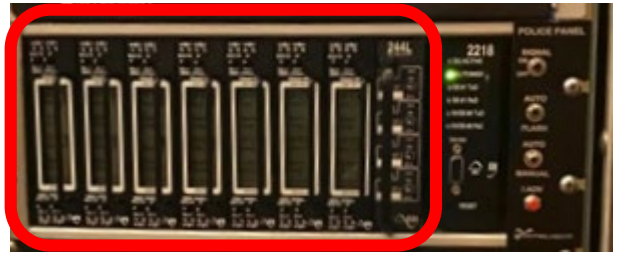
- **ATC 5301 v02 allows for many configurations**
  - Number and arrangement of assemblies and components will vary
  - Some assemblies or components may not be used
- **ATC 5301 v02 identifies some options** for assemblies or components
  - Options may be defined in the standard
  - May have an option for a manufacturer-specific design
- Where ATC 5301 v02 defines options, the agency **specification should remove ambiguities**:
  a) Have requirements that select one of the defined options or
  b) State that a manufacturer-specific design is allowed

Input Assembly

- Main functions are to:
  - **House SUs** – perform on-street detection
  - **House SIU** – communicates inputs to transportation controller
  - Provide communications between SUs and SIUs
- Options
  - **Number SUs supported** per Input Assembly **varies**
  - **12 SUs per Input Assembly** (24 input channels) is **common**
  - May use multiple Input Assemblies or other packaging
    - Additional SIUs may be required, SIU has 24 input channel max
    - Up to 120 input channels total

Input Assembly (cont.)

- Choices
  - Manufacturers may make **multiple designs of Input Assemblies**
  - Suggest that agencies determine the number input channels they need
  - Allow the manufacturer to provide the appropriate Input Assembly packaging



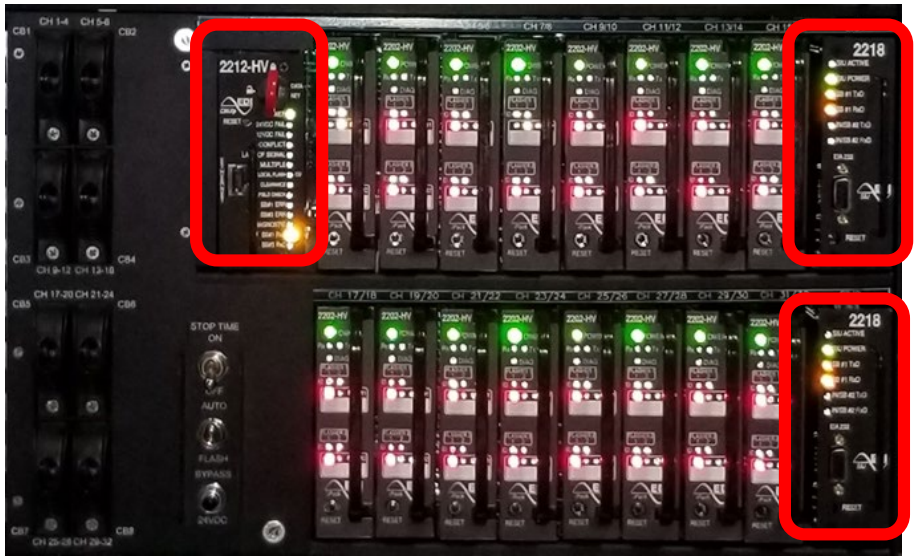
Photos by: Ralph W. Boaz

Output Assembly

- Main functions are to:
  - **House HDSPs** – control power to signals and other devices
  - **House CMU** – ensures no conflicting signals, other safety monitoring
  - **House SIU** – communicates between the HDSPs and controller
  - Provide communications between HDSPs and SIUs
  - Provide communications between HDSPs and CMU
- Options
  - **Number HDSPs supported** per Output Assembly **varies**
  - **8 HDSPs per Output Assembly** (16 output channels) is **common**
  - May use multiple Output Assemblies or other packaging
    - Additional SIUs may be required, SIU has 16 output channel max
    - Up to 32 output channels total

Output Assembly (cont.)

- Choices
  - Manufacturers may make **multiple designs of Output Assemblies**
  - Suggest that agencies determine the number output channels they need
  - Allow the manufacturer to provide the appropriate Output Assembly packaging



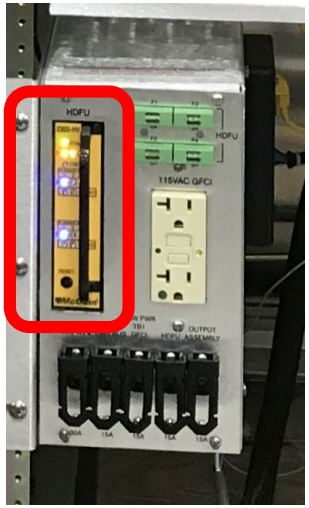
Photos by: Ralph W. Boaz

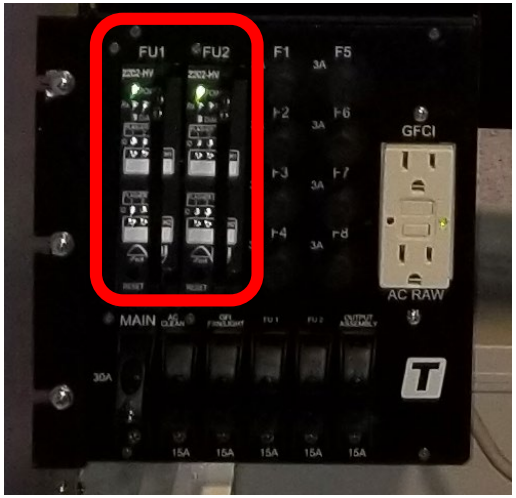
Field Termination Assembly (FTA)

- Main functions are to:
  - Provide **shielded termination point for input and output wiring** to field devices
- Options
  - **Design** of Field Termination Assembly is **manufacturer option**
- Choices
  - Manufacturers may make **multiple designs of FTAs**
  - Some have split input and output as FTAs

Service Assembly

- Main functions are to:
  - **Provide power service entry** from the utility company
  - **House main breakers, suppressors and filters**
  - **House ground fault circuit interrupter** (GFCI) receptacle
- Options
  - **Design** of Service Assembly is **manufacturer option**
  - **Houses HDFU** in most cabinet systems but this is **manufacturer option**





Photos by: Ralph W. Boaz

Serial Interface Unit (SIU)

- Main functions are to:
  - **Provide serial bus communications between system components**
    - Between **Controller and Sensor Units** for inputs
    - Between **Controller and Switch Packs** for outputs
  - Automatically adapt to functionality based on position in cabinet
- No Options
  - **Model 2218**

Photo Courtesy of Eberle Design, Inc.

High Density Switch Pack / Flasher Unit (HDSP/FU)

- Main functions are to:
  - **Provide power to control signals and devices** on the street
  - Automatically adapt to functionality based on position in cabinet
    - Also called **HDSP and HDFU** to reflect functionality
- No options – Determined by Voltage
  - **Model 2202-LV** (Low Voltage)
  - **Model 2202-HV** (High Voltage)

Photos Courtesy of Eberle Design, Inc.

Cabinet Monitor Unit (CMU)

- Main functions are to:
  - **Monitor various aspects of TFCS and put** cabinet system **in flash** under certain conditions
    - 120 VAC Monitoring (2212-HV only)
    - 48 VDC, 24 VDC and 12 VDC monitoring
    - Serial Bus Errors (SB1 and SB3)
    - Conflicting channels
    - Diagnostic errors
    - Many others
- No Options – Determined by Voltage
  - **Model 2212-HV** (High Voltage)
  - **Model 2212-LV** (Low voltage)

Photo Courtesy of Eberle Design, Inc.

Cabinet Power Supply (CPS)

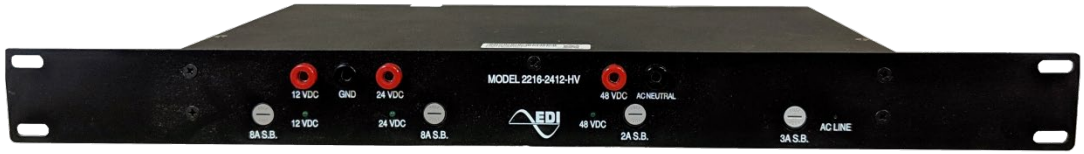
- Main functions are to:
  - **Convert service power** to power for subassemblies
  - **Create control signals** for orderly power up, power down and timekeeping
- Options:
  - **Model 2216-24** (HV AC cabinets, 48/24 VDC outputs)
  - **Model 2216-2412** (HV AC cabinets, 48/24/12 VDC outputs)
  - **Model 2217** (HV AC cabinets, card mounted, 48/24 VDC outputs)
  - **Model 2248** (LV DC cabinets, 48/24 VDC internal)
  - **Manufacturer-specific designs** also allowed

Cabinet Power Supply (CPS) (cont.)

- Choices:
  - **Choose a unit from the standard** that meets your voltage requirements **OR**
  - Allow a **manufacturer-specific design**

Model 2217

Model 2216-2412



Model 2248

Manufacturer-Specific Design

Photos Courtesy of Eberle Design, Inc.

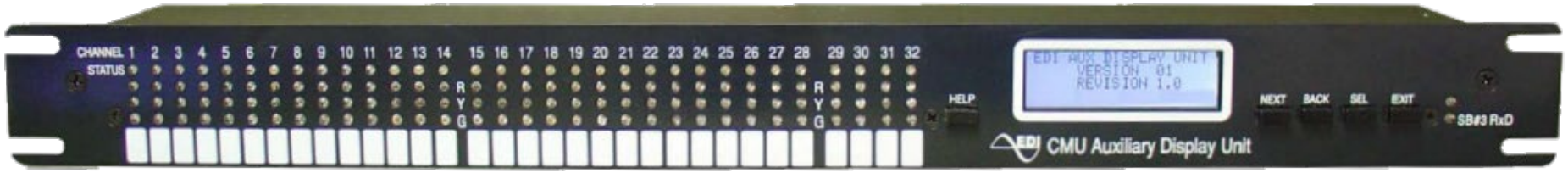
Auxiliary Display Unit (ADU)

- Main functions are to:
  - **Provide user interface for CMU** to view status, configuration, and logs
    - LCD 4 rows x 20 columns
    - LEDs for channel output status
    - Menu navigation buttons HELP, NEXT, BACK, SEL, and EXIT
  - **Not required for CMU to operate**
- Options:
  - **Model 2220**
  - **Manufacturer-specific designs** also allowed
  - **No ADU** – Laptop or tablet computer can be used during maintenance

Auxiliary Display Unit (ADU) (cont.)

- Choices:
  - Choose Model 2220 **OR**
  - Allow a manufacturer-specific design **OR**
  - Have no ADU

Model 2220



A Manufacturer-Specific Design

Upper Photo Courtesy of Eberle Design, Inc.

Lower Photo By Ralph W. Boaz

Sensor Unit (SU)

- Main functions:
  - **Detect Vehicles, Bicycles, Pedestrians, Light and Heavy Rail, weather conditions, and other on-street conditions**
- Options:
  - **NEMA 2-Channel** Inductive Loop Detector with Outputs and Status
  - **NEMA 4-Channel** Inductive Loop Detector with Outputs and Status
  - **Type 222 2-Channel** Inductive Loop Detector without Status
  - **Type 224 4-Channel** Inductive Loop Detector without Status
  - **Type 242L 2-Channel** DC Isolator with Status
  - **Type 244L 4-Channel** DC Isolator with Status
  - **Preemptor** (Ex. Fire and Rail)

ACTIVITY

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Question

Which of the following is a true statement?

Answer Choices

a) ATC 5301 defines a controller as part of the cabinet system

b) ATC 5301 defines all mechanical specifications of each assembly

c) Serial Interface Units are optional in ATC Cabinets

d) Where there are defined options in ATC 5301, the agency specification should remove ambiguities

Review of Answers

a) ATC 5301 defines a controller as part of the cabinet system

Incorrect. An ATC unit is defined by the ATC 5201 and ATC 5401 Standards.

b) ATC 5301 defines all mechanical specifications of each assembly

Incorrect. Mechanical specifications are only included where element interchangeability desired.

c) Serial Interface Units are optional in ATC Cabinets

Incorrect. Serial Interface Units are required for communications within the ATC cabinet system.

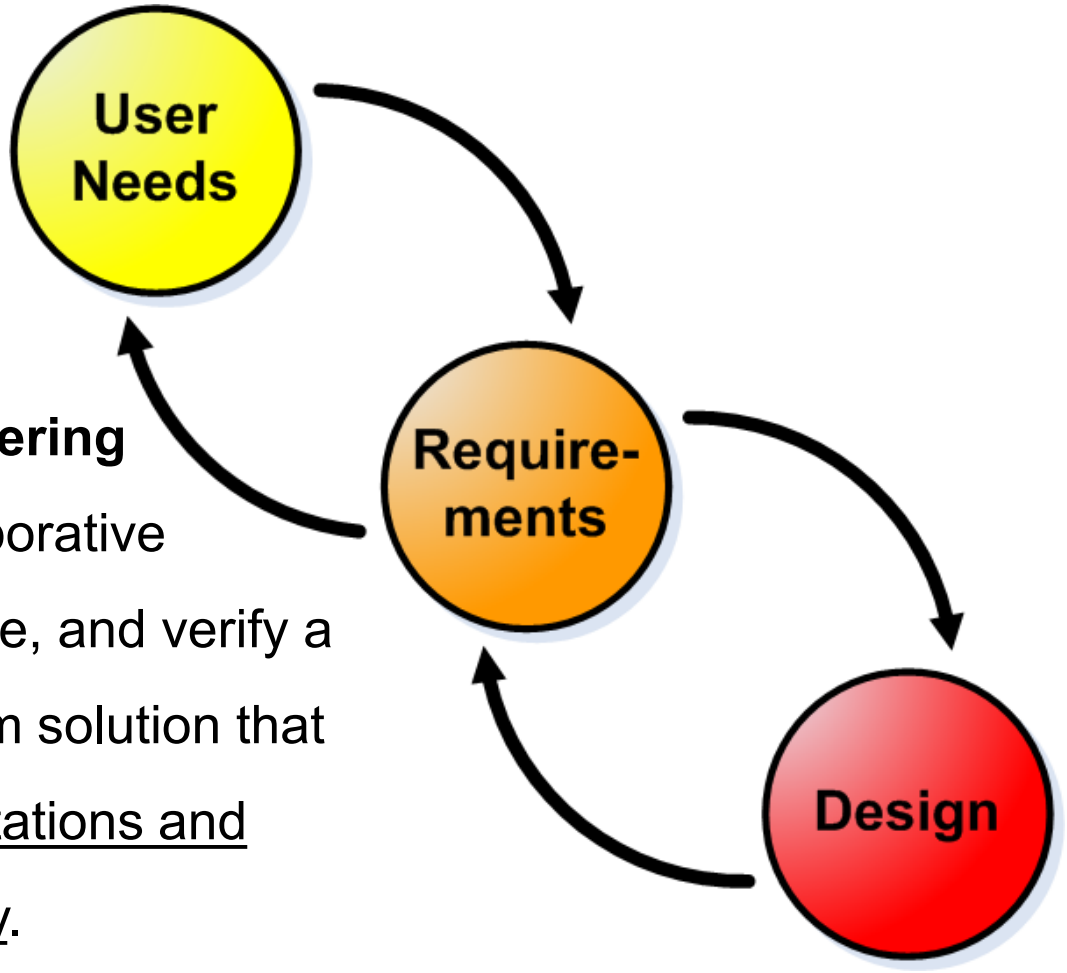
d) Where there are defined options in ATC 5301, the agency specification should remove ambiguities

Correct. This helps vendors know where they may innovate.

Learning Objective 2

Write requirements for ATC Cabinet Systems

Systems Engineering Approach to Developing an ATC Cabinet Procurement Specification



IEEE – Systems Engineering

An interdisciplinary collaborative approach to derive, evolve, and verify a life cycle balanced system solution that satisfies customer expectations and meets public acceptability.

Graphics: Ralph W. Boaz

Definition of a "Well-Formed" Requirement

[Actor] [Action] [Target] [Constraint] [Localization]

[Localization] [Actor] [Action] [Target] [Constraint]

Actor	Identifies who or what does the action
Action	Identifies what is to happen
Target	Identifies who or what receives the action
Constraint	Identifies how to measure success or failure of the requirement
Localization	Identifies the circumstances under which the requirement applies

Localization and constraint portions are important but not all requirements will have both.

Example Well-Formed Requirement

[Actor] [Action] [Target] [Constraint] [Localization]

[Localization] [Actor] [Action] [Target] [Constraint]

5.3.7 Color Graphics Display

The transportation controller shall provide a liquid crystal display (LCD) that is capable of color graphics.

ACTOR

CONSTRAINT

ACTION

TARGET

If a requirement can't be stated in this simple format, you probably need to use multiple requirements.

Graphics: Ralph W. Boaz

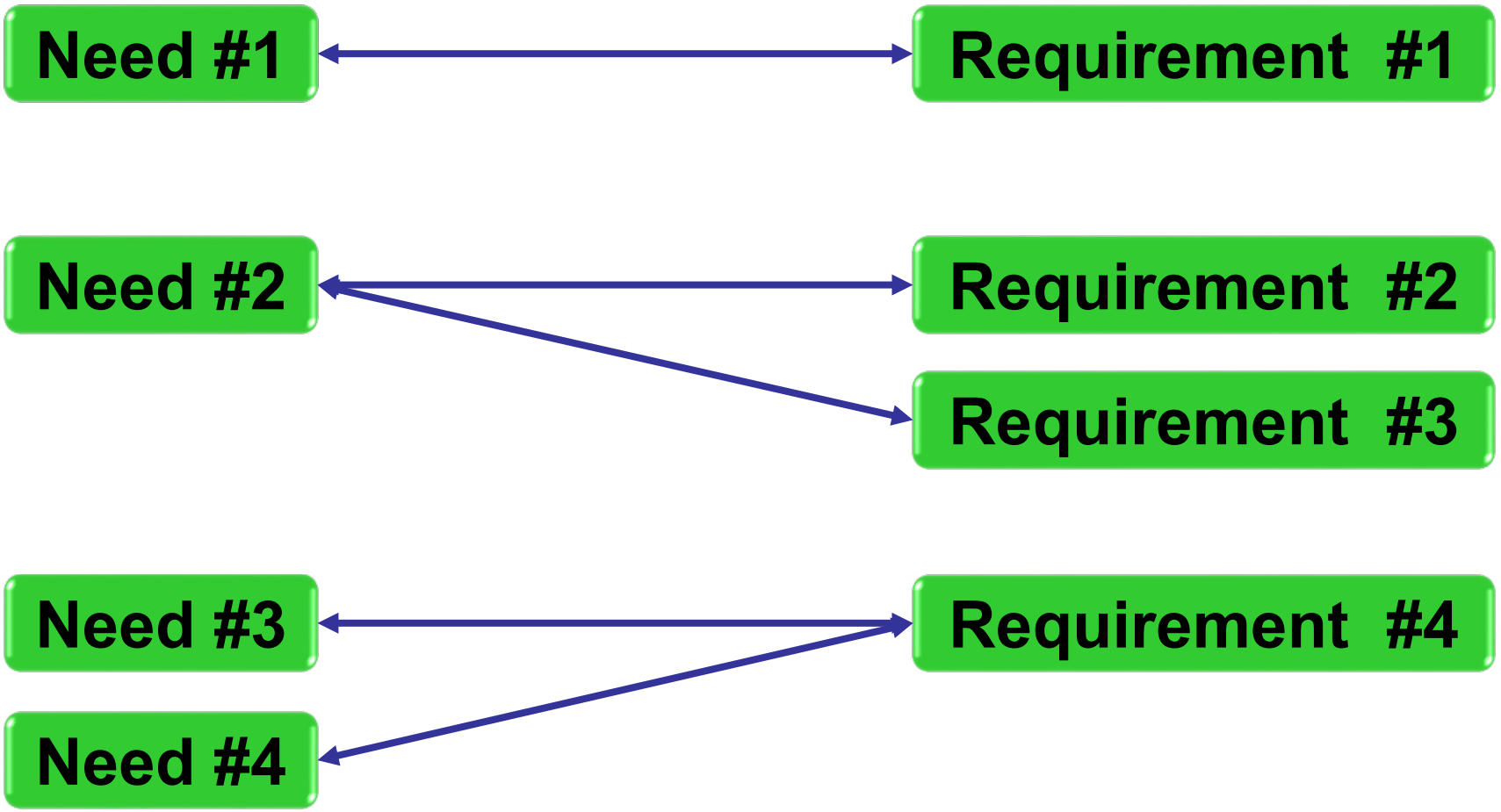
Characteristics of Well-Formed Requirements

- Necessary
  - Must be useful and traceable to needs
- Concise
  - Minimal, understandable and expressed in declarative language (e.g. “shall statements”)
- Attainable
  - Realistic to achieve within available resources and time
- Standalone
  - Stated completely in one place, not compound requirement
- Consistent
  - Does not contradict itself, nor any other stated requirement

Characteristics of Well-Formed Requirements (cont.)

- Unambiguous
  - Susceptible to only one interpretation
- Verifiable
  - Requirement can be met through inspection, analysis, demonstration, or test

Relationships of User Needs and Requirements



Graphics: Ralph W. Boaz

Traceability in ATC 5301 v02

Verify the Requirement	
Requirement ID	**Requirement Title**
5.13.1	Diagnostic Display Local Display
Requirement Text The TFCS shall contain a Diagnostic Display Unit (DDU) which supports local display of both historical and current cabinet status and log data collected by the monitoring subsystem.	
Justification for the Requirement: 1. The user needs the TFCS to be of a design that reduces the time required for maintenance personnel to perform maintenance actions in the field.	
Source for Justification: 1. UN ID 4.3.1.20	
Related Design Elements 1. 6.5 Model 2220 Auxiliary Display Unit	

Guidance on ATC Cabinet Requirements

- Requirements in ATC 5301 v02 were developed in the creation of the standard
- **Requirements must be developed for a specification** to ensure the ATC Cabinet design or configuration will meet the agency's needs
- **No need to repeat requirements that are already in the standard** in a specification **unless**:
  a) It is **clarifying an option** that is in the standard or
  b) Relates to an agency user need for which the **agency wants to show traceability**

Writing Requirements

7.1.1 Modern ITS Standards and Specifications

The city needs the transportation infrastructure to be based on modern ITS standards and specifications. *Much of the city's ITS infrastructure is based on 25-40 year old technology. Infrastructure based on modern ITS standards provides choices for ITS solutions today and in the future. It also offers the best opportunity to leverage new technologies for mobility and safety.*

Requirement(s)

8.1.2 ATC Cabinet Conformance

The TFCS shall have a certificate of its conformance to ATC 5301 v02 from an agency approved test facility.

Writing Requirements Based On User Needs

7.2.1 Existing Foundations

The city needs TFCS to use existing cabinet foundations at signalized intersections. *Intersections outside the downtown area have Caltrans 332 cabinet foundations. The downtown has both Caltrans 332 cabinet foundations and pedestal mounts for Caltrans 336 cabinets. The city wants to avoid the cost of having to replace foundations when installing a new cabinet system.*

Requirement(s)

8.2.1 Standard Cabinet Foundation

The TFCS shall have a cabinet shell and mounting compatible with Cabinet Housing 1B as defined by the Caltrans TEES 2009.

8.2.2 Downtown Cabinet Foundation

The TFCS shall have a cabinet shell and mounting compatible with Cabinet Housing 2 with pedestal adapter as defined by Caltrans TEES 2009.

Writing Requirements Based On User Needs

7.4.1 120 VAC Service Power

The city needs the TFCS to operate using existing 120 VAC service power. Numerous on street devices require 120 VAC including traffic signal displays and the cities Changeable Lane Assignment System (CLAS) and lighted cross walks.

Requirement(s)

8.1.3 120 VAC Service Power

The TFCS shall accept a nominal service power of 120 VAC at 60 Hz.

Writing Requirements Based On User Needs

7.8.1 Standard Cabinet Configuration

The city needs a TFCS configuration that is suitable for intersections that are outside the downtown area. *The number of inputs and outputs need to support 80% or more of the intersections in this configuration. The city has plans to include a UPS in the cabinet and network equipment. Room is required for Connected Vehicle Roadside Equipment once the city chooses to deploy it. The city is identifying this configuration for ease of procurement.*

Requirement(s)

8.4.1 Standard Cabinet Input Channels

For Standard Cabinet Configurations, the TFCS shall have an input assembly with a minimum of 24 sensor channels.

8.5.1 Standard Cabinet Output Channels

For Standard Cabinet Configurations, the TFCS shall have an output assembly with a minimum of 16 output channels.

Writing Requirements Based On User Needs

7.8.2 Downtown Cabinet Configuration

The city needs a configuration TFCS that is suitable for intersections that are in the downtown area. *The number of inputs and outputs need to support 80% or more of the intersections in this configuration. The city has plans to include a UPS in the cabinet and network equipment. Room is required for Connected Vehicle Roadside Equipment once the city chooses to deploy it. The city is identifying this configuration for ease of procurement.*

Requirement(s)

8.4.2 Downtown Cabinet Input Channels

For Downtown Cabinet Configurations, the TFCS shall have an input assembly with a minimum of 16 sensor inputs.

8.5.2 Downtown Cabinet Output Channels

For Downtown Cabinet Configurations, the TFCS shall have an output assembly with a minimum of 8 output channels.

Writing Requirements Based On User Needs

7.4.2 Multiple Applications

The city needs the TFCS to be used for multiple and concurrently running applications. *The city wishes to operate multiple concurrent applications on a single controller unit as part of the TFCS. The city may have a single TFCS operate multiple intersections simultaneously, adjacent ramp meters, and smart city applications not yet identified.*

Requirement(s)

8.3.1 Advanced Transportation Controllers

The TFCS shall use a transportation controller that conforms to ATC 5201 v06A

8.3.2 Application Programming Interface

The TFCS shall use a transportation controller that is equipped with API Software that conforms to ATC 5401 v02A

Writing Requirements Based On User Needs

7.2.2 Physical Security

The city needs TFCS enclosure that inhibits unauthorized entry into the cabinet. *The enclosure should be tamper resistant and use technology to restrict access to unauthorized users. Use of the common #2 key in some areas of the city has resulted in unauthorized access and vandalism.*

Requirement(s)

8.2.10 Cabinet Locks

The TFCS shall have a cabinet locking mechanism that uses a programmable key.

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Question

Which of the following would complete a well-formed requirement for our specification?

The TFCS shall …

Answer Choices

a) be weather resistant

b) certify conformance to the NEMA TS 2 Standard v06

c) utilize a Model 2220 Auxiliary Display Unit as defined by ATC 5301 v02

d) All of the above

Review of Answers

a) be weather resistant

Incorrect. This is not specific enough to be verifiable.

b) conform to the NEMA TS 2-2016

Incorrect. This is inconsistent. A cabinet system cannot conform to both NEMA TS 2-2016 and ATC 5301 v02.

c) utilize a Model 2220 Auxiliary Display Unit as defined by ATC 5301 v02

Correct! This requires that the cabinet system to use an ADU as defined in the standard.

d) All of the above

Incorrect. A and B do not make well-formed requirements.

Learning Objective 3

Create a procurement specification for ATC Cabinets

Considerations in Creating a Procurement Specification

1) Agencies may have a “standing specification” for multiple projects or have a specification for a single project

2) Small number of agencies create a specification with complete detail on electrical, mechanical, and communications requirements
   - e.g. Caltrans, New York City

3) Sometimes agencies “spec-in” a particular vendor
   - Technical reasons
   - Nontechnical reasons

4) Content of specification may be influenced by how a project is awarded
   - Low bid, scoring method, others

Considerations in Creating a Procurement Specification (cont.)

5) Recommend that requirements in specification are written to a level of detail that is necessary (not more)
   - e.g. Mounting
   - Be careful with mechanical drawings

Turn the ConOps into a Specification

1. Purpose of Document
2. Scope of the Project
3. Referenced Documents
4. Background
5. Concept for the Proposed Procurement
6. User-Oriented Operational Description
7. User Needs
8. Appendices

Example Outline for an Agency Specification

1. Purpose of Document
2. Scope of the Project
3. Referenced Documents
4. Background
5. Concept for the Proposed Procurement
6. User-Oriented Operational Description
7. User Needs
8. Requirements
9. Appendices

Example Requirements Section

8. Requirements
   - 8.1 General Requirements
   - 8.2 Housing and Mounting Requirements
   - 8.3 **Controller Requirements**
   - 8.4 Input Assembly Requirements
   - 8.5 Output Assembly Requirements
   - 8.6 Field Termination Assembly Requirements
   - 8.7 Service Assembly Requirements
   - 8.8 Environmental and Testing Requirements
   - 8.9 Warranty Requirements
   - 8.10 Documentation Requirements
   - 8.11 Procurement Requirements

Important!

Whatever is not covered in ATC 5301 v02 or is tailored for the agency should be included in the specification.

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Question

Which of the following is a correct statement?

Answer Choices

a) It's best to use Warranty Requirements found ATC 5301

b) Requirements are a major part of the ConOps

c) Almost any part of the procurement process may have requirements in a procurement specification

d) Most agencies create specifications with complete electrical, mechanical, and communications details

Review of Answers

a) It's best to use Warranty Requirements found ATC 5301

Incorrect. There are no warranty requirements in ATC 5301 v02.

b) Requirements are a major part of the ConOps

Incorrect. Requirements are not a part of the ConOps. User needs are.

c) Almost any part of the procurement process may have requirements in a procurement specification

Correct! Agencies should strive to make the procurement process clear and set expectations.

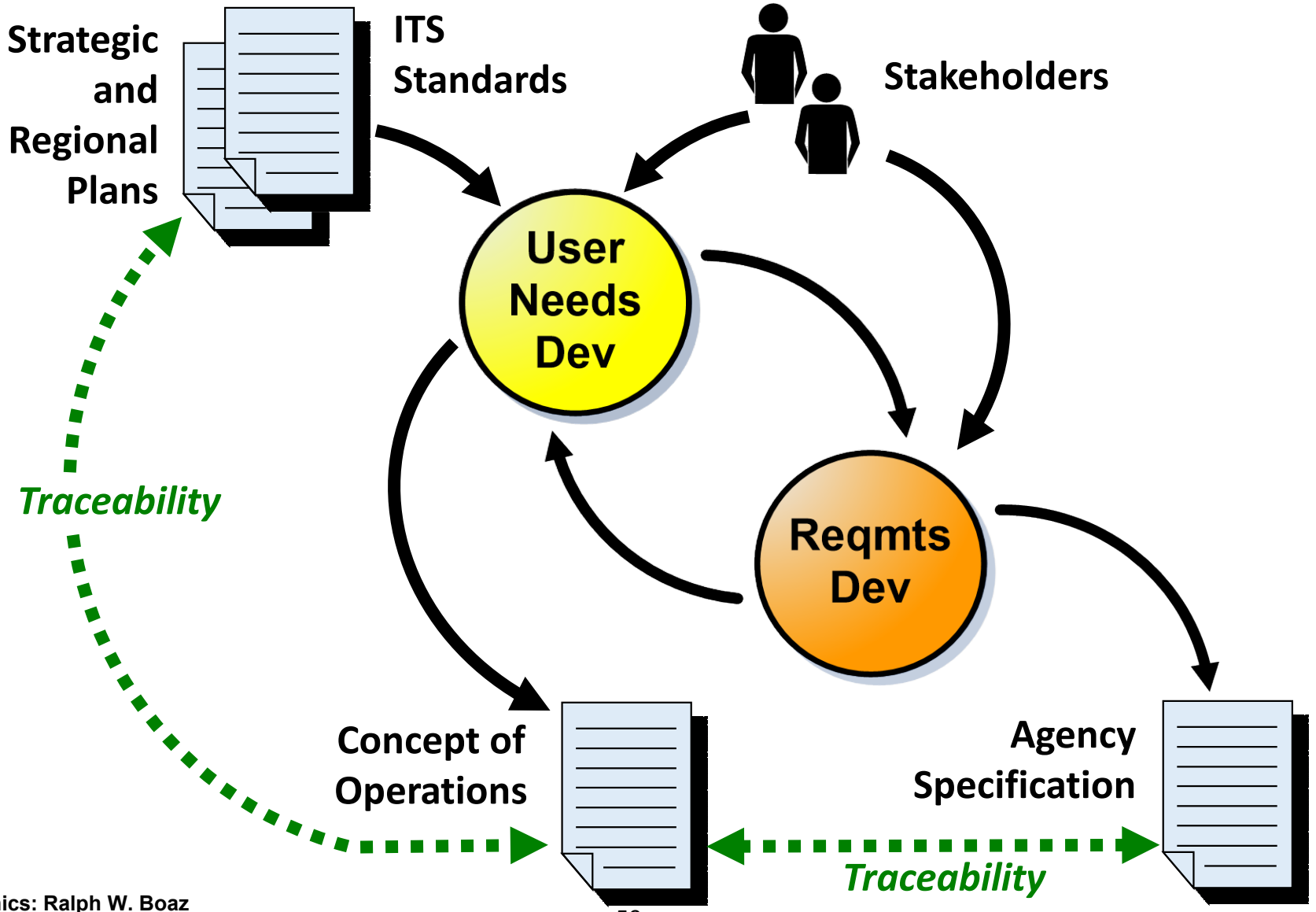
d) Most agencies create specifications with <u>complete</u> electrical, mechanical, and communications details

Incorrect. Most agencies only need engineering details in select areas based on their needs and requirements.

Learning Objective 4

Verify the ATC Cabinet specification

Systems Engineering Approach to Developing a Procurement Specification



Graphics: Ralph W. Boaz

Walk-throughs

- Meeting or meetings to systematically walk-through a document, design, software, etc.
- Purpose
  - Find anomalies
  - Improve product
  - Consider alternatives
  - Ensure completeness and correctness
- Primarily performed twice during User Need development and Requirements Development
- Specification developer or walk-through leader
- Potentially different audiences / reviewers for each stage
  - Larger body of stakeholders / selected stakeholders

Walk-through Workbook for User Needs

UN ID	UN Name	User Need	Comments
Major desired capability? Rationale accurately captured?			
7.2.1	Existing Foundations	The city needs TFCS to use existing cabinet foundations at signalized intersections. *Intersections outside the downtown area have Caltrans 332 cabinet foundations. The downtown has both Caltrans 332 cabinet foundations and pedestal mounts for Caltrans 336 cabinets. The city wants to avoid the cost of having to replace foundations when installing a new cabinet system.*	
7.2.2	…	…	
7.2.3	…	…	

Walk-through Workbook for Requirements

UN ID	UN Name	User Need	Comments
Major desired capability? Rationale accurately captured?			
7.2.1	Existing Foundations	The city needs TFCS to use existing cabinet foundations at signalized intersections. *Intersections outside the downtown area have Caltrans 332 cabinet foundations. The downtown has both Caltrans 332 cabinet foundations and pedestal mounts for Caltrans 336 cabinets. The city wants to avoid the cost of having to replace foundations when installing a new cabinet system.*	
Req ID	**Req Name**	**Requirement**	**Comments**
Well-formed? Logical consistent w/UN, parent/sibling requirements? Feasible? Verifiable: Inspection? Analysis? Demonstration? Test?			
8.2.1	Standard Cabinet Foundation	The TFCS shall have a cabinet shell and mounting compatible with Cabinet Housing 1B as defined by the Caltrans TEES 2009.	
8.2.2	Downtown Cabinet Foundation	The TFCS shall have a cabinet shell and mounting compatible with Cabinet Housing 2 with pedestal adapter as defined by Caltrans TEES 2009.	

Verifying a Specification - Exercise

7.8.1 Standard Cabinet Configuration

The city needs a TFCS configuration that is suitable for intersections that are outside the downtown area. *The number of inputs and outputs need to support 80% or more of the intersections in this configuration.* ***The city has plans to include a UPS in the cabinet and network equipment. Room is required for Connected Vehicle Roadside Equipment once the city chooses to deploy it.*** *The city is identifying this configuration for ease of procurement.*

Requirement(s)

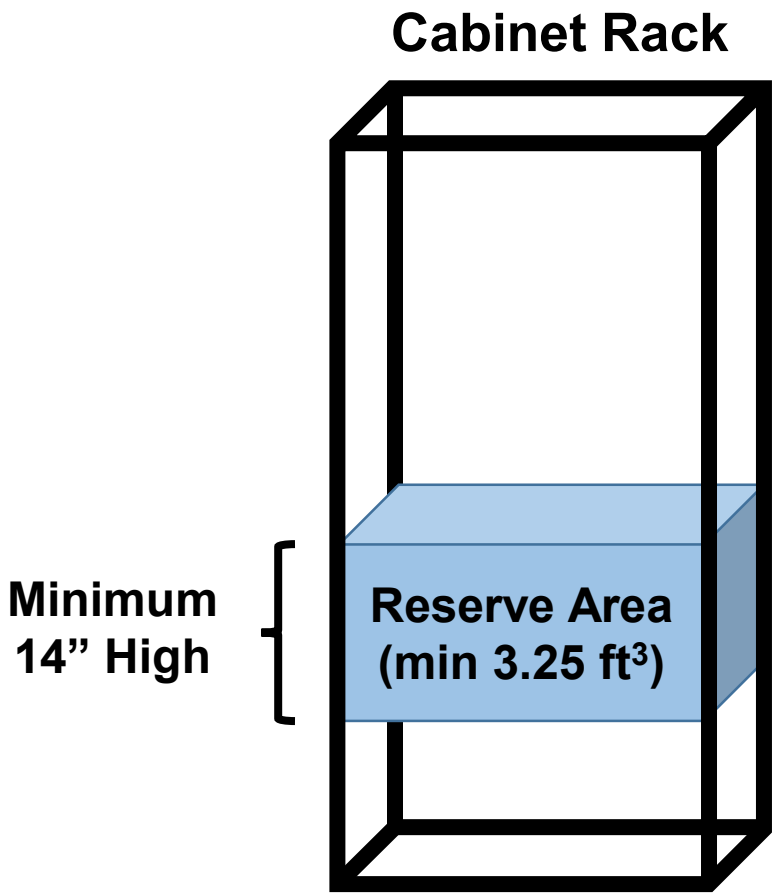
8.4.1 Standard Cabinet Input Channels

8.5.1 Standard Cabinet Output Channels

8.2.5 Standard Cabinet Reserve Area

For Standard Cabinet Configurations, the TFCS shall have a reserve space that is a minimum of 14 inches high and 3.25 cubic feet of space has shown in Figure 8-1.

Verifying a Specification – Exercise (cont.)



- Reserve area for future enhancements.
- Position in cabinet may vary.
- Picture not to scale

Figure 8-1 Reserve Area for Standard Cabinet Configurations

Graphics: Ralph W. Boaz

Verifying a Specification – Exercise (cont.)

User needs for downtown pedestal mount cabinets must be re-evaluated!

- User need **7.8.2 Downtown Cabinet Configuration** has the same statements regarding a UPS and other equipment
- Downtown cabinets include those that are pedestal mount
  - Roughly 1/3 the space of a standard cabinet
- Choices for the agency:

a) Remove the statements about the additional equipment from user need 7.8.2

b) Have a smaller reserve space for the downtown cabinets

c) Remove pedestal mounted cabinets from user need **7.2.1 Existing Foundations** and subsequent requirement

Verifying the Specification Using Traceability

- Create a traceability matrix of user needs to requirements
- Tool used to help verify completeness and correctness
- Suggest capturing traceability throughout the requirements development process

Needs-To-Requirements Traceability

- Every user need must be addressed by at least one requirement
- Every requirement must trace to at least one user need
- Any user need that is not addressed by at least one requirement means:
  - A requirement was missed or
  - The user need must be reevaluated

Needs-To-Requirements Traceability (cont.)

- Any requirement that does not address at least one user need means:
  - The requirement must be reevaluated or
  - A user need was missed
- Every aspect of each user need should be addressed by requirements

Needs-to-Requirements Traceability Matrix (NRTM)

UN ID	User Need	Req ID	Requirement
7.8.1	Standard Cabinet Configuration	8.2.5	Standard Cabinet Reserve Area
		8.4.1	Standard Cabinet Input Channels
		8.5.2	Standard Cabinet Output Channels
7.8.2	Downtown Cabinet Configuration	8.4.2	Downtown Cabinet Input Channels
		8.5.2	Downtown Cabinet Output Channels

Full Traceability shown through Tables

UN ID	User Need	Source(s)
7.1.1	Modern ITS Standards and Specifications	ITS Strategic Deployment Plan (4.1.1)
7.2.1	Existing Foundations	Stakeholders (Public Works)
7.2.2	Physical Security	Stakeholders (IT, Operations)
7.4.1	120 VAC Service Power	Stakeholders
7.4.2	Multiple Applications	Livable Community Plan (5.2.1)
7.8.1	Standard Cabinet Configuration	Stakeholders (Procurement Office)
7.8.2	Downtown Cabinet Configuration	Stakeholders (Procurement Office)

UN ID	User Need	Req ID	Requirement
7.8.1	Standard Cabinet Configuration	8.2.5	Standard Cabinet Reserve Area
		8.4.1	Standard Cabinet Input Channels
		8.5.2	Standard Cabinet Output Channels
7.8.2	Downtown Cabinet Configuration	8.4.2	Downtown Cabinet Input Channels
		8.5.2	Downtown Cabinet Output Channels

ACTIVITY

STANDARDS ITS TRAINING

U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

Question

Which of the following is true statement?

Answer Choices

a) The rationale of a user need should be examined for requirements

b) Every user need must be addressed by at least two requirements

c) It's best to wait until the end of requirements development to start a traceability matrix

d) All of the above

Review of Answers

a) The rationale of a user need should be examined for potential requirements

Correct! The rationale of a user need provides understanding of the need and can be a source for requirements.

b) Every user need must be addressed by at least two requirements

Incorrect. Every user need must be addressed by at least one requirement.

c) It's best to wait until the end of requirements development to start a traceability matrix

Incorrect. Capturing traceability throughout the requirements development process is suggested.

d) All of the above

Incorrect. B and C were false statements.

Module Summary

Describe the features of ATC 5301 Standard v02 transportation field cabinet systems

Write requirements for ATC Cabinet Systems

Create a procurement specification for ATC Cabinets

Verify the ATC Cabinet specification

ATC 5301 v02 Standards Curriculum

A322a: Understanding User Needs for Transportation Field Cabinet Systems Using ATC 5301 v02

A322b: Understanding Requirements for Transportation Field Cabinet Systems Using ATC 5301 v02

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!