4 FUNCTIONAL REQUIREMENTS

This section defines the Functional Requirements to be supported by the ATC. These functions fall into three major categories:

- Manage/Configure Controller Applications
- Manage External Devices
- Facilitate Ease of Maintenance & Future Hardware or Software Updates

The ATC is fundamentally defined as a general-purpose field computing device supporting many different possible software applications. Therefore the particular functional and sub-functional requirements applicable to any particular ATC implementation cannot be fully defined here and are left to each end-users’ discretion so long as the basic functions described here are supported by the particular ATC.

4.1 Manage/Configure Controller Applications

4.1.1 Install and Update Applications Software

The ATC shall provide hardware to support the installation and update of applications software. If performed locally, this requirement shall be satisfied by the following hardware:

- Front panel serial port for interfacing with laptop computer, PDA or similar locally connected device with software for performing this function
- Front panel Ethernet port for interfacing with laptop computer, PDA or similar locally connected device with software for performing this function
- Front panel portable memory device interface and a minimal front panel user interface for initiating bulk data transfers to and from a portable memory device – satisfied by the following requirements:
  - USB port with support for portable memory device and BSP-described drivers for portable memory device file access
  - Front panel display and keyboard or a serial interface for connection to a laptop computer or PDA device to serve as an operator interface for initiating file transfers to and from a portable memory device when such a device is connected to USB port per above requirement

If performed remotely, this requirement shall be satisfied by the following hardware:
• Separate Ethernet port for possible use to communicate with a remote device having the necessary software for performing this function.

• Separate Serial port for possible use to communicate with a remote device having the necessary software for performing this function.

4.1.2 Installing and Upgrading the Operating System Software

The ATC shall provide hardware to support the installation and upgrade of drivers, utilities, etc. This requirement shall be satisfied by the same local and remote requirements given in Section 4.1.1.

4.1.3 Maintain Clock/Calendar Function and Synchronize with External Sources

The ATC shall provide hardware to support a clock/calendar function:

• The Engine Board shall include a clock/calendar device to support the maintenance and backup of current time and date by the ATC unit in the absence of AC service power.
  
  o Clock/calendar device shall maintain time/date for a minimum of 30 days without AC service power applied to the controller.

  o Clock/calendar device drift shall be less than ± 1 minute per 30 days at 25°C.

• Applications software executing in the ATC shall be able to set time and date on the clock/calendar device to the nearest 0.1 seconds via the BSP.

• When AC service power is present, current time/date information shall be maintained by the O/S and easily accessed by the application software utilizing the BSP.

• Power transients and short term power outages shall not introduce clock drift.

• The Engine Board/BSP shall utilize the LINESYNC signal and the Engine Board Real Time Clock (RTC) to maintain an accurate Operating System Time (OST) by following these rules:
  
  o Under normal AC service power conditions (as defined in section 7.2.6.1) or during power failure conditions of less than 500 ms as indicated by the POWERDOWN signal, OST timing shall be derived from the 8.33 ms LINESYNC signal.

  o Once each hour, the BSP RTC driver shall automatically copy the current OST time to the RTC with an accuracy of 0.1 seconds.
Upon power failure, after reapplication of power and system initialization, the BSP RTC driver shall copy the RTC time values into the OST registers with an accuracy of 0.01 seconds.

- Accuracy requirements of the LINESYNC signal is stated in section 7.2.5.2.

**Guidance:** The accuracy requirements allow for 0.1 second accuracy in the ability to set the RTC, 0.01 second accuracy to synchronize the OST to a transition edge of the RTC when re-establishing the OST, and an additional 17 ms due to the asynchronous nature of the LINESYNC signal. Thus, the net error is 0.127 seconds plus the accuracy of the RTC. (Authorized Engineering Information)

### 4.1.4 Configure and Verifying Parameter(s)

The ATC shall provide hardware to support the configuration and verification of parameters for particular local applications.

If performed locally, this requirement shall be satisfied by the following hardware:

- Front panel display and keyboard(s) to support operator configuring/verifying of application parameter(s) and/or
- Serial communication port for locally connected laptop, PDA or similar device with software to support operator configuring/verifying application parameter(s) from this device

If performed remotely, this requirement shall be satisfied by the following hardware:

- Serial communications port or
- Ethernet port

This hardware is understood to be matched with applications support, and/or BSP support functions supporting NTCIP transfers through remote system interface.

### 4.1.5 Uploading/Downloading Data Block(s)

The ATC shall provide hardware to support file transfers and bulk transfers of new application databases.

If performed locally, this requirement shall be satisfied by the following hardware:
• Communication port(s) for interface to locally connected laptop, PDA or similar
device with necessary software to support operator configuration and verification
of application parameter(s) from this device

If performed remotely, this requirement shall be satisfied by:

• Communications port (no provisions for operator data entry), and
• presence of application support and/or BSP support for NTCIP transfers through
communications port

### 4.1.6 Monitoring and Verifying Present Application Status

The ATC shall provide hardware to monitor system health overall as well as internal
parameters related to particular application such as operating modes, event logs, device
failures, algorithm results, etc.

If performed locally, this requirement shall be satisfied by the following hardware:

• Communication port(s) for interface to locally connected laptop, PDA or similar
device with necessary software to support operator monitoring and verification of
present applications status from this device

If performed remotely, this requirement shall be satisfied by the following hardware:

• Requirements listed above, and
• Presence of BSP and/or applications support for NTCIP transfers through
communications port(s).

### 4.1.7 Allowing Operator Control of Application(s)

The ATC shall provide hardware to support the operator control of start/stop/run times of
all applications.

If performed locally, this requirement shall be satisfied by:

• Communication port(s) for interface to locally connected laptop, PDA or similar
device with necessary software to support operator control of applications
(start/stop/run times, etc.).
• BSP description of controller resident operator interface software to control other
applications tasks (start/stop/run time/etc.).

Remote performance of this function is not supported.
4.1.8 Facilitate the Long Term Retention of Data

The ATC shall provide hardware to facilitate long term data logging and other local data storage applications via:

- SRAM memory for applications to store data
- BSP-described support of FLASH memory file management system

4.2 Manage External Devices

The ATC shall include hardware to provide control, management, and monitoring of a variety of field devices through conventional parallel I/O that conforms to the existing NEMA (TS2-2003) and Type 170 and 179 (as reflected by CALTRANS TEES, and the New York State TRANSPORTATION MANAGEMENT EQUIPMENT SPECIFICATIONS) controller interface specifications, and shall provide serial interfaces as listed below. The four (4) otherwise undedicated serial ports required in the following two subsections may be shared by the requirements of these two subsections.

4.2.1 Manage/Control a Variety of External Field Devices

The ATC shall include hardware to provide management/control of a variety of external field devices. This standard describes required interfaces to provide standardized communication with external devices via industry-standard asynchronous and synchronous serial communication connections.

In support of this requirement, this standard calls for a minimum of four (4) otherwise undedicated general-purpose serial communications ports for possible interface to external field devices:

- Each port shall support asynchronous or synchronous communications
- Each port shall support a range of baud rates as defined in section 5.4.3 Serial Interface Ports of this standard
- Ports shall be configurable to the various mechanical field connections defined in section 6.2.3 and the respective modulation and demodulation methods defined in section 6.3.2 of this standard

The standard also provides details of packaging and interfaces that allow this controller to be deployed in industry standard cabinet configurations including: NEMA TS2 Types 1 and 2, ITS and Model 332 cabinets. The ATC must provide backward interface compatibility with existing NEMA, Models 170, 179, and ATC 2070 controllers.
One dedicated synchronous serial port shall be provided to directly interface (select one as appropriate)

- to an ITS or NEMA TS2 Type 1 cabinet, or
- via a parallel I/O module to a NEMA TS2 Type 2 or Model 332 cabinet

### 4.2.2 Monitor the Status of External Field Devices

The ATC shall provide hardware to monitor the status of a variety of external field devices. This standard describes the required interfaces to provide standardized communication with external devices via industry-standard asynchronous and synchronous serial communication connections.

In support of this requirement, this standard calls for a minimum of four (4) otherwise undedicated general-purpose serial communications ports for possible interface to external field devices. (Note that these ports are shared with the four ports required for the management and control of external devices listed in section 4.2.1).

- Each port shall support asynchronous or synchronous communications
- Each port shall support a range of baud rates as defined in section 5.4.3 Serial Interface Ports of this standard
- Ports shall be configurable to the various mechanical field connections defined in section 6.2.3 and the respective modulation and demodulation methods defined in section 6.3.2 of this standard

The standard also provides details of packaging and interfaces that allow this controller to be deployed in industry standard cabinet configurations including: NEMA TS2 Types 1 and 2, ITS and Model 332 cabinets. The ATC must provide backward interface compatibility with existing NEMA, Models 170, 179, and ATC 2070 controllers.

One dedicated synchronous serial port to directly interface (select one as appropriate)

- to an ITS or NEMA TS2 Type 1 cabinet, or
- via a parallel I/O module to a NEMA TS2 Type 2 or Model 332 cabinet

### 4.3 Facilitate Ease of Maintenance & Future Hardware or Software Updates

#### 4.3.1 Board Support Package (BSP)

The ATC hardware described here requires an appropriate BSP, supplied by the Engine Board vendor, to support the indicated functions and to facilitate the porting of
applications software between different CPU and operating systems combinations. It is implicitly understood throughout this standard that the associated BSP will support, at a minimum, the following classes of functions:

- Serial communications
- Field cabinet I/O
- FLASH memory file management
- Portable memory devices, as needed
- Applications task control
- Time & date management functions
- User interface support

4.3.2 Provide a Platform that Allows for Hardware Upgrades

This ATC standard is intended to provide a general design that readily adapts to newer processors, O/Ss, and increased memory size and speed. In order to maintain an upgrade path for previously deployed ATC 2070 controller units, the engine board form, fit and complement of serial ports of this standard are defined such that older ATC 2070 units can benefit from upgrades to technology defined by this standard. While the ATC packaging is ultimately left open to allow manufacturers to be responsive to special needs, this standard describes packaging and interfaces that allow the ATC Controller to be deployed in industry standard cabinet configurations.

4.3.2.1 Standardize Controller Packaging

The overall ATC physical design shall allow for either rack mount or shelf mount cabinet configurations.

- Controller unit may be capable of being mounted in rack cabinet including, but not limited to, cabinets adhering to the new ITS Cabinet standard and the Model 332 cabinet specifications.
- If used in standard NEMA TS1 or TS2 cabinet, the controller unit shall be shelf-mounted.

4.3.2.2 Standardize Engine Board Contents

A key design goal of this ATC standard is that it provides for easy hardware upgrades to adapt to newer processors, and increased memory size and speed. It does this by requiring that all computational functions be concentrated on an Engine Board within the ATC. To maintain interchangeability, the Engine Board (CPU module) shall conform to a designated specific physical form and pin-out interface. Pins designated as "Reserved"
allow for future enhancements to the Engine Board and are not to be used for any purpose. They shall be no-connects on both Engine Board and Host modules. Section 5 of this standard designates minimum Engine Board requirements on:

- CPU and RAM memory
- FLASH memory storage
- Operating System Software
- Serial ports
- Ethernet interfaces
- Standardized (form, fit and function) pin out interface
- Real-time clock

### 4.3.2.3 Standardize Communication Interfaces

The ATC standard includes Communication Interface slot(s) for optional plug-in internal Communication Interface module(s) that have a standardized interface (form, fit, and function) established so that the Communication Boards of various manufacturers shall operate properly when installed within another manufacturer’s unit.

### 4.3.3 Facilitate Software Application Portability

The ATC facilitates application portability by abstracting application software from the ATC hardware thereby allowing application programs to be written that can be made to operate on any ATC (regardless of manufacturer). This is accomplished through a layered software architecture and open source operating system as defined in Section 2.2.5 and Annex A. In previous controller architectures, source code would require considerable modification and, in some cases, to be completely rewritten to run on a different vendor’s platform. The ATC facilitates portability by requiring only modest efforts on the part of the developer such as recompiling source code and linking object modules for a particular processor.

### 4.3.4 Facilitate Diagnostic Capabilities

The ATC facilitates diagnostics capabilities by providing standardized external physical interfaces for parallel and serial I/O, and non-volatile memory to log time/date stamped messages/errors/etc. These capabilities allow both manufacturer and third party diagnostic tools to be developed.