

## **Appendix G**

### **New York State ITS Standards Specification Development Guide**

# **ITS Standards Communications Framework**

**Prepared for**

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## Revision History

Filename	Version	Date	Author	Comment
NYStateSpecDevGuide – ApF – ITS Communications Framework.doc	0.3	11/22/06	M. Insignares / P. Chan	Initial Draft
NYStateSpecDevGuide – ApG – ITS Communications Framework.doc	0.40	1/22/07	M. Insignares	Exchanged order of Appendix F & G.

# 1 Introduction

Based on ITS Standards Framework 10 ITS Standards Communications Packages have been developed, addressing wireline, wide area wireless, and WAV/DSRC communications. These are illustrated in the text and figures below.

These communications packages represent high-level design alternatives for ITS communications.

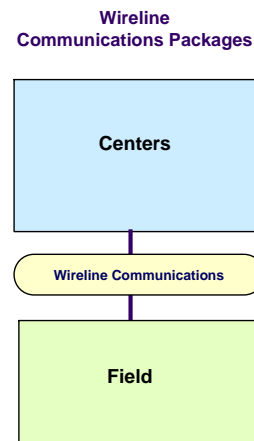
As is shown, the communications packages relate directly to information contained in the National and Regional ITS Architectures. Therefore, the communications packages directly bridge ITS Architectures and ITS Standards for deployments.

## 1.1 Wireline Communications Packages

The Wireline Communications Packages cover Center-to-Field and Center-to-Center communications.

### Wireline Communications Packages

- Wireline CP 1 - Center-to-Field Communications over IEEE 802 IP Networks
- Wireline CP 2 - Center-to-Field Communications Point-to-Point or Point-to-MultiPoint
- Wireline CP 3 - XML Messaging for Center-to-Center Communications

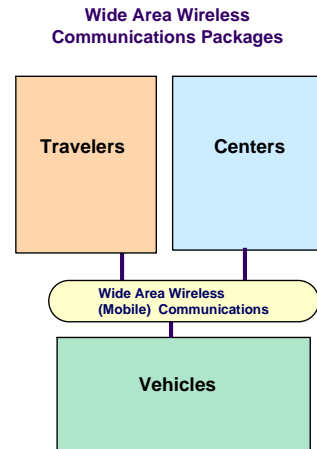


## 1.2 Wide Area Wireless Communications Packages

The Wide Area Wireless Communications Packages provide communications support between a) fixed resources (e.g., centers, kiosks) and mobile resources (e.g., vehicles and PDAs), and b) between mobile resource (or mobile-to-mobile).

### Wide Area Wireless Communications Packages

- Wide Area Wireless CP 1 - Mobile XML Messaging over Cellular Networks
- Wide Area Wireless CP 2 - Mobile XML Messaging over Wi-Max Networks
- Wide Area Wireless CP 3 - Mobile XML Messaging over Private IP Networks
- Wide Area Wireless CP 4 - Mobile XML Messaging over Private non-IP Networks
- Wide Area Wireless CP 5 - Mobile XML Messaging over Wi-Fi Local Area Networks

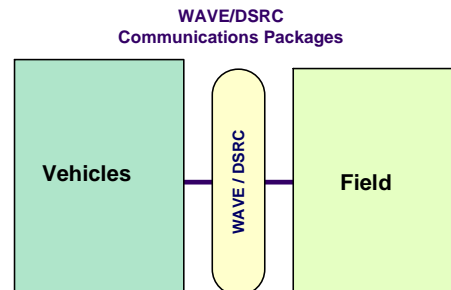


## 1.3 WAVE/DSRC Communications Packages

The WAVE/DSRC Communications Packages provide communications support between vehicles and field devices. The U.S. FCC has assigned a spectrum in the 5.9 GHz range for this purpose.

### WAVE/DSRC Communications Packages

- WAVE/DSRC CP 1 - Resource Manager Applications
- WAVE/DSRC CP 2 - IP Applications



## 2 Wireline Communications Packages

### 2.1 Wireline CP 1 - Center-to-Field Communications over IEEE 802 IP Networks

This communications package is used in ITS applications to connect center systems and field devices using an IEEE 802 IP-based network. The communications media may include privately installed (DOT owned) fiber and coaxial communications, or a leased IP-network.

**Table 2-1. Wireline CP 1 - Center-to-Field Communications over IEEE 802 IP Networks**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	NTCIP MIB Objects	NTCIP 1200 Series MIBs
Application Level	SNMP	NTCIP 2301
Transport Level	TCP IP	NTCIP 2202 identifies the use of these IETF Standards
Subnetwork Level	Layer 2 – Data Link  IEEE 802 Networks, Token Ring, FDDI, HDLC, Frame Relay, ATM, Fibre Channel  Layer 1 - Physical  T1, E1, 10BASE-T, 100BASE-TX, ISDN, SONET, DSL	NTCIP 2104 defines framework for IEEE 802 Networks.
Plant Level	Fiber, Coax	

## 2.2 Wireline CP 2 - Center-to-Field Communications Point-to-Point or Point-to-MultiPoint

This communications package is used in ITS applications to connect center systems and field devices within a point-to-point or point-to-multipoint network configuration using serial communications. The communications media may include privately installed (DOT owned) communications, dial-up, or leased line.

**Table 2-2. Wireline CP 2 - Center-to-Field Communications Point-to-Point or Point-to-MultiPoint**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	NTCIP MIB Objects	NTCIP 1200 Series MIBs
Application Level	SNMP	NTCIP 2301
Transport Level	TP (null)	NTCIP 2201
Subnetwork Level	Layer 2 - Data Link SLIP, PPP, PMPP  Layer 1 - Physical RS-232, V.35, V.34	NTCIP 2103 (PPP) NTCIP 2101 /2102 (PPP/PMPP) V Series Modem FSK Modem
Plant	Twisted pair, Leased line (also fiber and coax)	

### 2.3 Wireline CP 3 - XML Messaging for Center-to-Center Communications

This communications package is used to support XML messaging over IP-based networks between ITS center systems (center-to-center). A wide variety of network configurations are supported, including connection of centers via the Internet. Communications media may include privately installed (DOT owned) communications, leased IP communications networks (e.g., frame relay), dial-up, or leased line.

**Table 2-3. Wireline CP 3 - XML Messaging for Center-to-Center Communications**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	XML Schema WSDL	IEEE 1512.x APTA TCIP TMDD SAE J2354
Application Level	Gzip, XML, SOAP	NTCIP 2306 - Application Profile for Message Encoding and Transport. Defines encoding rules for WSDL, XML messages, and Gzip compression. References IETF and W3C Standards for XML, SOAP, WSDL, and the Gzip standards.
Application Level	HTTP/ FTP HTTPS	NTCIP 2306 references the following standards: IETF RFC 2612 (HTTP) IETF RFC 959 (FTP)
Transport Level	TCP IP	IETF RFC 793 (TCP) IETF RFC 791 (IP)
Subnetwork Level	Layer 2 – Data Link IEEE 802 Networks, Token Ring, FDDI, SLIP, PPP, HDLC, Frame Relay, ATM, Fibre Channel  Layer 1 - Physical	NTCIP 2104 defines framework for IEEE 802 Networks.  NTCIP 2103 identifies PPP.



	RS-232, V.35, V.34, T1, E1, 10BASE-T, 100BASE-TX, ISDN, SONET, DSL	
Plant	Twisted pair, Leased line, Fiber, Coax	

### 3 Wide Area Wireless Communications Packages

#### 3.1 Wide Area Wireless CP 1 - Mobile XML Messaging over Cellular Networks

This communications package is used in ITS applications to connect centers and vehicles, centers and traveler information devices (e.g., PDA, cellular telephone). Communications between mobile command center vehicles and other vehicles may also be supported. This communications package supports compressed XML messaging over cellular and PCS IP-based networks using the 3G (third generation) wireless digital communications technologies such as cdma2000 and IP-based interfaces (together IP-based wide area wireless networks are being developed – e.g., 1xRTT, and 1xEV-DO).

**Table 3-1. Wide Area Wireless CP 1 - Mobile XML Messaging over Cellular Networks**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	XML Schema WSDL	IEEE 1512.x APTA TCIP TMDD SAE J2354
Application Level	Gzip, XML	NTCIP 2306 - Application Profile for Message Encoding and Transport. Defines encoding rules for WSDL, XML messages, and Gzip compression. References IETF and W3C Standards for XML, SOAP, WSDL, and the Gzip standards.
Application Level	HTTP/ HTTPS	NTCIP 2306 references the following standards: IETF RFC 2612 (HTTP) IETF RFC 959 (FTP)
Transport Level	TCP IP	IETF RFC 793 (TCP) IETF RFC 791 (IPv4) IETF RFC 2460 (IPv6)
Subnetwork Level	3GPP2 P.R0001 - Wireless IP	Standards of the 3G Wireless

	Architecture Based on IETF Protocols cdma2000 <ul style="list-style-type: none"> <li>• 1xRTT</li> <li>• 1xEV-DO</li> </ul>	Partnership (3GPP2) and TIA (Telecommunications Industry Association).
Plant Level	E.g., Spread Spectrum Radio 800 Mhz (Cellular) / 1900 Mhz (PCS)	FCC

### **3.2 Wide Area Wireless CP 2 - Mobile XML Messaging over Wi-Max Networks**

This communications package can be used to accomplish wide area wireless communications in ITS applications similar to those described in Wide Area Wireless CP 1. The difference between the two approaches is found in the wireless subnetwork and plant levels, which outline the use of the IEEE 802 Wi-Max standards.

**Table 3-2. Wide Area Wireless CP 2 - Mobile XML Messaging over Wi-Max Networks**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	XML Schema WSDL	IEEE 1512.x APTA TCIP TMDD SAE J2354
Application Level	Gzip, XML	NTCIP 2306 - Application Profile for Message Encoding and Transport. Defines encoding rules for WSDL, XML messages, and Gzip compression. References IETF and W3C Standards for XML, SOAP, WSDL, and the Gzip standards.
Application Level	HTTP/ HTTPS	NTCIP 2306 references the following standards: IETF RFC 2612 (HTTP) IETF RFC 959 (FTP)

Transport Level	TCP IP	IETF RFC 793 (TCP) IETF RFC 791 (IPv4) IETF RFC 2460 (IPv6)
Subnetwork Level	802.2 802.16 (Wi-Max)	NTCIP 2104 defines framework for IEEE 802 Networks.
Plant Level	Microwave	FCC Licensed and Unlicensed

### 3.3 Wide Area Wireless CP 3 - Mobile XML Messaging over Private IP Networks

This communications package can be used to accomplish wide area wireless communications in ITS applications similar to those described in Wide Area Wireless CP 1. The difference between the two approaches is found in the wireless subnetwork and plant levels. While Wide Area Wireless CP1 and CP2 outline the use of leased (or public) wireless IP networks, this communications profile would be used for those applications that will be installing their own private wireless IP-based communications networks. Example private wireless networks are used extensively to communicate between public safety dispatch and vehicle systems – for example, 700/800 MHz and AMPS cellular systems with an IP service module included.

**Table 3-3. Wide Area Wireless CP 3 - Mobile XML Messaging over Private IP Networks**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	XML Schema WSDL	IEEE 1512.x APTA TCIP TMDD SAE J2354
Application Level	Gzip, XML	NTCIP 2306 - Application Profile defines Message Encoding and Transport. Defines encoding rules for WSDL, XML messages, and Gzip compression.
Application Level	HTTP/ HTTPS	NTCIP 2306 references the following standards: IETF RFC 2612 (HTTP) IETF RFC 959 (FTP)
Transport Level	TCP IP	IETF RFC 793 (TCP) IETF RFC 791 (IP)
Subnetwork Level	Vendor Specific	Project or Vendor Specific
Plant Level	700/800 MHz, AMPS Cellular	

### 3.4 Wide Area Wireless CP 4 - Mobile XML Messaging over Private non-IP Networks

This communications package can be used to accomplish wide area wireless communications in ITS applications similar to those described in Wide Area Wireless CP 1 with subnetwork communications and plant being privately (agency) owned and operated. The difference between this communications package and CP 3 is the lack of support for the TCP/IP at the transport level. Example private wireless networks are used extensively to communicate between public safety dispatch and vehicle systems – for example, 700/800 MHz and AMPS cellular systems.

**Table 3-4. Wide Area Wireless CP 4 - Mobile XML Messaging over Private non-IP Networks**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	XML Schema WSDL	IEEE 1512.x APTA TCIP TMDD SAE J2354
Application Level	Gzip, XML	NTCIP 2306 - Application Profile for Message Encoding and Transport. Defines encoding rules for WSDL, XML messages, and Gzip compression. References IETF and W3C Standards for XML, SOAP, WSDL, and the Gzip standards.
Transport Level	Vendor Specific	Project or Vendor Specific
Subnetwork Level	Vendor Specific	Project or Vendor Specific
Plant Level	700/800 MHz, AMPS Cellular	

### 3.5 Wide Area Wireless CP 5 - Mobile XML Messaging over Wi-Fi Local Area Networks

This communications package is used to support XML messaging between center systems and mobile resources (vehicles, traveler systems, etc.) over wireless Wi-Fi (IEEE 802.11b,g) IP-based local area networks. ITS applications may include connecting vehicle and garage systems, maintenance crew PDAs and maintenance centers, etc.

**Table 3-5. Wide Area Wireless CP 5 - Mobile XML Messaging over Wi-Fi Local Area Networks**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	XML Schema WSDL	IEEE 1512.x APTA TCIP TMDD SAE J2354
Application Level	Gzip, XML	NTCIP 2306 - Application Profile for Message Encoding and Transport. Defines encoding rules for WSDL, XML messages, and Gzip compression. References IETF and W3C Standards for XML, SOAP, WSDL, and the Gzip standards.
Application Level	HTTP/ HTTPS	NTCIP 2306 references the following standards: IETF RFC 2612 (HTTP) IETF RFC 959 (FTP)
Transport Level	TCP IP	IETF RFC 793 (TCP) IETF RFC 791 (IP)
Subnetwork Level	802.2 802.11 b, g (Wi-Fi)	IEEE 802 Network Standards
Plant Level	2.4 Ghz Radio	Unlicensed

## 4 WAVE/DSRC Communications Packages

### 4.1 WAVE/DSRC CP 1 - Resource Manager Applications

This communications package is used to support messaging between vehicle onboard units (OBUs) and roadside units (RSUs). ITS applications (on OBUs and RSUs) must conform with the IEEE 1609.1 Resource Manager specifications, which bridges communications to the lower levels and the IEEE 802.11 p (5.9 GHz). The OBU is an SNMP Agent application and the RSU is an SNMP Manager. ITS Application level standards are being developed for the Electronic Payment System (EPS), and a portion of the spectrum is reserved for public/vehicle safety applications, include Wireless Short Messages.

**Table 4-1. WAVE/DSRC CP 1 - Resource Manager Applications**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	ASN.1	OmniAir EPS Applications Committee
Application Level	PER – Packed Encoding Rules SNMP	IEEE 1609.1 – Application Resource Manager
Application Level	Radio Security Service (Infrared, PKI Security, RF-ID Security)	IEEE 1609.2 – WAVE Application Services
Transport Level	IEEE 1609.3 <ul style="list-style-type: none"> <li>• TCP/UDP (IETF)</li> <li>• ISO 21210 (Mobile IP)</li> <li>• IETF 3095 (ROHC)</li> </ul>	IEEE 1609.3 – WAVE Network Services
Subnetwork Level	IEEE 1609.4 MAC Extension IEEE 802.2 IEEE 802.11 p	IEEE 1609.4 – WAVE Media Access Control (MAC) Extension Services IEEE 802.2 IEEE 802.11 p
Plant Level	5.9 Ghz	FCC Licensed



## 4.2 WAVE/DSRC CP 2 - IP Applications

This communications package is used to support ITS applications that communicate between vehicle onboard units (OBUs) and roadside units (RSUs). IP-based ITS applications bypass the upper layer IEEE 1609.1 & IEEE 1609.2 specifications and communicate directly with the IEEE 1609.3 network services layer, which bridges communications to the lower levels and the IEEE 802.11 p (5.9 GHz). The OBU is an SNMP Agent application and the RSU is an SNMP Manager. ITS Application level standards are being developed for the Roadside to Vehicle Alerts (SAE-J2734).

Additional IP applications may be developed to support Commercial Vehicle Operations and Transit Signal Priority.

**Table 4-2. WAVE/DSRC CP 2 - IP Applications**

ITS Standards Framework	Technology/Implementation	Standards
Information Level	ASN.1	SAE-J2734
Application Level	PER SNMP	SAE DSRC committee is also investigating the use of byte-encoded compressed XML
Transport Level	TCP/UDP (IETF) ISO 21210 (Mobile IP) IETF 3095 (ROHC)	IEEE 1609.3
Subnetwork Level	IEEE 1609.4 MAC Extension IEEE 802.2 IEEE 802.11 p	IEEE 1609.4 MAC Extension IEEE 802.2 IEEE 802.11 p
Plant	5.9 Ghz	FCC