

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:

- 1 • Separate Ethernet port for possible use to communicate with a remote device
2 having the necessary software for performing this function.
- 3 • Separate Serial port for possible use to communicate with a remote device
4 having the necessary software for performing this function.
- 5

6 **4.1.2 Installing and Upgrading the Operating System Software**

7

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

11

12 **4.1.3 Maintain Clock/Calendar Function and Synchronize with** 13 **External Sources**

14

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

16

- 17 • The Engine Board shall include a clock/calendar device to support the
18 maintenance and backup of current time and date by the ATC unit in the absence
19 of AC service power.
- 20 ○ Clock/calendar device shall maintain time/date for a minimum of 30 days
21 without AC service power applied to the controller.
- 22 ○ Clock/calendar device drift shall be less than ± 1 minute per 30 days at 25°C.
- 23 • Applications software executing in the ATC shall be able to set time and date on
24 the clock/calendar device to the nearest 0.1 seconds via the BSP.
- 25 • When AC service power is present, current time/date information shall be
26 maintained by the O/S and easily accessed by the application software utilizing
27 the BSP.
- 28 • Power transients and short term power outages shall not introduce clock drift.
- 29 • The Engine Board/BSP shall utilize the LINESYNC signal and the Engine Board
30 Real Time Clock (RTC) to maintain an accurate Operating System Time (OST)
31 by following these rules:
- 32 ○ Under normal AC service power conditions (as defined in section 7.2.6.1) or
33 during power failure conditions of less than 500 ms as indicated by the
34 POWERDOWN signal, OST timing shall be derived from the 8.33 ms
35 LINESYNC signal.
- 36 ○ Once each hour, the BSP RTC driver shall automatically copy the current
37 OST time to the RTC with an accuracy of 0.1 seconds.

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- 1 ○ Upon power failure, after reapplication of power and system initialization, the
2 BSP RTC driver shall copy the RTC time values into the OST registers with
3 an accuracy of 0.01 seconds.

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

5
6 ***Guidance: The accuracy requirements allow for 0.1 second accuracy in the
7 ability to set the RTC, 0.01 second accuracy to synchronize the OST to a
8 transition edge of the RTC when re-establishing the OST, and an additional
9 17 ms due to the asynchronous nature of the LINESYNC signal. Thus, the
10 net error is 0.127 seconds plus the accuracy of the RTC. (Authorized
11 Engineering Information)***
12

13 4.1.4 Configure and Verifying Parameter(s)

14
15 The ATC shall provide hardware to support the configuration and verification of
16 parameters for particular local applications.

17
18 If performed locally, this requirement shall be satisfied by the following hardware:

- 19
20 • Front panel display and keyboard(s) to support operator configuring/verifying of
21 application parameter(s) and/or
22 • Serial communication port for locally connected laptop, PDA or similar device
23 with software to support operator configuring/verifying application parameter(s)
24 from this device

25
26 If performed remotely, this requirement shall be satisfied by the following hardware:

- 27
28 • Serial communications port or
29 • Ethernet port

30
31 This hardware is understood to be matched with applications support, and/or BSP
32 support functions supporting NTCIP transfers through remote system interface.
33

34 4.1.5 Uploading/Downloading Data Block(s)

35
36 The ATC shall provide hardware to support file transfers and bulk transfers of new
37 application databases.

38
39 If performed locally, this requirement shall be satisfied by the following hardware:
40

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- 1 • Communication port(s) for interface to locally connected laptop, PDA or similar
2 device with necessary software to support operator configuration and verification
3 of application parameter(s) from this device

4 If performed remotely, this requirement shall be satisfied by:

- 5
- 6 • Communications port (no provisions for operator data entry), and
- 7 • presence of application support and/or BSP support for NTCIP transfers through
8 communications port
- 9

10 **4.1.6 Monitoring and Verifying Present Application Status**

11

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

15

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

- 17
- 18 • Communication port(s) for interface to locally connected laptop, PDA or similar
19 device with necessary software to support operator monitoring and verification of
20 present applications status from this device

21

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

- 23
- 24 • Requirements listed above, and
- 25 • Presence of BSP and/or applications support for NTCIP transfers through
26 communications port(s).
- 27

28 **4.1.7 Allowing Operator Control of Application(s)**

29

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

32

33 If performed locally, this requirement shall be satisfied by:

- 34
- 35 • Communication port(s) for interface to locally connected laptop, PDA or similar
36 device with necessary software to support operator control of applications
37 (start/stop/run times, etc.).
- 38 • BSP description of controller resident operator interface software to control other
39 applications tasks (start/stop/run time/etc.).

40 Remote performance of this function is not supported.

1

2 **4.1.8 Facilitate the Long Term Retention of Data**

3

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

6

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

9

10 **4.2 Manage External Devices**

11

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

19

20 **4.2.1 Manage/Control a Variety of External Field Devices**

21

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

26

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

30

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

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

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1
2 One dedicated synchronous serial port shall be provided to directly interface (select one
3 as appropriate)

- 4 • to an ITS or NEMA TS2 Type 1 cabinet, or
 - 5 • via a parallel I/O module to a NEMA TS2 Type 2 or Model 332 cabinet
- 6

7 **4.2.2 Monitor the Status of External Field Devices**

8
9 The ATC shall provide hardware to monitor the status of a variety of external field
10 devices. This standard describes the required interfaces to provide standardized
11 communication with external devices via industry-standard asynchronous and
12 synchronous serial communication connections.

13
14 In support of this requirement, this standard calls for a minimum of four (4) otherwise
15 undedicated general-purpose serial communications ports for possible interface to
16 external field devices. (Note that these ports are shared with the four ports required for
17 the management and control of external devices listed in section 4.2.1).

- 18 • Each port shall support asynchronous or synchronous communications
- 19 • Each port shall support a range of baud rates as defined in section 5.4.3 Serial
20 Interface Ports of this standard
- 21 • Ports shall be configurable to the various mechanical field connections defined in
22 section 6.2.3 and the respective modulation and demodulation methods defined
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25 to be deployed in industry standard cabinet configurations including: NEMA TS2 Types 1
26 and 2, ITS and Model 332 cabinets. The ATC must provide backward interface
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- 32

33 **4.3 Facilitate Ease of Maintenance & Future**

34 **Hardware or Software Updates**

35 **4.3.1 Board Support Package (BSP)**

36
37 The ATC hardware described here requires an appropriate BSP, supplied by the Engine
38 Board vendor, to support the indicated functions and to facilitate the porting of

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1 applications software between different CPU and operating systems combinations. It is
2 implicitly understood throughout this standard that the associated BSP will support, at a
3 minimum, the following classes of functions:

- 4
- 5 • Serial communications
- 6 • Field cabinet I/O
- 7 • FLASH memory file management
- 8 • Portable memory devices, as needed
- 9 • Applications task control
- 10 • Time & date management functions
- 11 • User interface support
- 12

13 **4.3.2 Provide a Platform that Allows for Hardware Upgrades**

14
15 This ATC standard is intended to provide a general design that readily adapts to newer
16 processors, O/Ss, and increased memory size and speed. In order to maintain an
17 upgrade path for previously deployed ATC 2070 controller units, the engine board form,
18 fit and complement of serial ports of this standard are defined such that older ATC 2070
19 units can benefit from upgrades to technology defined by this standard. While the ATC
20 packaging is ultimately left open to allow manufacturers to be responsive to special
21 needs, this standard describes packaging and interfaces that allow the ATC Controller to
22 be deployed in industry standard cabinet configurations.

23 **4.3.2.1 Standardize Controller Packaging**

24
25 The overall ATC physical design shall allow for either rack mount or shelf mount cabinet
26 configurations.

- 27
- 28 • Controller unit may be capable of being mounted in rack cabinet including, but
29 not limited to, cabinets adhering to the new ITS Cabinet standard and the Model
30 332 cabinet specifications.
- 31 • If used in standard NEMA TS1 or TS2 cabinet, the controller unit shall be shelf-
32 mounted.

33 **4.3.2.2 Standardize Engine Board Contents**

34
35 A key design goal of this ATC standard is that it provides for easy hardware upgrades to
36 adapt to newer processors, and increased memory size and speed. It does this by
37 requiring that all computational functions be concentrated on an Engine Board within the
38 ATC. To maintain interchangeability, the Engine Board (CPU module) shall conform to a
39 designated specific physical form and pin-out interface. Pins designated as “Reserved”

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1 allow for future enhancements to the Engine Board and are not to be used for any
2 purpose. They shall be no-connects on both Engine Board and Host modules. Section
3 5 of this standard designates minimum Engine Board requirements on:

- 4
- 5 • CPU and RAM memory
- 6 • FLASH memory storage
- 7 • Operating System Software
- 8 • Serial ports
- 9 • Ethernet interfaces
- 10 • Standardized (form, fit and function) pin out interface
- 11 • Real-time clock

12 **4.3.2.3 Standardize Communication Interfaces**

13

14 The ATC standard includes Communication Interface slot(s) for optional plug-in internal
15 Communication Interface module(s) that have a standardized interface (form, fit, and
16 function) established so that the Communication Boards of various manufacturers shall
17 operate properly when installed within another manufacturer's unit.
18

19 **4.3.3 Facilitate Software Application Portability**

20

21 The ATC facilitates application portability by abstracting application software from the
22 ATC hardware thereby allowing application programs to be written that can be made to
23 operate on any ATC (regardless of manufacturer). This is accomplished through a
24 layered software architecture and open source operating system as defined in Section
25 2.2.5 and Annex A. In previous controller architectures, source code would require
26 considerable modification and, in some cases, to be completely rewritten to run on a
27 different vendor's platform. The ATC facilitates portability by requiring only modest
28 efforts on the part of the developer such as recompiling source code and linking object
29 modules for a particular processor.
30

31 **4.3.4 Facilitate Diagnostic Capabilities**

32

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