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National Transportation Communications for ITS Protocol Point to Multi-Point Protocol Using RS-232 Subnetwork Profile

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FOREWORD

This document uses only metric units.

This document defines a subnetwork profile that is a combination of standards intended to meet specific requirements for data transfers to and from roadside devices in either a networked or direct-connect environment.

This document is an NTCIP Subnetwork Profile Standard. Subnetwork Profile (SP) Standards provide definitions and requirements for the data link and physical layers of a communications stack that follows the OSI Basic Reference Model.

The text includes mandatory requirements in Annex A that are defined as normative.

For more information about NTCIP standards, visit the NTCIP Web Site at <http://www.ntcip.org>. For a hardcopy summary of NTCIP information, contact the NTCIP Coordinator at the address below.

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This document was separately balloted and approved by AASHTO, ITE, and NEMA after recommendation by the Joint Committee on the NTCIP. Each organization has approved this standard as the following standard type, as of the date:

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History

From 1996 to 1999, this document was referenced as NEMA TS 3.SP-PMPP232. However, to provide an organized numbering scheme for the NTCIP documents, this document is now referenced as NTCIP 2101. The technical specifications of NTCIP 2101 are identical to the former reference, except as noted in the development history below:

TS 3.SP-PMPP232 v98.01.07. August 1998 – Accepted as a User Comment Draft by the Joint Committee on the NTCIP.

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INTRODUCTION

The context of the NTCIP is one part of the Intelligent Transportation Systems standardization activities covering base standards, profiles, and registration mechanisms.

- Base Standards define procedures and rules for providing the fundamental operations associated with communications and information that is exchanged over fixed-point communications links.
- Profiles define subsets or combinations of base standards used to provide specific functions or services. Profiles prescribe particular subsets or options available in base standards necessary for accomplishing a particular function or service. This provides a basis for the development of uniform, nationally recognized conformance.
- Registration Mechanisms provide a means to specify and uniquely identify detailed parameters within the framework of base standards and/or profiles.

Within the Joint Committee on the NTCIP, the Profiles Working Group is concerned with the methodology of defining profiles, and the definition and documentation of profiles in Standards Publications. This document is intended to provide a complete subnetwork profile (SP) that specifies the communications over an asynchronous, half-duplex or full-duplex dedicated digital circuit. This SP specifies the requirements for an unbalanced connectionless operation. This subnetwork profile can be used with different transport profiles (TP) addressing the network and transport layers with protocols such as UDP or TCP, or it can be used directly with an application profile (AP) such as the Simple Transportation Management Framework. The objective is to facilitate the specification of ITS systems characterized by a high degree of interoperability and interchangeability of its components.

This publication defines a subnetwork profile that is a combination of standards intended to meet specific requirements for data transfers to and from roadside devices in either a networked or direct-connect environment. The purpose of this standard is to provide the information necessary to establish a connection using the Point to Multi-Point Protocol (PMPP) via an RS-232 interface. This combination of protocols and standards has been combined in a profile termed SP-PMPP232 within the NTCIP. The SP-PMPP232 is a subnetwork specification and uses protocols and standards to address the Data Link Layer (Layer 2 of the OSI Reference Model) and Physical Layer (Layer 1 of the OSI Reference Model) to manage connected devices that coexist on a common channel. The SP-PMPP232 supports a variety of upper layer protocols over a common physical implementation. It contains mandatory requirement statements that are applicable to all devices claiming conformance to this standard. It also contains options and conditional requirements, which may be applicable to a specific environment in which a device is used.

In 1992, the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section began the effort to develop the NTCIP. The Transportation Section's purpose was to respond to user needs to include standardized systems communication in the NEMA TS 2 standard, Traffic Controller Assemblies. Under the guidance of the Federal Highway Administration's NTCIP Steering Group, the NEMA effort was expanded to include the development of communications standards for all transportation field devices that could be used in an Intelligent Transportation Systems (ITS) network.

In September 1996, an agreement was executed among AASHTO, ITE, and NEMA to jointly develop, approve, and maintain the NTCIP standards. The Joint Committee on the NTCIP created the Profiles Working Group to develop a method for organizing Class Profiles. The first meeting of the working group was in September 1997.

After research into how national and international standards organizations combine protocols and standards to address all seven layers of the OSI Basic Reference Model, the committee adopted the approach defined in the *NTCIP Profile Framework*. Following that approach, a protocol stack was specified by application, transport, and subnetwork profiles. An application profile addresses the

application, presentation, and session layers. A transport profile addresses the transport and network layers. A subnetwork profile addresses the data link and physical layers. The *NTCIP - Point to Multi-Point Protocol Using RS-232 Subnetwork Profile* (SP - PMPP232) is a subnetwork profile for use in center-to-roadside communications.

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Section 1 GENERAL

1.1 SCOPE

This standard is applicable to transportation related devices that must operate in a typical primary/secondary configuration where one device is the designated primary while one or more other devices are connected to one channel acting as secondaries. As a subnetwork profile, it specifies a set of protocols and standards applicable to the data link and physical layers of the OSI Reference Model. The SP-PMPP232 is intended to provide an interoperability standard for the Physical and Data Link Layer aspects of communications in transportation related devices. The primary purpose of this standard is to provide a simple data exchange tool that uses a connectionless delivery mechanism.

This subnetwork profile lists the requirements for an implementation using an unbalanced mode of operation for the data link layer that have been derived from the High-Level Data Link Control (HDLC) standard. This subnetwork profile defines not only the definition of the physical and the data link layer protocols but also the interface definition between the data link layer and higher layer protocols.

1.2 PROFILE-PROTOCOL-LAYER RELATIONSHIPS

A profile defines a combination of base standards and/or other profiles that collectively perform the intended function. The definition of Subnetwork Profiles and their functions and responsibilities are defined within NTCIP 8003 - Profile Framework. This profile references computer communications and transportation protocol standards for the Data Link and Physical Layers of the OSI Reference Model.

The OSI Reference Model defines seven layers, each performing a particular role in the transmission of data over a medium. This subnetwork profile defines the first two layers.

The first layer, the Physical Layer, deals with how the bits of information are transmitted over a communications channel. It deals with the mechanical and electrical interfaces, and the physical transmission medium.

The second layer, the Data Link Layer, has the task of transforming the information that came in over the wire into data that appears to be free of transmission errors. It should incorporate mechanisms to insure the integrity of the data and provide a method of insuring that, if need be, no data is lost. An unbalanced configuration provides for only one primary station and one or more secondary stations to operate as point-to-point or point-to-multipoint, half duplex or full duplex, and stop/start (asynchronous) transmission. An unbalanced configuration is a scenario where a designated primary station is responsible for controlling the interchange of data with each secondary station and for establishing and maintaining the link.

This subnetwork profile requires a Primary/Secondary relationship between devices and controllers (i.e., this profile does not support contention-based communications). The profile will function on low speed communications links that may either be full or half duplex. This SP does not address higher layer functionality such as routing, segmentation and re-transmission of data packets, nor is it concerned with the application(s) residing in the device.

This Subnetwork Profile does not address the organization and definition of the information related to transportation device's end application. Additionally, it does not require a particular Transport Profile or Application Profile. However, it does indicate a particular mechanism to identify higher layer protocols by means of the Initial Protocol Identifier (IPI). The IPI is directly analogous to the Protocol Identifier employed in the Point-to-Point protocol. It provides a mechanism to permit "multiplexing" messages generated by