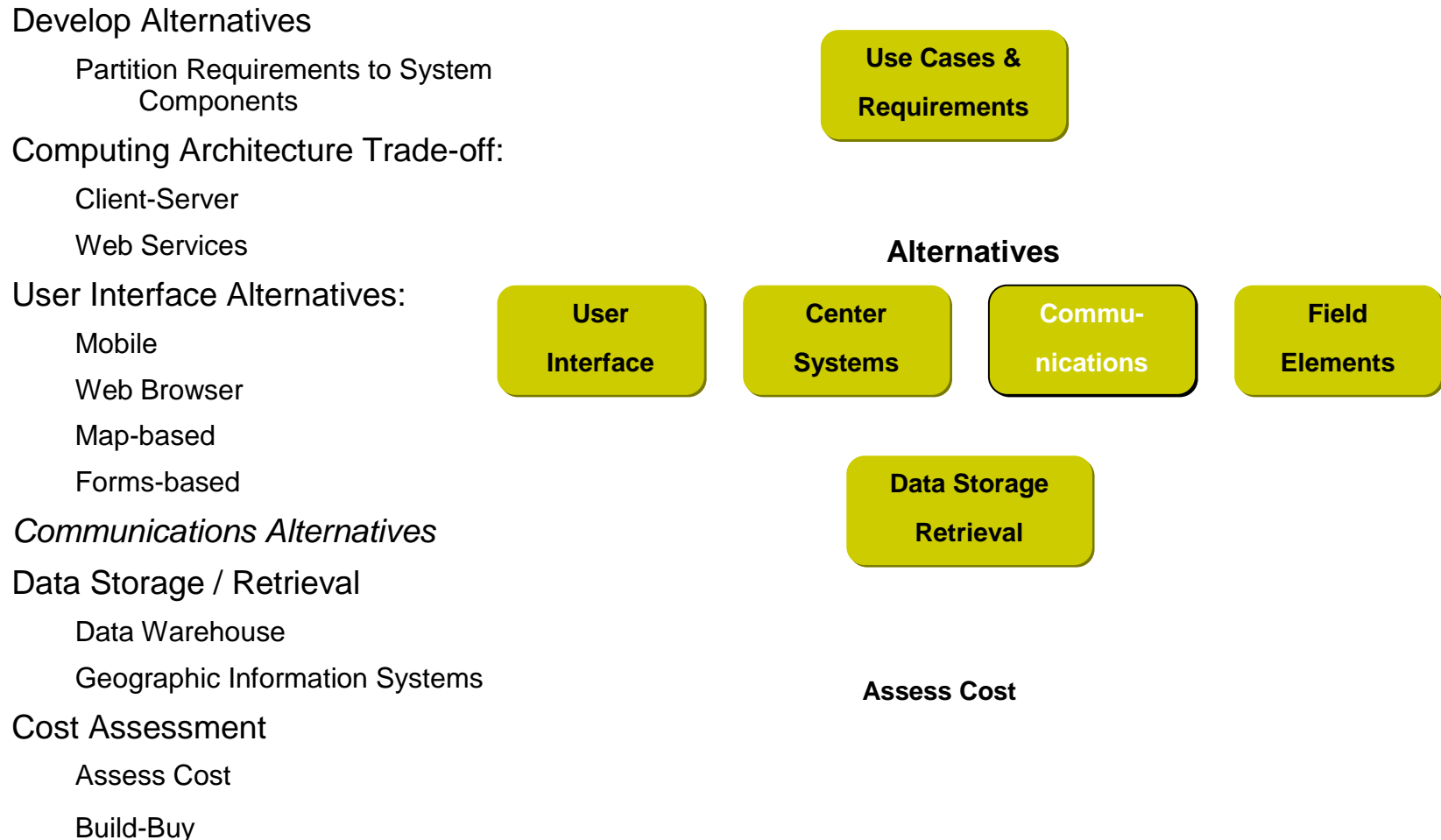


## **6 ITS Communications Framework and Alternatives Analysis**

Both the NYSDOT Project Development Process (Project Scoping) and System Engineering (High Level Design) support a process-step related to the development and evaluation of design/implementation alternatives. For the purposes of this ITS standards specification guide, only communications alternatives development is discussed. While many other project design aspects need to be considered in an ITS project, the ITS standards focus on communications. The graphic below shows where ITS communications fit within the process of alternatives development and evaluation.

**Figure 6-1. ITS Project Alternatives Analysis Process**



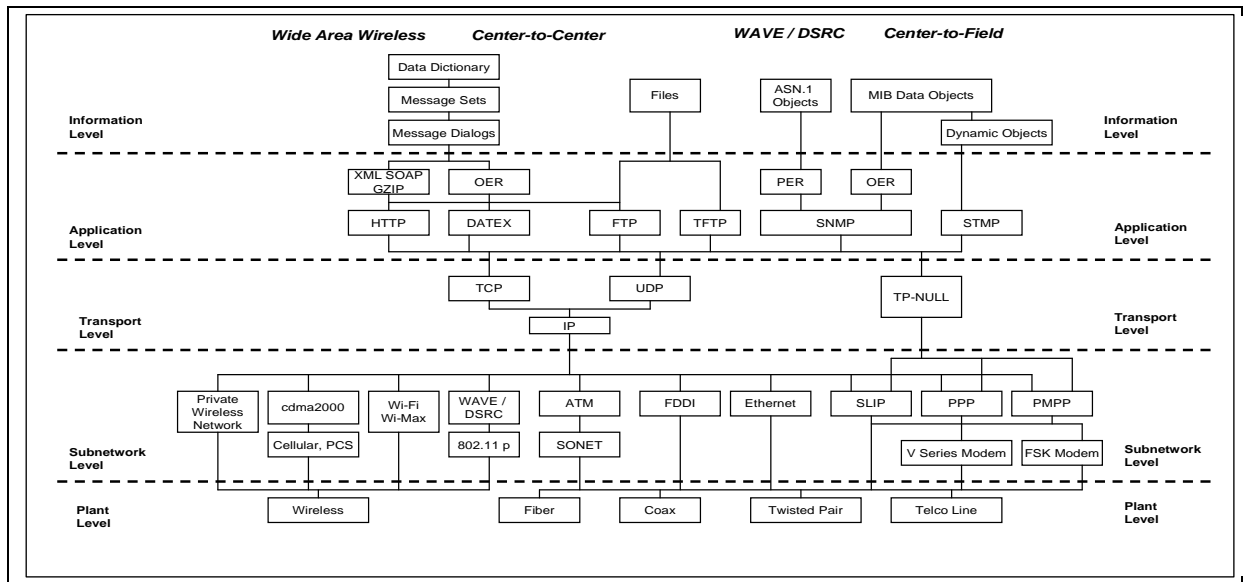
### **6.1 An ITS Communications and Standards Framework for New York State**

It is recommended that New York State formalize and adopt an ITS Communications and Standards Framework.

One such framework, which may be used (and has been expanded in this guide to include all key ITS standards), is the NTCIP Framework. The NTCIP Framework covers *wireline center-to-field* and *wireline center-to-center communications*. The NTCIP Framework has been expanded to include ITS and industry standards for *wide area wireless* and *WAVE/DSRC* communications. This expanded framework has been coined the NYS ITS Communication Framework.

The ITS Communications Framework uses a layered or modular approach to communications standards, similar to the layering approach adopted by the Internet and the International Organization of Standards. The ITS Communications Framework and is shown in the figure below.

Figure 6-2. An ITS Communications Framework for New York State



Each of the ITS Standards Framework levels is described below:

- Information Level Standards.** Information standards define the meaning of data and messages and generally deal with ITS information (rather than information about the communications network). This is similar to defining a dictionary and phrase list within a language. These standards are above the traditional OSI seven-layer model. Information level standards represent the functionality of the system to be implemented.
- Application Level Standards.** Application standards define the rules and procedures for exchanging information data. The rules may include definitions of proper grammar and syntax of a single statement, as well as the sequence of allowed statements. This is similar to combining words and phrases to form a sentence, or a complete thought, and defining the rules for greeting each other and exchanging information. These standards are roughly equivalent to the Session, Presentation and Application Layers of the OSI model.
- Transport Level Standards.** Transport standards define the rules and procedures for exchanging the Application data between point 'A' and point 'X' on a network, including any necessary routing, message disassembly/re-assembly and network management functions. This is similar to the rules and procedures used by the telephone company to connect two remotely located telephones. Transportation level standards are roughly equivalent to the Transport and Network Layers of the OSI model.
- Subnetwork Level Standards.** Subnetwork standards define the rules and procedures for exchanging data between two 'adjacent' devices over some communications media. This is equivalent to the rules used by the telephone company to exchange data over a cellular link versus the rules used to exchange data over a twisted pair copper wire.

These standards are roughly equivalent to the Data Link and Physical Layers of the OSI model.

- **Plant Level Standards.** The Plant Level is shown in the ITS Standards Framework only as a means of providing a point of reference. The Plant Level includes the communications infrastructure over which communications standards are to be used and will have a direct impact on the selection of an appropriate Subnetwork Level for use over the selected communications infrastructure. The ITS standards do not prescribe any one media type over another.

*To ensure a working system, deployments must specify and/or select one or more standards at each level.*

Key ITS Standards are listed in Appendix D. Appendix E contains an overview of the contents of each national standard recommended. Core information level dialogs, messages, and MIB definitions are shown in Appendix F.

## **6.2 ITS Standards Communications Packages**

An ITS Standards Communication Package combines specific standards into alternatives for deployment. The communications packages represent re-usable communications stacks that together define all of the levels of communications required for ITS deployments. Others are possible, but these represent a starting point to ease ITS communications architecture and design. This should help project developers a head start in understanding which ITS standards to apply in developing an ITS communications solution.

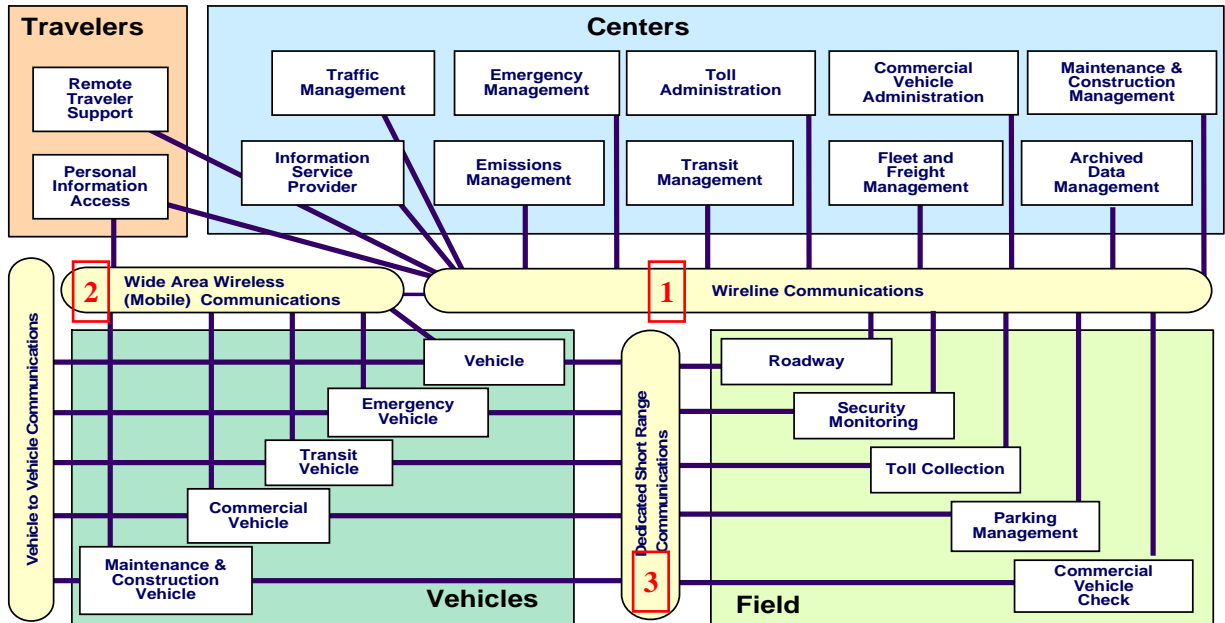
The communications packages may also be thought of as a checklist to be used in developing procurement specifications, and can be used to show a high level communications design, suitable as introductory material when describing a complete ITS communications solution.

The Communications Packages are grouped into 3 areas, with direct relation to the communications methods National ITS Architecture. This is done intentionally to form a bridge between the regional ITS architecture market packages and the standards-based communications packages. The 3 groups are:

- Wireline Center-to-Field and Center-to-Center Communications,
- Wide Area Wireless Communications, and
- WAVE / DSRC

This is illustrated in the figure below.

Figure 6-3. Relation of Communications Packages to National ITS Architecture

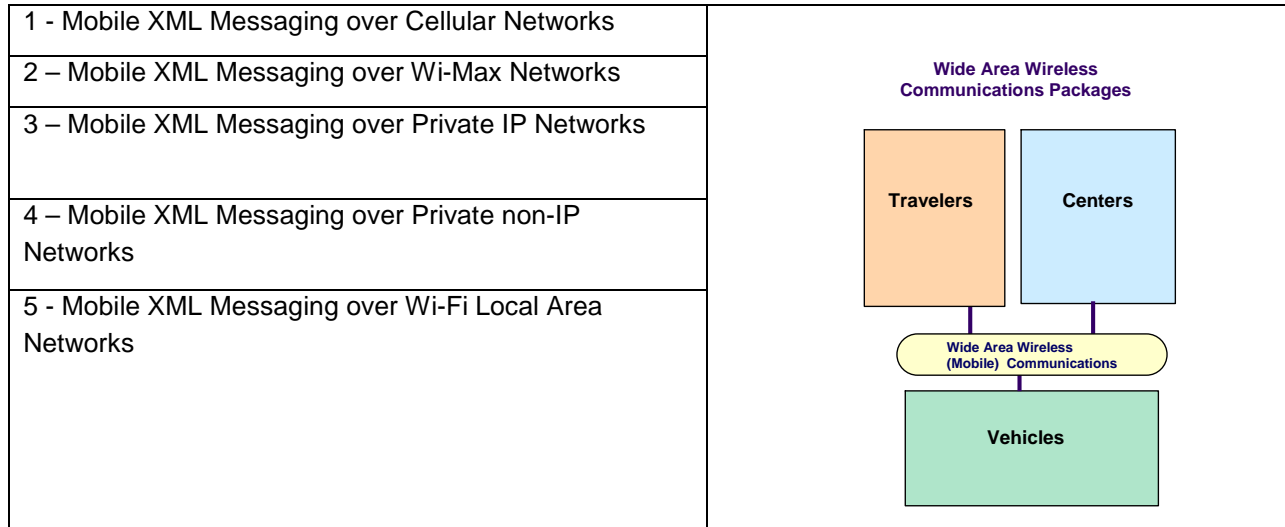


Appendix G contains a detailed description of each of the 10 communications packages defined. A summary of each is contained in the tables below:

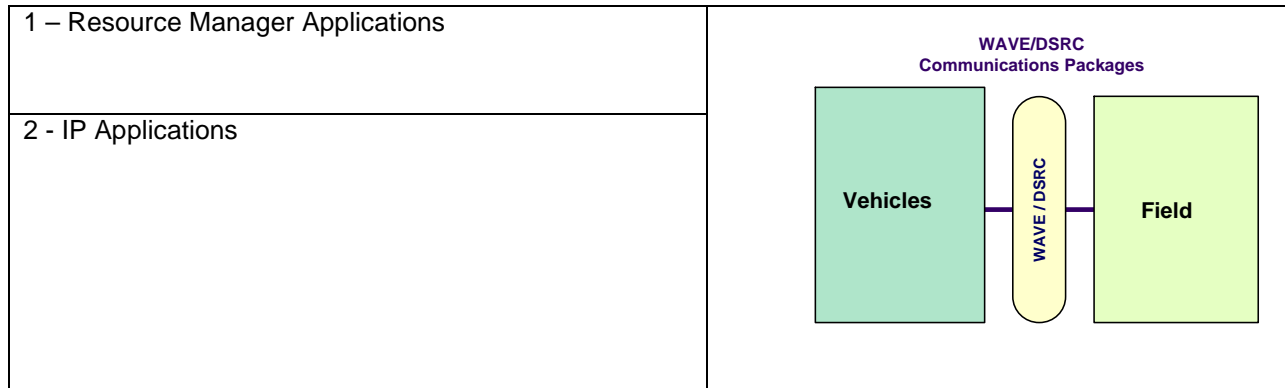
Figure 6-4. Wireline Communications Packages

1 - Center-to-Field Communications over IEEE 802 IP Networks	<p style="text-align: center;"><b>Wireline Communications Packages</b></p> <p>The diagram shows a vertical flow of data from the Centers (blue box) to the Field (green box) through the Wireline Communications Packages (yellow box).</p>
2 - Center-to-Field Communications Point-to-Point or Point-to-MultiPoint	
3 - XML Messaging for Center-to-Center Communications	

**Figure 6-5. Wide Area Wireless Communications Packages**

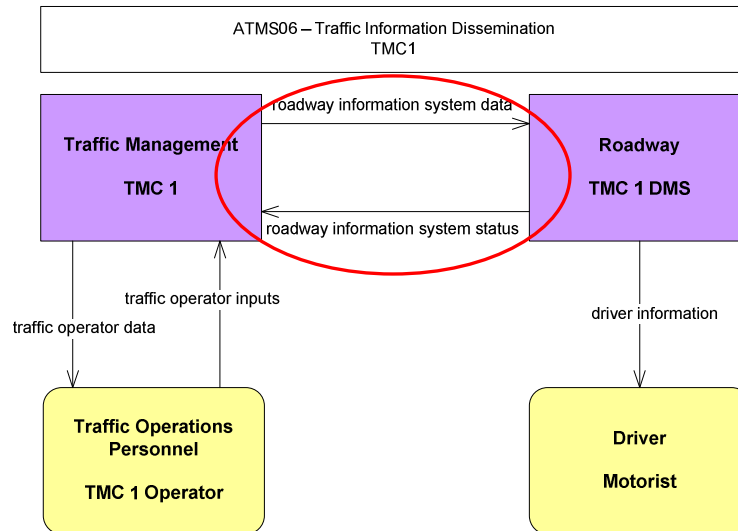


**Figure 6-6. WAVE/DSRC Communications Packages**



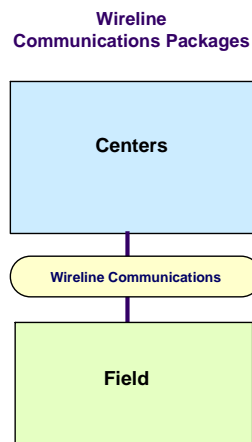
### 6.3 Using the ITS Standards Communications Packages to Identify Communications Alternatives

Carrying forward from the example ConOps developed previously, let's identify what part of the ITS communications framework applies to the following portion of the market package below.



Identifying what communication package(s) apply involves the following steps:

1. Identify what classes of the architecture are being connected. The architecture has 4 classes: travelers, centers, field, and vehicles. In this case, a Traffic Management Center (centers) is being connected to a Roadway (field) ITS element. Connecting centers and field is part of the wireline communications packages. Shown below.



2. Next identify which alternative best applies, or allow all to be possible alternatives. We can select from the following options:



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

In this case option 1 will apply – Center-to-field Communication over IEEE 802 IP Networks, though multiple options can be used in conducting an alternatives analysis.

- Looking up this option in the framework (see Appendix G) yields the following communication stack showing pre-determined communications solutions for all communications layers.

**Figure 6-7. Example Using ITS Communications Framework**

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

#### **6.4 *Mapping from ITS Architecture Flows to ITS Standards Messages and MIB Definitions***

To facilitate use of ITS architecture concepts, notably market packages, ITS architecture flows, which show the interconnection of the architecture subsystems, a mapping is necessary. It is worthy to mention that the requirements of the ITS architecture are high-level and do not map to the ITS standards requirements. Therefore, this more detailed mapping is necessary.

A mapping of ITS architecture flow to ITS standards messages and MIB definitions (information level standards) is shown in Appendix H.

This mapping allows a quick determination of which ITS standards messages apply to the architecture flows in a market package.