4.0 COMPONENT FEATURES AND REQUIREMENTS

An AEI site should include the following component subsystems:

- Presence detector
- Wheel detector
- Tag reader
- Controller
- Communications
- Power supply
- Surge suppressor

To perform its intended functions, an AEI site must have the components listed above and shown in Fig. 4.1.

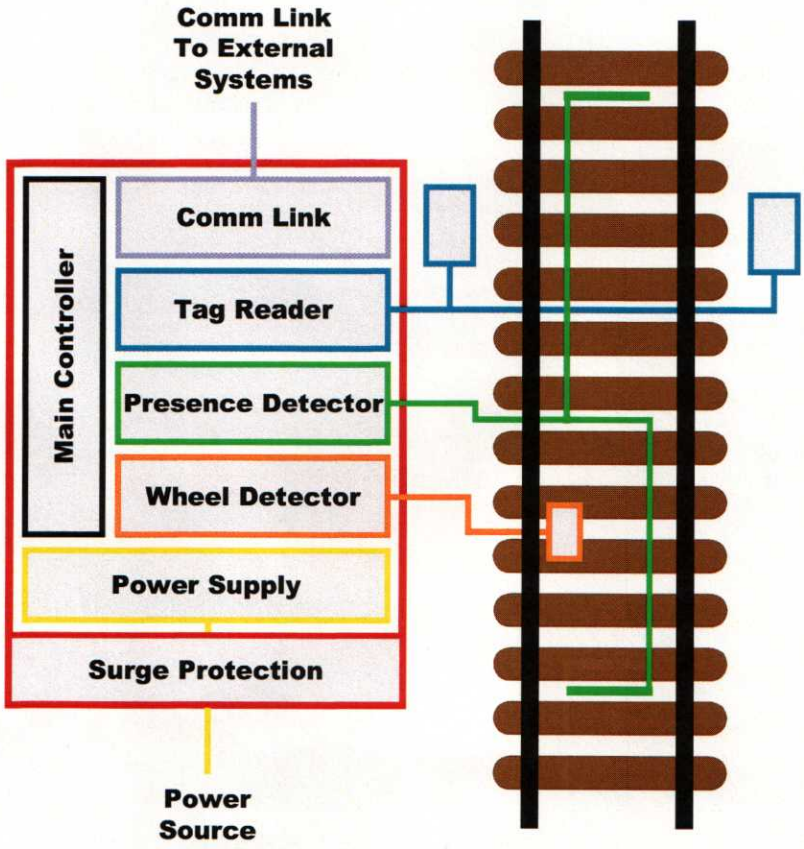

Fig. 4.1 AEI site components

4.1 Presence Detector Subsystem

4.1.1 Detect Start of Train

The AEI site should sense and report when a train enters the AEI site's read range.

To reduce power consumption and extend the life of the equipment, much of the equipment should be in standby mode, or even powered down, when not in use. The presence detector is one means for the AEI site to detect a train in time to turn on the train movement and tag reading subsystems and start the read without missing any tag reads or axle counts.

4.1.2 Detect End of Train

The AEI site should sense and report when a train exits the AEI site's read range.

The AEI site cannot build the final consist for a train until the entire train has passed through and exited the AEI site's read range. With no train in range, the train movement and tag reading subsystems can return to standby mode.

4.2 Wheel Detector/Train Movement Subsystem

See paragraph 2.2.1.1, "Capture Train Movement Data." For purposes of allocating functionality, some "train movement" processing is hosted on the controller component.

Ideally, the wheel detector/train movement subsystem will have sufficient redundancy to correctly detect and build consists even when it has a faulted sensor.

The AEI site wheel detector/train movement subsystem should function in both directions and be compliant with each movement type of the S-9203A movement status criteria.

4.2.1 Count Axles

The AEI site wheel detector/train movement subsystem should count axles on trains passing through the AEI site's read range.

The wheel detector is the main driver of the train movement subsystem. Although newer ways of counting wheels are emerging, wheel detectors have traditionally been made of a magnetic sensing system that is able to detect when a wheel passes over it. The sensor is traditionally mounted to the flange side of the rail just under the clearance of the wheel with its connecting cable run in the gravel of the track bed.

4.2.2 Direction

4.2.2.1 The AEI site wheel detector/train movement subsystem should determine the direction of travel for trains passing through the AEI site's read range.

4.2.2.2 Reversing Direction

The AEI site wheel detector/train movement subsystem should not double-count axles when trains stop and/or reverse direction while passing through the AEI site's read range.

Note: This implies correct function at very low speeds.

4.2.3 Speed

The AEI site wheel detector/train movement subsystem should determine the speed of trains passing through the AEI site's read range.

4.4.2 Data Evaluation

4.4.2.1 Car Recognition

The AEI site-controller subsystem should use the train movement data to identify, at a minimum, the following types of cars. To further clarify the requirements for car type, refer to the Universal Machine Language Equipment Register (UMLER):

- 4- and 6-axle locomotives
- Standard 4-axle railcars
- Standard 6-axle railcars
- Articulated and fixed drawbar railcars
- Amtrak
- Other commuter-type railcars
- RoadRailer equipment
- Specialty equipment

4.4.2.2 Data Reconciliation

The AEI site-controller subsystem should reconcile the train movement data and the AEI tag data, assembling a full consist that conforms to Standard S-9203A (latest version).

4.4.2.3 Error Reporting

The AEI site-controller subsystem should flag any errors or inconsistencies identified in reconciling the tags read with the train movement data. For instance, if a tag is in error and reports too few axles, the known physical model of the axle count of the train must be used to indicate a problem in the tag.

4.4.3 Data Caching

The AEI site-controller subsystem should cache consist reports for a desired minimum of 200 trains to allow for data recovery as well as power and communication outages. This feature will also allow users to recover data that was lost or not collected.

4.4.4 Secure Access

See paragraph 5.2, "Security Requirements."

4.4.5 Data Reporting

The AEI site-controller subsystem should assemble and provide consist reports to external entities that provide the correct password. See paragraph 2.2.1.4, "Report Consists."

4.4.5.1 Pushing Consist Reports

The AEI site-controller subsystem should push consist reports to a list of predefined recipients within 5 minutes of identifying that a train has passed. That list of predefined recipients may be determined by consist information, such as the train operator, cargo, or errors detected.

4.4.5.2 Responding to Consist Report Queries

The AEI site-controller subsystem should construct and push consist reports in response to queries from authorized external systems that provide the correct password.

4.4.5.3 Train Reporting and S918A Compliance

The AEI site-controller subsystem should construct consist reports that comply with the requirements of Standard S-9203A (latest version).

4.4.6 Maintenance Functions

4.4.6.1 Maintenance Reporting and S-9203A Compliance

The AEI site-controller subsystem should provide maintenance reports that comply with the requirements of Standard S-9203A (latest version).

Specific requirements of Standard S-9203A include, but are not limited to, the following:

- Functional maintenance reporting with designated intervals established
- Individual message adherence to preset percentages, accuracy, and descriptiveness of actual event
- Triggering a message, independent of the predetermined interval, upon request
- Validation of time synchronization
- Complete reports, utilizing selected displays, AHM, EMS, and EOC

4.4.6.2 Fault Reporting

The AEI site-controller subsystem should alarm fault indications, including but not limited to fatal and warning conditions, sensor faults and failures, loss of a communication link, loss of primary power, and UPS status, to a predefined external entity.

This feature will allow users with administrative access to respond promptly to faults, thereby improving availability.

4.4.6.3 Remote Diagnostics

The AEI site-controller subsystem should provide remote diagnostics, indicating when the AEI site system or any component thereof is in need of service and how it should be serviced.

This feature will allow users with administrative access to identify and troubleshoot faults remotely, thereby reducing maintenance costs. Ideally, the remote diagnostics will function when the controller subsystem is not in a defined normal operating condition.

4.4.7 Remote Configuration

The AEI site-controller subsystem should support remote configuration by users with appropriate access.

4.4.7.1 Multiple Configurations

The AEI site-controller subsystem should support a minimum of eight separate user configurations.

4.4.7.2 Configurable User Parameters

The AEI site-controller subsystem should allow users with the correct password to modify user-specific parameters including, but not limited to, site number or ID, delimiters, reported time, track orientation/designation, password, report filtering criteria, and report delivery address(es).

Users may specify that they receive consist reports for all trains or only for trains that satisfy specific criteria such as size, direction, or car type. Users must identify the IP address(es) and/or phone numbers to which consist reports will be sent.

4.4.7.3 Configurable Administrative Parameters

The AEI site-controller subsystem should allow users with the correct password to modify site-specific parameters, including, but not limited to, system time, user configurations, diagnostic thresholds and reporting address(es), consist report hold time, alternate communications links, and default track identification.

User configuration includes adding, deleting, and modifying user names and passwords. The tag-reader subsystem needs to be told how many tracks and in what configuration it is dealing with. These privileges are reserved for the owning road of the site.

4.4.7.3.1 Passwords

The AEI site should support adding, deleting, and modifying user names and passwords.

4.4.7.3.2 Track Orientation

The AEI site should support setting its track orientation to E-W, W-E, N-S, or S-N.

Note: This determines the train travel direction reported for the consist.

4.4.7.3.3 Site Health Check Report Interval

The AEI site should support setting how often a health check report is generated to its owning host system.

4.5 Communications Subsystem

The AEI site communications subsystem should support multiple communication paths from the site controller to external clients, including, but not limited to, IP Networks and modem connections from 2400 baud to 56 KB.

In this context, *support* means to be able to utilize multiple communication paths if they are provided. The available communication paths will be site-specific.

4.5.1 Secondary Communication Paths

The AEI site communications subsystem should be capable of automatically switching to a secondary communication path if the primary communication path is inoperative or unavailable.

4.6 Power Supply Subsystem

The AEI site power-supply subsystem should provide sufficient power to operate the AEI site equipment, except for heaters and air conditioners, for a minimum of 6 hours in the absence of primary power.

AEI sites must have an uninterruptable power supply that will last long enough for a technician to remedy a "typical" power outage. Battery backup is the norm, but solar or other hybrid solutions are acceptable.

4.6.1 UPS Status Reporting

The AEI site power-supply subsystem should report to the controller subsystem its status, including, but not limited to, prime power availability and remaining operating time.

4.7 Surge Suppression Subsystem

An AEI site must provide the protection of its sensitive electronic equipment from high electrical surges. Presumably, this takes the form of Faraday shielding and surge suppressors on I/O paths. All possible surge paths must be protected. All but direct lightning strikes to the site must be guarded against—meaning that a nearby lightning strike on the track may not bring the site down. Sites that can handle a direct strike are preferred—as long as the direct hit protection is not cost prohibitive. See paragraph 4.4.7.3.1, "Surge Suppression."

4.7.1 Input/Output Protection

The AEI site subsystem should protect all sensor, data, communication, and power inputs and outputs.