

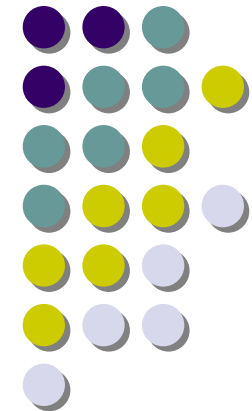
DRAFT - Briefing Book

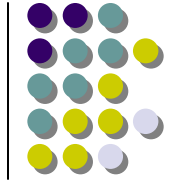
Task 2.A.1 – Review of National Standards and Testing Program

Albany, NY
{Date TBD}

Manny Insignares
Patrick Chan, P.E.

ConSysTec Corp





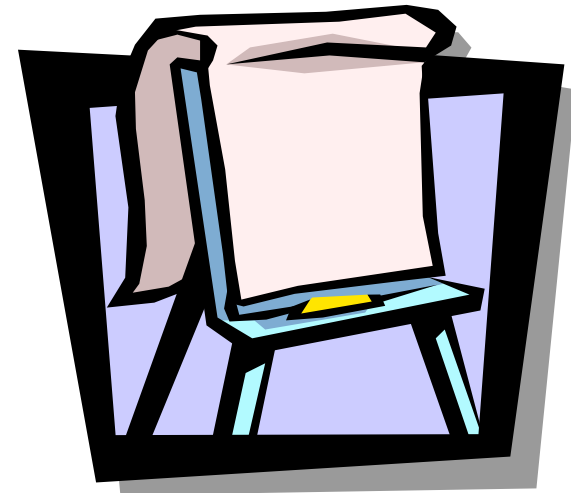
Presentation Summary

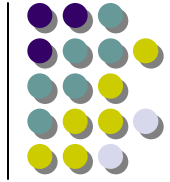
- Introductions
- National ITS Standards Program Overview
- Standards Development Organizations
- Standards Testing Program
 - ITS Standards Testing Program
 - Testing and Conformity Assessment
- Background Information
 - Center-To-Field Communications
 - Center-To-Center Communications
- Impact on NYSDOT
 - Interactive Discussion
 - Procurement and Engineering Process



Introductions

- Facility Amenities and Safety Instructions
- A word from our Sponsor
- Briefer and Participant Introductions
 - Your name
 - Your organization
 - ITS experience
 - ITS project involvement
 - Your expectations

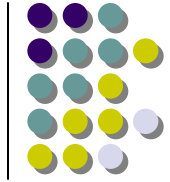




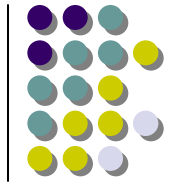
National ITS Standards Program Overview



National ITS Standards Program Overview



- ITS Standards Program began in 1996
- 7 Standards Development Organizations
 - American Association of State Highway Transportation Officials (AASHTO)
 - American Public Transportation Association (APTA)
 - American Society for Testing & Materials (ASTM)
 - Institute of Electrical and Electronics Engineers (IEEE)
 - Institute of Transportation Engineers (ITE)
 - National Electrical Manufacturers Association (NEMA)
 - Society of Automotive Engineers (SAE)



National ITS Standards Program

- Program encompasses 5 key areas:
 - Development
 - Testing
 - Deployment
 - Technical Assistance
 - Training and Outreach



National ITS Standards Program

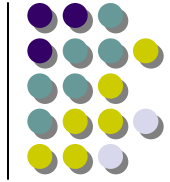
- Development Activities

- Establish cooperative agreements between the Program and standards development organizations (SDOs) to accelerate the development of standards
- Fund technical support for standards development working groups
- Support the participation of representatives from public agencies in the standards development process

- Testing Activities

- Measure the operation, correctness, and completeness of ITS standards in realistic transportation settings
- Measure the degree of interoperability of ITS systems
- Provide testing results and information about the performance of standards

National ITS Standards Program



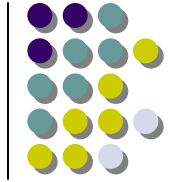
- Deployment Activities

- Provide tools that help state and local deployers implement standards-based ITS
- Provide platforms that allow state and local deployers to exchange ideas and to discuss standards deployment-related issues

- Technical Assistance Activities

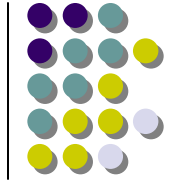
- Deliver a comprehensive program of technical assistance to state and local deployers
- Increase the knowledge base of state and local deployers on ITS standards evaluation, procurement, deployment, and maintenance issues

National ITS Standards Program



- Training and Outreach Activities

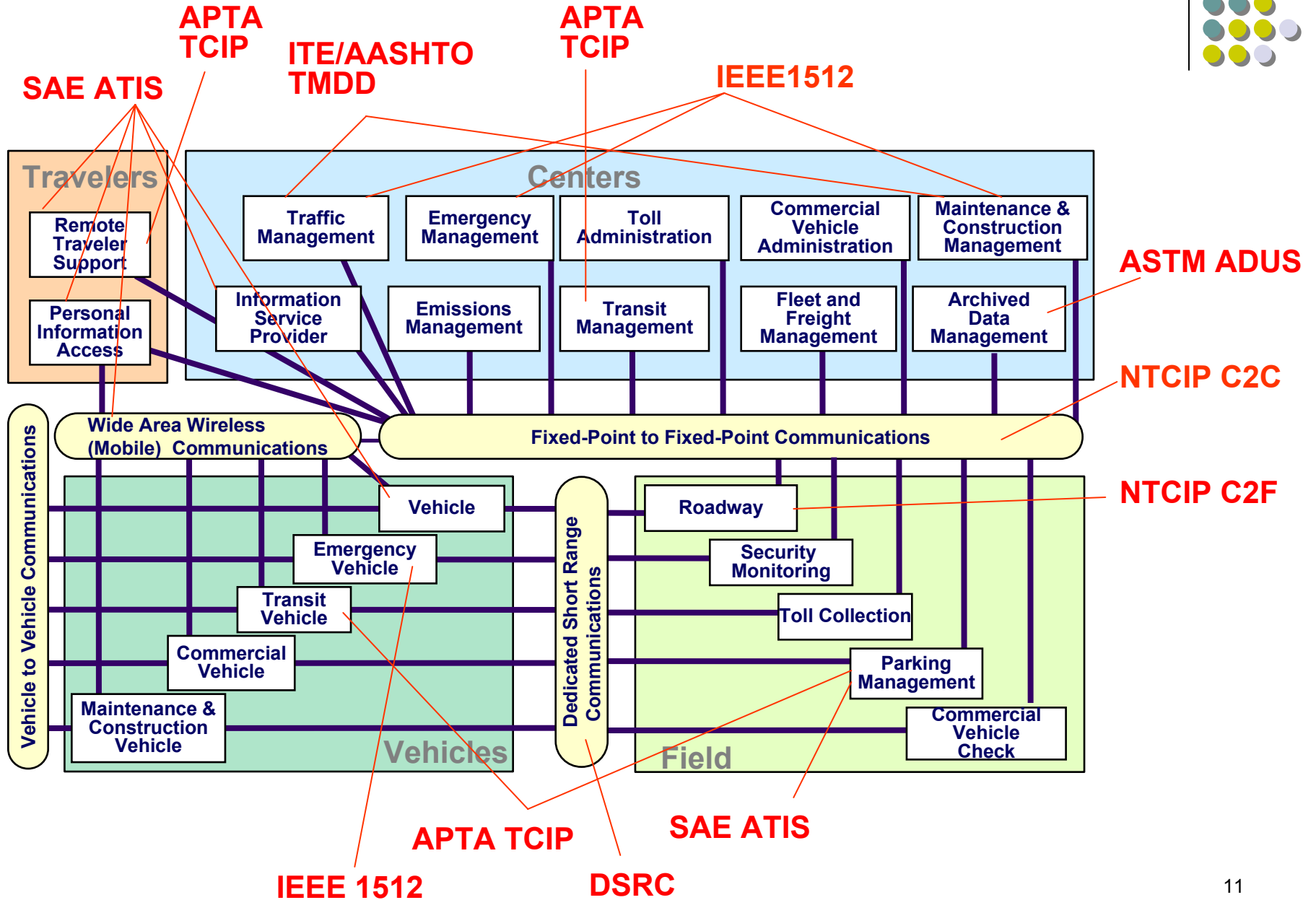
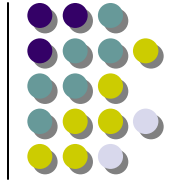
- Develop materials and resources that promote the awareness and use of ITS standards
- Offer comprehensive technical training in various ITS standards at locations throughout the country



Standards Development Organizations (SDOs)



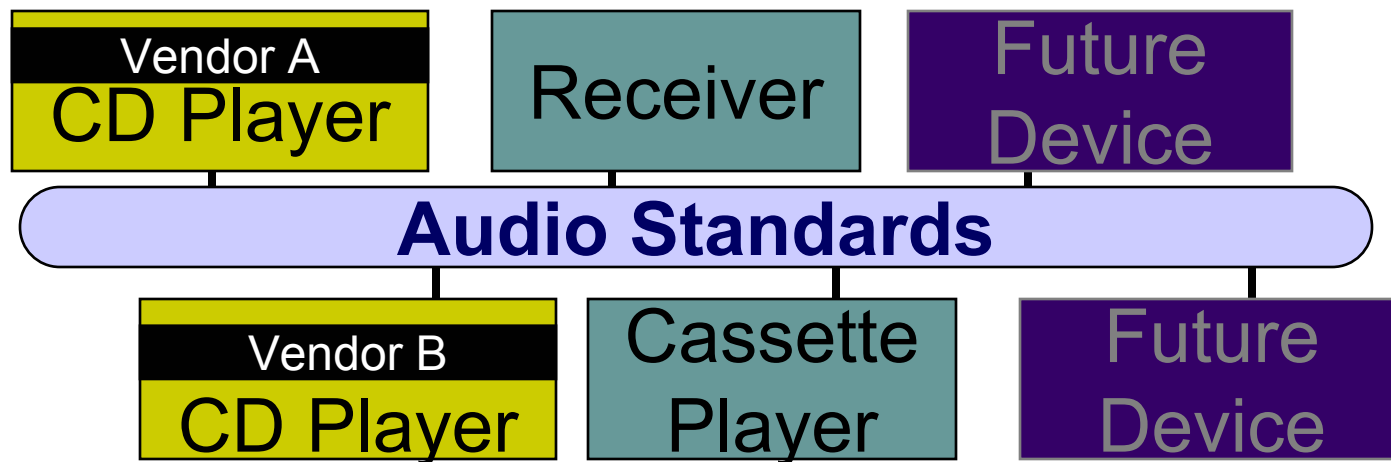
Relation to National ITS Architecture

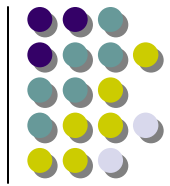




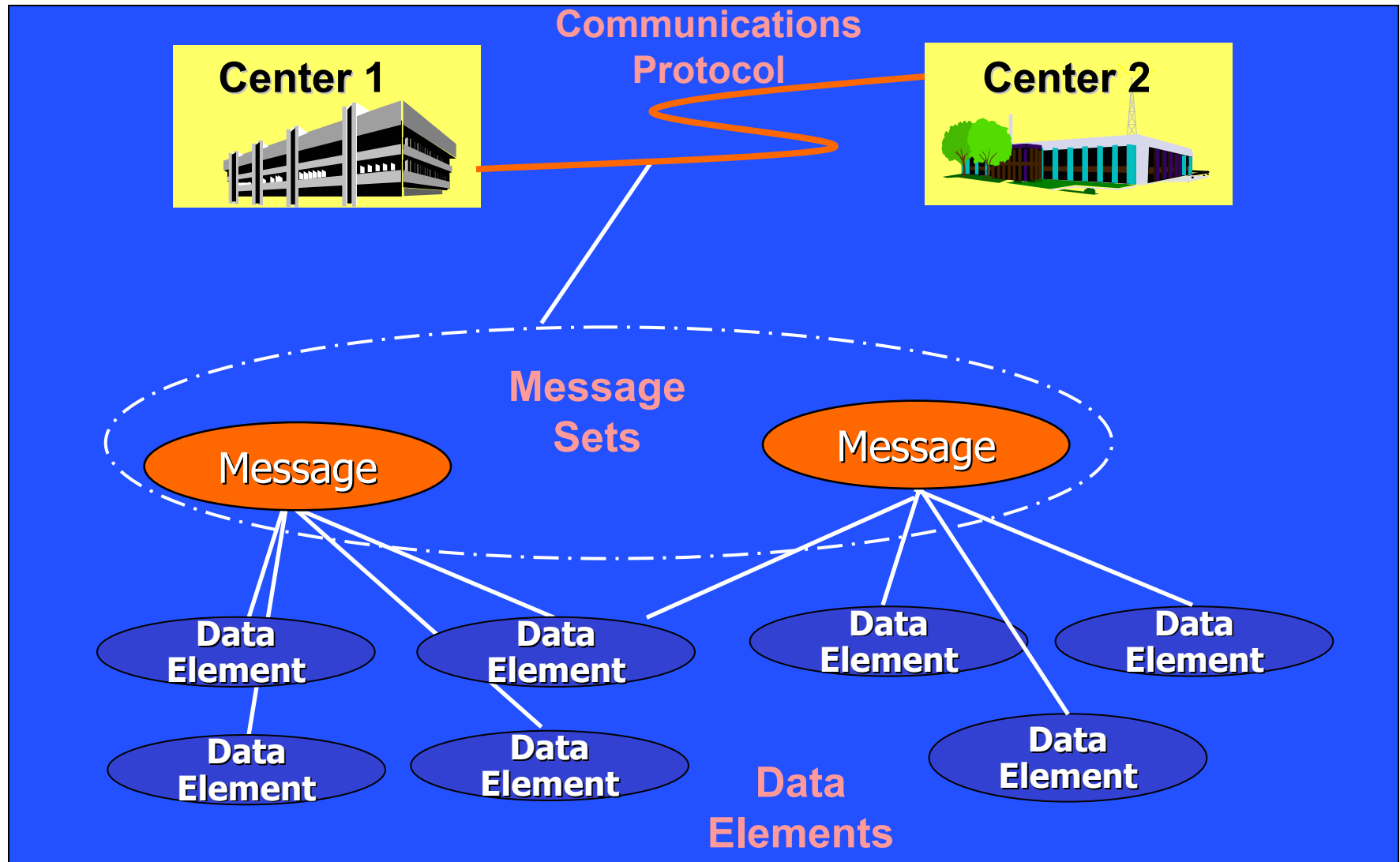
ITS Standards Lead to...

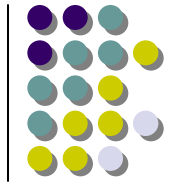
- Interchangeability – support for multiple manufacturers / vendors devices on the same communications channel. Ability to swap one vendors devices with another vendors.
- Interoperability – support multiple device types (e.g., DMS, CCTV, Signal Controllers) on the same communications channel.
- Expandability - add future devices that adhere to standards.



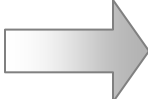
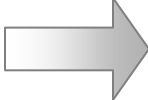



ITS Standards Structure



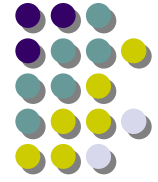


ITS Standards Structure

- Data Elements  “words”
- Message Set  “sentences”
- Communications Protocol  “rules for sending sentences across an interface”

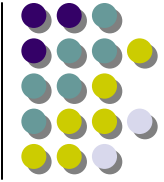


Current Status of “NYSDOT Relevant” Center-based Standards

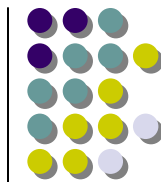


ITS Functional Area	SDO	Message Set / Protocol Name	Version Status
Traffic Management	ITE/AASHTO	Message Set for External TMC Communications	Version 2 nearing completion
Incident Management	IEEE	1512 BASE, 1512.1 (Traffic Incidents), 1512.3 (HAZMAT)	Version 2 nearing completion
Traveler Information	SAE	J2354 – ATIS Message Set	Version 2 development commencing soon
Transit	APTA	TCIP	Version 2 under development
Center-to-Center Communications	NTCIP	W3C Web Services Architecture-based	Version 1 under development. Being deployed as part of NYSDOT IEN.

Current Status of “NYSDOT Relevant” Center-to-Field Standards

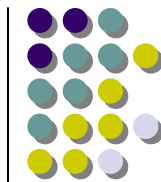


ITS Functional Area	SDO	Version Status
DMS	NTCIP	Version 2 in Ballot. VDOT, ENTERPRISE, ISTHA
ESS	NTCIP	Version 2 nearing completion. NYSDOT is using SSI statewide.
TSS	NTCIP	Version 1 in Ballot. Device support is uncertain.
DCM	NTCIP	Version 1 in Ballot. Device support is uncertain.
CCTV	NTCIP	Version 1 in Ballot. Some vendor support.
Video Switch	NTCIP	Version 1 in development.
Ramp Meters	NTCIP	Version 1 complete. Standard is being deployed in Utah.
Traffic Signal Controller	NTCIP	Version 1 is complete. 2070 or ATC is required.



NTCIP Standards Highlights

- NTCIP – National Transportation Communications for ITS Protocol
- Joint NEMA/ITE/AASHTO Standards Development Organizations
- Center-to-Field Communications
 - Based on the Internet Engineering Task Force’s SNMP (Simple Network Management Protocol)
 - Byte Encoding Rules
 - “Home Grown” Periodic Messaging Mechanism called STMP
 - Point-to-Multipoint Protocol (Multidrop)
 - Point-to-Multipoint Protocol (FSK Modems)
 - Point-to-Point Protocol (Dial-up)
 - Ethernet Protocol
 - Simple File Transfer Mechanism



NTCIP Standards Highlights

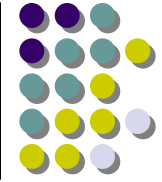
- NTCIP – Center-to-Field Communications
 - Device Specific “NTCIP Objects”
 - Dynamic Message Signs
 - Actuated Signal Controller
 - Ramp Meters
 - CCTV and Video Switch
 - Environmental Sensor Stations
 - Data Collection Devices
 - Electrical and Lighting Management



NTCIP Standards Highlights

- NTCIP – Center-to-Center Communications (C2C)
 - Traffic Management Center Generic Reference Model
 - Technology Neutral Model for C2C Communications
 - DATEX – Data Exchange
 - International Standards Organization (ISO) Standard
 - Two major deployments – TRANSCOM and TravInfo in CA
 - XML-based Standard
 - World Wide Web Consortium-based Standard
 - “Home Grown” Simple File Transfer-based Standard called *XMLDirect*
 - Has gained support from NYSDOT and TxDOT for transferring traffic, incident, and traveler information messages

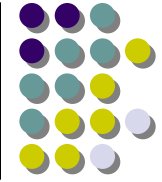
ITE/AASHTO Standards Highlights



- ITE/AASHTO - TMDD
 - Traffic Management Data Dictionary (TMDD)
 - Message Sets for External TMC Communications (MS/ETMCC)
 - TMC to TMC Communications Only
 - Volume I - Concept of Operations and Functional Requirements
 - Volume II – Data Dictionary and Messages

... the MS/ETMCC and TMDD are typically referred to together as “TMDD”

ITE/AASHTO Standards Highlights



- ITE/AASHTO - TMDD

- Relevant Functional Area

- Sharing Administrative Information

- Agency Contact Information

- Event Information

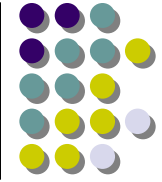
- Current and Planned Events (Incidents, Road Construction, and Special Events)

- Dynamic Message Signs

- Sign Inventory, Message Libraries, Status, and Control (e.g., request another center to display a message)

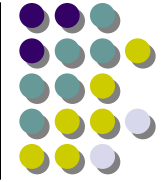
- *NOTE: “Control” typically means a request for one center to perform a function based on another center’s request, and not necessarily shared control of the device. BUT, it **could** mean shared control of a device.*

ITE/AASHTO Standards Highlights



- ITE/AASHTO - TMDD
 - Relevant Functional Area
 - CCTV
 - Inventory, Status, and Control
 - Video Switch
 - Inventory, Status, and Control
 - Environmental Sensor Station
 - Inventory and Status
 - Gate
 - Inventory, Status, and Control

ITE/AASHTO Standards Highlights



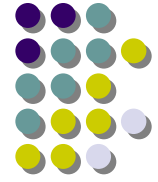
- ITE/AASHTO - TMDD
 - Relevant Functional Area
 - Highway Advisory Radio
 - Inventory and Status
 - Lane Control Signals
 - Inventory, Status, and Control
 - Ramp Meters
 - Inventory, Status, and Control
 - Traffic Signal Controller
 - Inventory, Status, and Control
 - Traffic Detectors
 - Inventory and Status
 - Traffic Network Information
 - Links, Nodes, and Status

ITE/AASHTO Standards Highlights

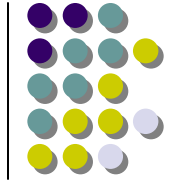


- ITE/AASHTO – Advanced Traffic Controller (ATC)
 - Supports deployment of multiple ITS devices within a single cabinet
 - Software Application Interface
 - Device Interface
 - Physical Design requirements

APTA TCIP Standards Highlights



- TCIP – Transit Communications Interface Profile
 - Overview of Relevant Functional Areas
 1. TCIP Framework
 2. Common Public Transportation Objects (CPT)
 3. Incident Management (IM)
 4. Passenger Information (PI)
 5. Scheduling/Runcutting (SCH)
 6. Spatial Representation (SP)
 7. On-board (OB)
 8. Control Center (CC)
 9. Fare Collection (FC)



IEEE Standards Highlights

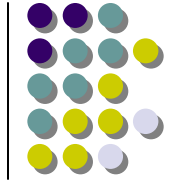
- IEEE - Overview
 - Standard for Data Dictionary and Message Sets
 - Dedicated Short-Range Communications (DSRC)
 - Application Layer Interface, Security, Internet Protocol (IP) communications stack
 - Data Dictionary and Message Sets for DSRC
 - Incident Management
 - 1512 Standard of Families



IEEE Standards Highlights

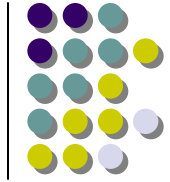
- IEEE 1512 Family
 - 1512.BASE
 - Data Dictionary, Center Status, and Base Messages
 - 1512.1 – Traffic Incidents
 - Traffic Management Center to Public Safety Interfaces
 - 1512.2 – Public Safety
 - Messages to support communications between public safety centers (law enforcement, fire and rescue, and emergency medical)
 - 1512.3 – HAZMAT
 - Message to support communications for hazardous materials operations
 - 1512.4 – Emergency Vehicle (NEW)
 - New standard to support messaging requirements between dispatch centers and emergency vehicles

ASTM Standards Highlights

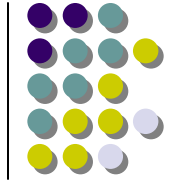


- ASTM - Overview
 - Dedicated Short Range Communications (DSRC)
 - Focus on Communications Layer
 - 5.9 GHz, Physical Layer for Microwave Comm, DSRC Data Link Layer
 - Data Archiving and Retrieval
 - Guide has been developed
 - Primarily volunteer effort with little funding put into the effort

SAE Standards Highlights



- SAE - Overview
 - Mayday
 - Data Dictionary and Message Sets for Advanced Traveler Information Systems (ATIS)
 - On-board Device Interfaces
 - ITIS – International Traveler Information Systems Phrase List
 - Rules for Converting ASN.1 to XML
 - Location Referencing Message Specification (LRMS)



Standards Testing



Standards Testing



- What is and what is not Standards Testing?
- Federal ITS Standards Testing Program
- NTCIP Testing and Conformity Assessment Working Group

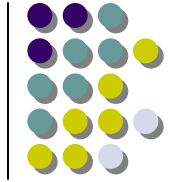


Standards Testing

- What ITS standards do not include:
 - Standards are not intended to substitute center or field device functional requirements
 - Standards do not specify the way a device is to be used (i.e., operational concept)
 - Standards do not include performance requirements
 - Standards do not include environmental requirements
 - Standards do not certify, nor provide a way to certify, a device or manufacturer

.. a device and center system may conform with the standard but not comply with your specifications

Standards Testing



- What ITS standards do include
 - ITS Standards *focus on communications and system interfaces*
 - Data elements, message sets, and protocols
 - Correlate which pieces of information are required to accomplish a function
 - A set of functional requirements from which the data element, message sets, and protocols were derived. Your system may require the same functional requirements as the standards, and/or additional features, and/or fewer features.

Federal ITS Standards Testing Program



- March 1999, U.S.DOT contracted with Battelle to test ITS Standards
 - Could be characterized as an *evaluation* of ITS standards *in deployments*
- Purpose is to build confidence in maturity and quality of standards through independent testing and reporting on standards used in deployments
- Key Goals are to ascertain that:
 - Deploying standards will lead to interoperability and interchangeability
 - Standards support core functionality and capabilities of relevant technologies
 - Standards are unambiguous, complete, and consistent
 - Standards are stable

Federal ITS Standards Testing Program



- Testing Process
 - Establish the Standards Baseline (“Core Functions”)
 - Does implementation faithfully follow the standard?
 - Are proprietary protocols used – data elements, messages, custom “NTCIP Objects”?
 - Conduct Interviews
 - Public sector, Integrator, manufacturers
 - Identify strengths and weaknesses
 - Conformance with standards’ communications protocol
 - Review of data packets over the wire
 - Field Testing
 - Controlled field test and exception to standards reports

Federal ITS Standards Testing Program



- Test Reports
 - Dynamic Message Signs
 - Reviewed 19 Core Functions
 - Two vendors' deployments
 - Concluded that the DMS Standard is effective and make positive contribution to the interoperability of DMS systems
 - Environmental Sensor Stations
 - Reviewed 52 Core Functions
 - Concluded that the ESS Standard is effective and make positive contribution to the interoperability of ESS systems

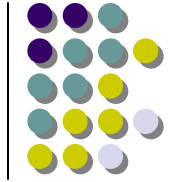
NTCIP Testing and Conformity Assessment (TCA) Working Group



- Primary focus is on *how* to test the NTCIP standards
 - Relatively new group, created in Summer 2002
 - Have published 4 documents
 - Process, control, and information management policy
 - *a.k.a. NTCIP 8007, a.k.a. "Guidance"*
 - Guide on NTCIP Testing Certification
 - NTCIP Testing Guide for Users
 - Case Study on NTCIP Testing, State of the Practice

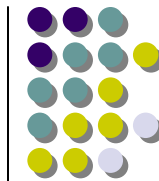
NTCIP TCA Working Group

NTCIP 8007



- Testing Process (abridged):
 - Requirements Traceability to Test Case
 - Test Case Definition
 - Test Procedure
 - Pass/Fail Criteria

... primarily applicable to center-to-field communications



NTCIP TCA Guidance

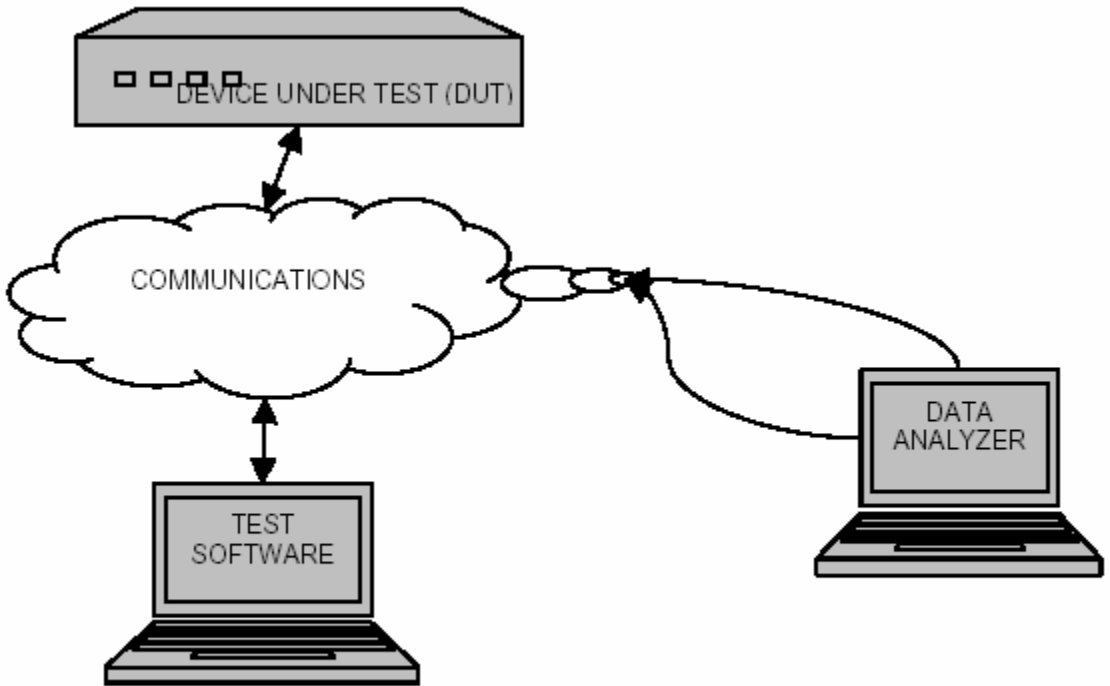


Figure 4: The Typical NTCIP Test Environment

From NTCIP 8007

NTCIP TCA Guidance

Requirement Traceability

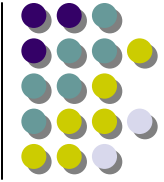


Table 1: Requirements to Test Case Traceability Table

Requirements to Test Case Matrix			
Requirement ID	Requirement Title	Test Case ID	Test Case Title
3.3.1.3	Explore Data	TC001	Walk the MIB
3.4.1.1.1	Determine DUT Component Information	TC002	Retrieve Module Table
•	•	•	•
•	•	•	•
•	•	•	•
RX.X.X.X	Example Requirement X	TCXXX	Example Test Case X

NTCIP TCA Guidance

Test Case Definition Table

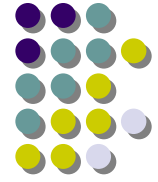
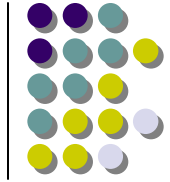


Table 2: Test Case Definition Table

Test Case ID	Test Case Title	Test Case Description	Input Variable	Variable Definition	Value
TC001	Walk the MIB	This test case issues a series of GET-NEXT requests in order to identify what data is supported by the device within the user-specified start and end points.			
			start_node	The OBJECT IDENTIFIER at which to start the walk. (Any valid OBJECT IDENTIFIER)	
			end_node	The OBJECT IDENTIFIER at which to end the walk (Any valid OBJECT IDENTIFIER; the value 0.0 shall mean walk to the end).	

NTCIP TCA Guidance

Test Procedure

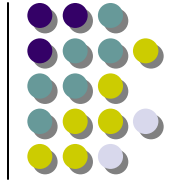


The definition for each NTCIP Test Procedure shall include:

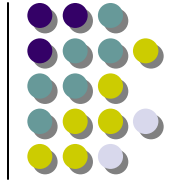
- Test Case Identifier
- Test Case Title
- Test Case Description
- Test Step Number – The test step number is a unique number within a test procedure that indicates the order of execution incrementing in number.
- Test Step Type – The test step type indicates the general type of work to be accomplished within the step.
- Test Step Description – The test step description provides a general description about what the step is accomplishing.
- Test Step Data (dependent upon the type) – The test step data is a placeholder for other columns of data that may be needed within a test procedure step depending on the type of step.

NTCIP TCA Guidance

Pass/Fail



- According to NTCIP 8007
 - The device under test shall ‘pass’ the given test case if and only if it meets (passes) the criteria for all verification steps defined for the given test case. Otherwise, the device under test shall ‘fail’ the test case.

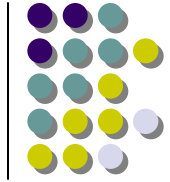


Background Information for Center-to-Field Communications

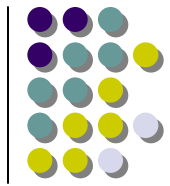


Background Information

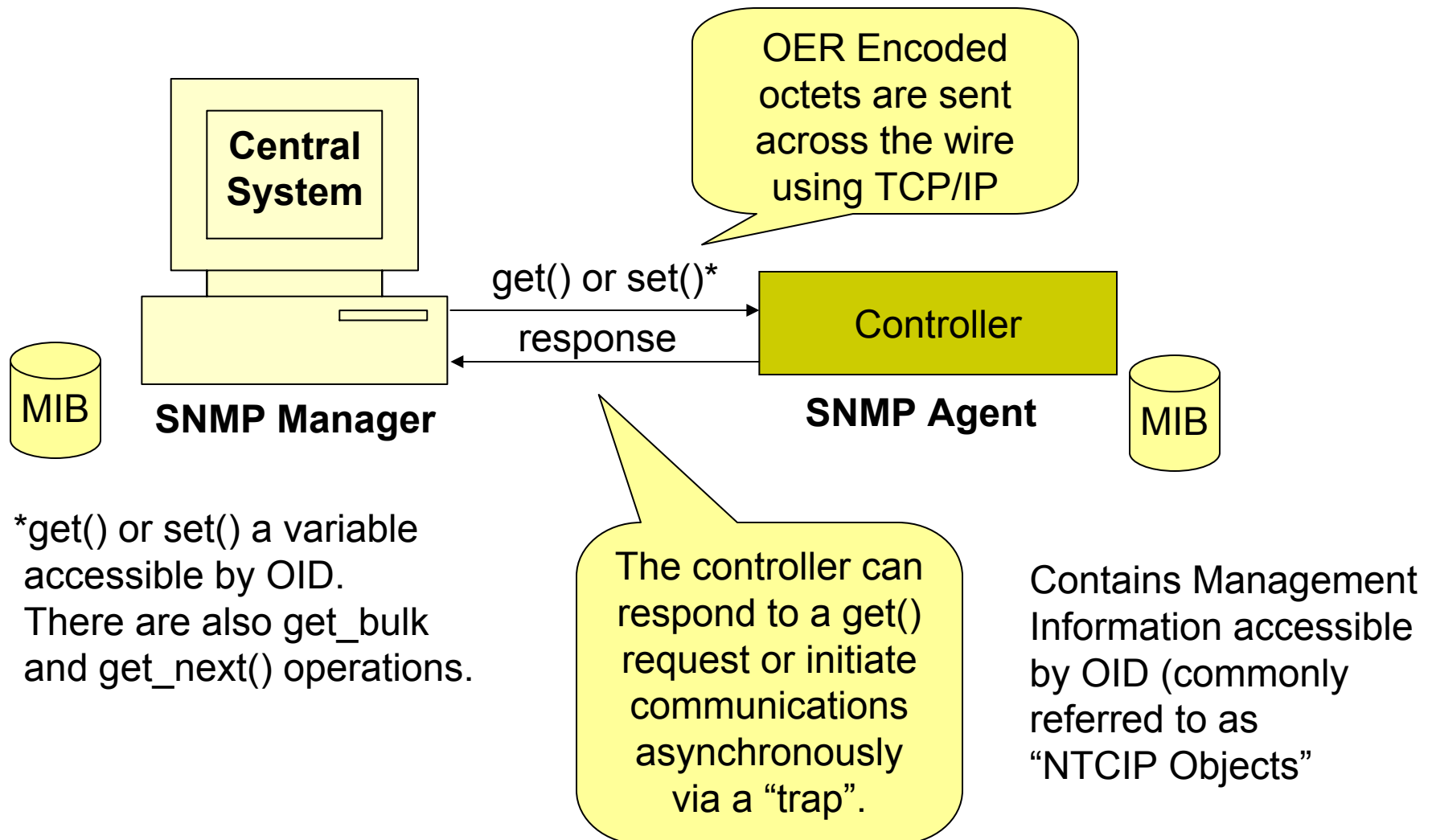
Center-to-Field Concepts

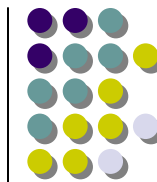


- SNMP Concepts
 - SNMP – Simple Network Management Protocol
 - SNMP or MIB Objects
 - OID - Object Identifier Definition
 - MIB Document
 - MIB Compiler
 - MIB – Management Information Base
 - ASN.1 – Abstract Syntax Notation
 - OER - Octet Encoding Rules
 - BER - Basic Encoding, PER - Packed Encoding)
- STMP – Simple Transportation Management Protocol
 - An NTCIP “invented” technique to allow a controller to provide periodic asynchronous communications with a center computer
- PRL - Protocol Requirements List
 - Maps functional requirements to NTCIP Objects (more or less)



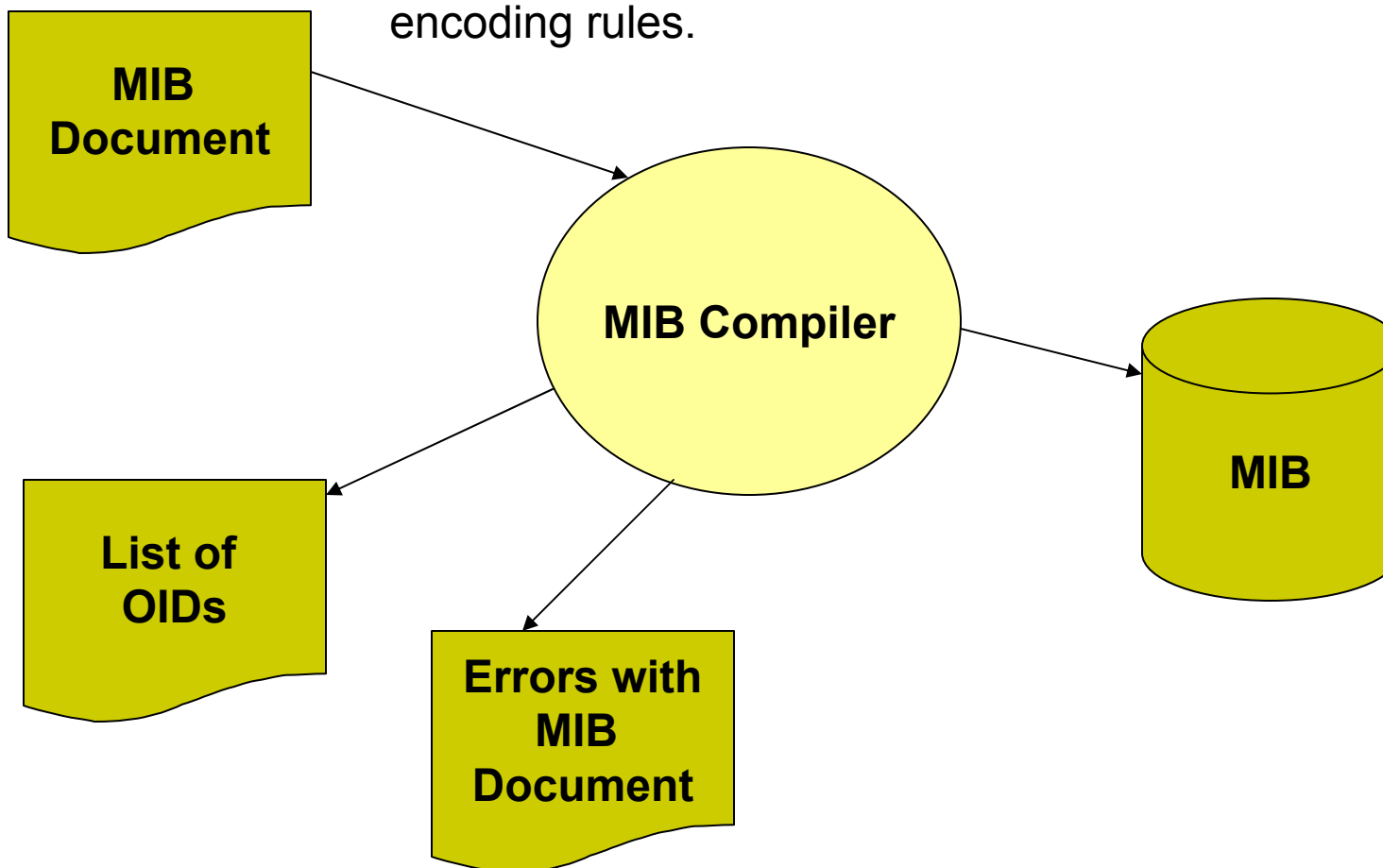
SNMP Manager and Agent



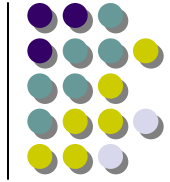


Creating the MIB

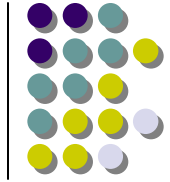
The MIB Document is created with a language that is a subset of ASN.1. ASN.1 specifies Octet encoding rules.



Center-to-Field Testing Tools



- MIB Compiler
- MIB Viewer
- SNMP Manager Software
- Device Simulator (for example, SNMP Agent running on a PC)
- NTCIP Exerciser
 - SNMP Manager
 - Device Simulator

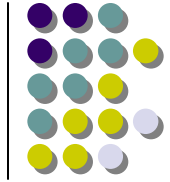


Background Information for Center-to-Center Communications (XML-based Standard)



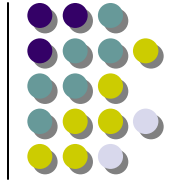
Background Information

Center-to-Center Concepts

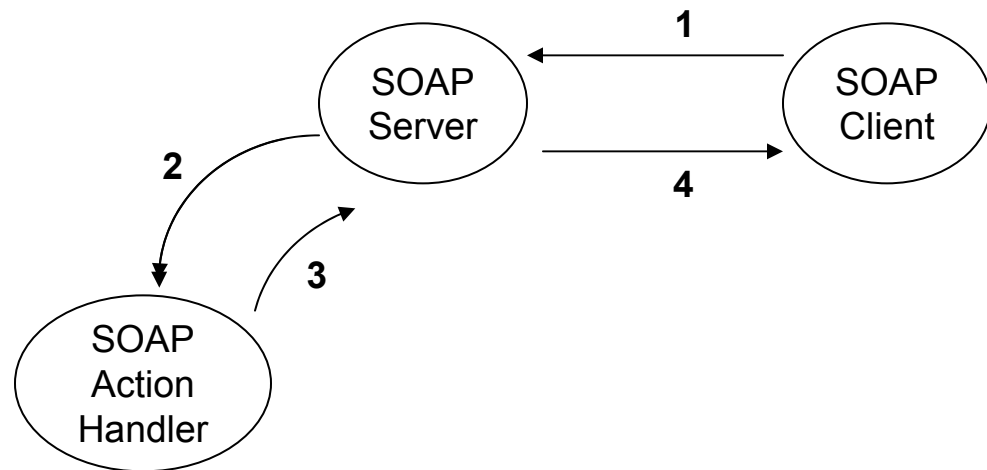


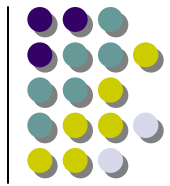
- W3C – World Wide Web Consortium
- HTTP – HyperText Transfer Protocol
- SOAP – Simple Object Access Protocol
- WSDL – Web Services Description Language
- XML – eXtensible Markup Language
- XML Schema

SOAP over HTTP Request/Reply Only



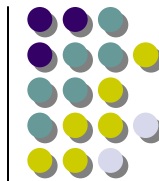
- 1. SOAP Client makes a Request of a SOAP Server
- 2. SOAP Server hands off processing to SOAP Action Handler
- 3. SOAP Action Handler Returns Processing Results to SOAP Server
- 4. SOAP Server makes a Reply to the SOAP Client





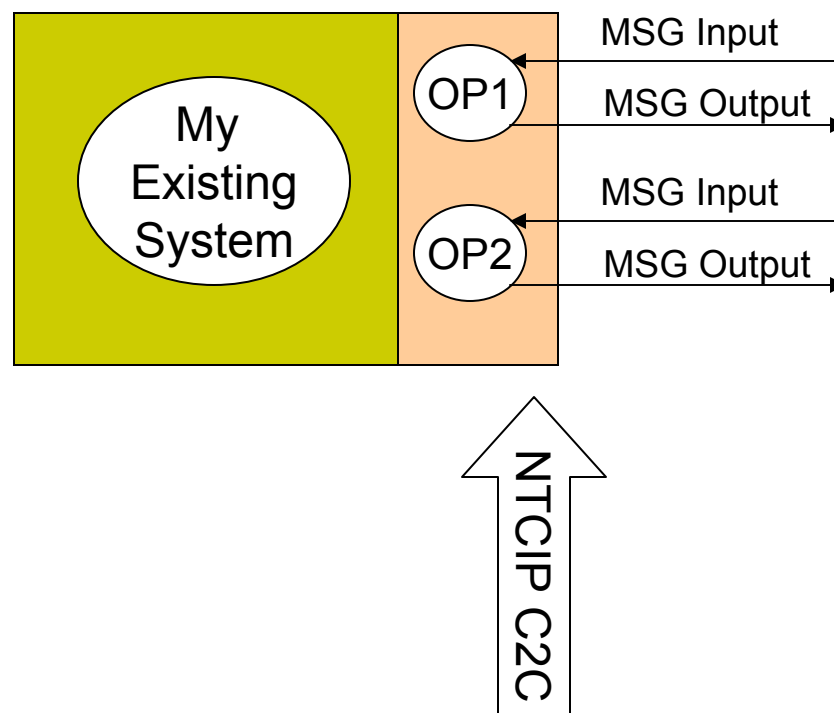
Web Services

- A service is an interface that exposes the capabilities of my system to other systems.
- Services can contain one or more operations
- Operations receive one or more messages (typically one) as an input and respond with one or more output messages
- WSDL (Web Services Description Language) models Web Services
- SOAP (Simple Object Access Protocol) transports XML content
- XML Schema is a template for the XML-based messages (the content)



WSDL/SOAP in a Nutshell

- Services
 - Operations
 - Message Inputs
 - Message Outputs
 - Bindings
 - SOAP and HTTP



Accompanying Table Example For MS/ETMCC

Center Services Summary Table Relationships (MS/ETMCC Example)

Traceability
National ITS
Architecture

Traceability
Standards Clauses

Traceability
- Functional Requirements
- UML Use Case

Traceability
- UML SEQ Diagrams
- XML Schema

Microsoft Excel - TMDD Messages.xls

File Edit View Insert Format Tools Data Window Help

A1 ConSysTec Corp., Manny Insignares

	A	B	C	D	E	F	G
1	ConSysTec Corp., Manny Insignares						
2	Last updated this: 11-3-03						
3							
4	TMDD & MS/ETMCC 07-08-03						
5	TMDD VOL II						
6	Will Map to GRM UML Use Cases - Derived from TMDD UML Sequence Diagrams - Messages are described in TMDD XML Schema						
7	Subsystem Ref	Service	Ref	Operation	MSG Input	MSG Output	
8	TMS	2.3	SVC_AdministrativeData	2.3.1	OP_ShareAgencyInformation	MSG_RequestAgencyInfo	MSG_InfoAgency
9				2.3.2	OP_ShareContactInformation	MSG_RequestContactInfo	MSG_InfoContact
10				2.3.3	OP_ShareOrganizationInformation	MSG_RequestOrganizationInfo	MSG_InfoOrganization
11							
12		2.5	SVC_Event	2.5.1	OP_ShareCurrentEventInformation	MSG_RequestEventCurrentInfo	MSG_InfoEventCurrent
13				2.5.2	OP_SharePlannedEventInformation	MSG_RequestEventPlannedInfo	MSG_InfoEventPlanned
14				2.5.3	OP_ShareSpecialEventInformation	MSG_RequestSpecialEventInfo	MSG_InfoSpecialEventInfo
15				2.5.4	OP_ShareForecastEventInformation	MSG_RequestEventForecastInfo	MSG_InfoEventForecast
16							
17		2.6	SVC_DMS	2.6.1	OP_ShareDMSInventory	MSG_RequestDMSInventory	MSG_InfoDMSInventory
18				2.6.2	OP_ShareDMSLibrary	MSG_RequestDMSLibrary	MSG_InfoDMSLibrary
19				2.6.3	OP_ShareDMSStatus	MSG_RequestDMSStatus	MSG_InfoDMSStatus
20				2.6.5	OP_ShareDMSControl	MSG_RequestDMSControl	MSG_ResultDMSControl
21							
22		2.7	SVC_CCTV	2.7.1	OP_ShareCCTVInventory	MSG_RequestCCTVInventory	MSG_InfoCCTVInventory
23				2.7.2	OP_ShareCCTVStatus	MSG_RequestCCTVStatus	MSG_InfoCCTVStatus
24				2.7.4, 2	OP_ShareCCTVControl	MSG_RequestCCTVControl	MSG_ResultCCTVControl

TMDD / Sheet2 / Sheet3

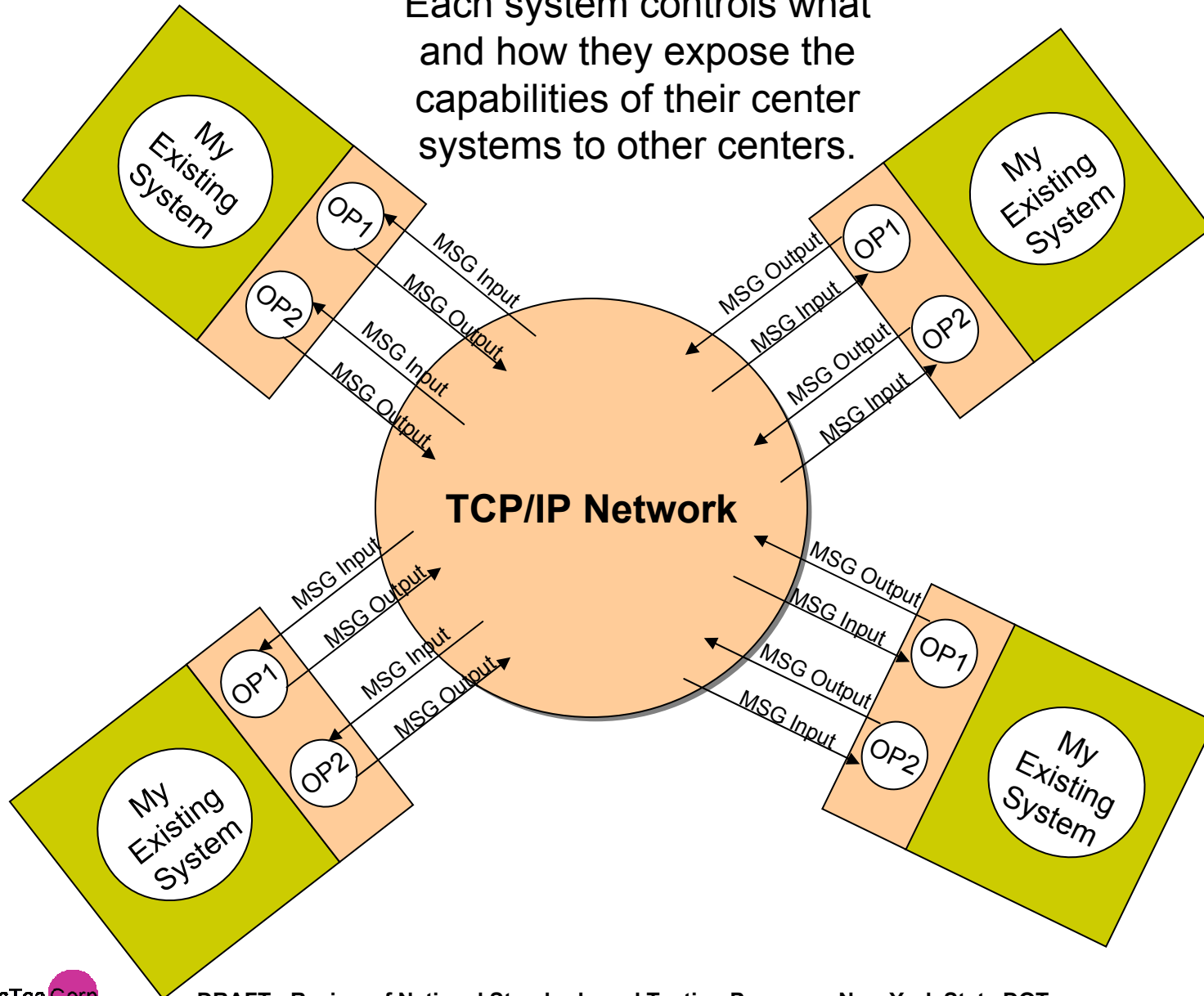
Ready

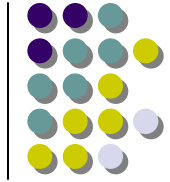
Test Plan Support (per 8007)



NTCIP C2C in a Network

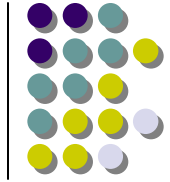
Each system controls what and how they expose the capabilities of their center systems to other centers.





Center-to-Center Tools

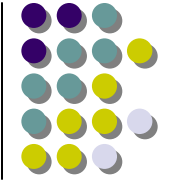
- Schema Viewer / Editor (e.g., XMLSpy)
- XML Message Builder
- Message Validation against Schema
- FTP and HTTP Client Software
- SOAP Client and SOAP Listener
- SOAP Server Simulator and SOAP Publisher
- XML*Direct* Client
- WSDL Editor



Impact on NYSDOT (Interactive Discussion)

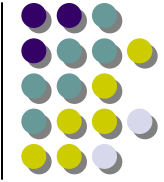


ITS Standards Procurement and Engineering Process Discussion

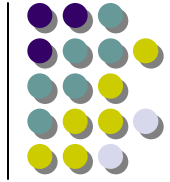


- Design Report
 - How and where to address ITS Standards and Project Architecture?
- Plans Specifications & Estimates
 - How do you develop an ITS Standards Specs?
 - How and where to include/document ITS Standards Specifications?
- System Testing during Design and Build
 - Unit and/or Factory Testing of ITS Standards Specs
 - Field Test
 - System Acceptance Test

Design Report for Project Elements (both Center-to-Field and Center-to-Center)



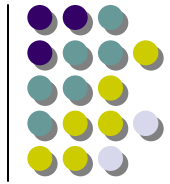
- Project Architecture (consistent with rule 940)
 - Document what portions of the ITS Architecture are being developed
 - Identify ITS Systems
 - ITS System Functional Requirements
 - Document ITS Architecture Interfaces
 - Identify what systems need to be interconnected and information and control flows exchanged
 - Center-to-Field
 - Center-to-Center
 - Document Applicable ITS Standards
 - Document Operational Concept
 - Information Sharing and Sharing of Device Control
 - Leverage Customized Market Packages



PS&E – Center-to-Field

1. Hold Workshop to Review Functional Requirements (of the devices)
2. Based on Requirements Determine NTCIP Objects
3. Develop a MIB document and compile it to ensure it works
 - The MIB Document is ready to share with potential vendors
4. Create a standards portion of the specifications document

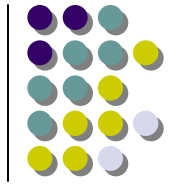
Example: Protocol Requirements List (PRL)



DMS Functional Requirements

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.4	Features			M	Yes	
2.4.1	Manage the DMS Configuration			M	Yes	
2.4.1.1	Determine the DMS Identity			M	Yes	
		3.4.1.1.2	Determine Sign Type and Technology	M	Yes	
		NTCIP1201.3.4.2	Determine Device Component Information	O	Yes / No	
		NTCIP1201.3.4.5	Determine Supported Standards	O	Yes / No	

Standards-based System Testing – Center-to-Field



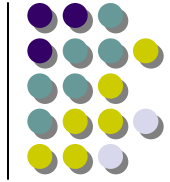
1. Create a test plan
 - Need to identify what field device functions are going to be tested.
 - Need to identify what get() / set() operations are needed to be performed to execute a function.
2. Device Manufacturer should provide a MIB Document (electronic).
 - This should be reviewed initially by the consultants and problems evaluated before the test.
 - The manufacturers MIB should be compiled to ensure that it works
3. Determine whether the device complies with the MIB Spec created previously
 - Determine whether the device supports all of the NTCIP Objects Specified.
 - This can be done through a series of get()/set() operations put into a script.

Standards-based System Testing – Center-to-Field



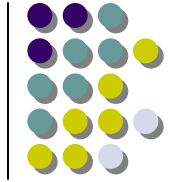
4. Create a document of Test Results for “MIB” testing.
5. Special software may be required to test STMP (e.g., Traffic Signal Controller)
 - STMP Set up
 - STMP faults
6. Testing may be required before device is in the field (unit or factory acceptance test) and after device is in the field (standalone with device).
7. Need to test the center system also (Center System Test). After the Center System Test, both sides of the communications protocol have been tested separately and they *should* integrate.

Standards-based System Testing – Center-to-Field



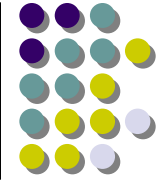
8. Integration test – Center System with actual field communications, and field devices installed. The contractor would create a test plan, an independent group would review the test plan, and supervise the test to be conducted by the manufacturer.
9. Create a document with Test Results for STMP, Unit Test, Standalone Field Test, Center System Test, and Integration Test.

PS&E – Center-to-Center



1. Create a Project Architecture
 - Can be derived from a Regional ITS Architecture, if one exists
2. Based on a mapping of standards to architecture flows in the project architecture, one can create a short list of messages and operations that need to be Supported (Requirements)
3. Hold Workshop to Review Requirements
4. Based on Requirements Create a Services Summary Table
5. Create WSDL from Services Summary Table
6. Create a “Subset” Schema containing relevant messages

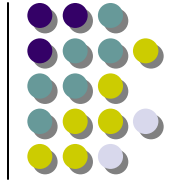
Standards-based System Testing – Center-to-Center



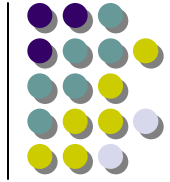
1. Create a test plan based on WSDL or Services Summary Table for a given center. Table would contain:
 - Operation, Input Message, Output Message
2. Create sample “request” messages
3. Send sample message to the server being tested using test client software
4. Evaluate returned message
 - Validate against schema

...NOTE: Also need to create bad messages to see how server handles faults

Standards-based System Testing – Center-to-Center



5. Taken from the system being tested, create sample test “request” messages for other system
6. Validate messages against schema
7. Additional testing would be required if center systems support publish/subscribe



Wrap up

Q & A, Comments Review Action Items

