

POSITIVE TRAIN CONTROL

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After several train accidents, the **Federal Regulations Association** mandated that all road locomotives be equipped with **Positive Train Control** by Dec 31, 2015.

What is Positive Train Control (PTC) It's systems that are mission critical, fault tolerant vital signaling systems connected via digital radios to mobile and fixed railroad equipment. When deployed, PTC will provide interoperability between all the participating railroads. Trains from any railroad will be able to operate on the tracks of any other railroad, without ever losing contact with their own network operations center. With PTC installed on RR road locomotives, the system will prevent trains from hitting other trains. The PTC computer system will take over the locomotive before exceeding limits or if an unsafe condition develops.

The purpose of PTC is to prevent train to train collisions, Prevent Over speed derailments, prevent work zone incursions, ant to prevent movement through switch in wrong directions

Train Control: PTC will continually monitor trains, exchanging information with Train Management Computers (TMC) and gathering precise speed and position information from GPS/TMC. PTC will have a copy of train orders, number of cars, weight, route and track characteristics along the route,

including speed restrictions, curves, grades and crossings. Track authority (permission to occupy and move on a sector of track) will be continuously updated as train dispatchers and train control computers at the network operation center issue and modify train orders and operate signals.

Block Sections: With information from train control above, PTC will monitor and enforce compliance with train orders and signals, ensuring the train operate only on the block sections it is authorized to occupy and move on.

Track Circuits: In addition to information provided from track circuits on the tracks, PTC will provide dispatchers and train control computers precise, real time position of the train on the track. In "dark territory", where there are no track circuits, PTC will be the only real-time train location information source.

Signals: The aspect of all signals on the tracks will be extended through the TMC to an onboard computer display showing all signals ahead of the train, including those that are not physically visible due to terrain, curves or visual distance. If a signal is not observed, PTC will immediately apply corrective action programmed for that event, from slowing down the train to a safe speed to the application of full emergency brakes to stop the train in the shortest possible distance. At the same time it will visually and audibly warn the engineer and report the event to the dispatcher and the train control computers.

Switches: PTC will query and monitor the status of track switches ahead and behind the train. This status will be reported to the engineer, the dispatcher and the train management computers. Interlocking Systems: The PTC System will work with the dispatcher, train control computers and TMC to continuously

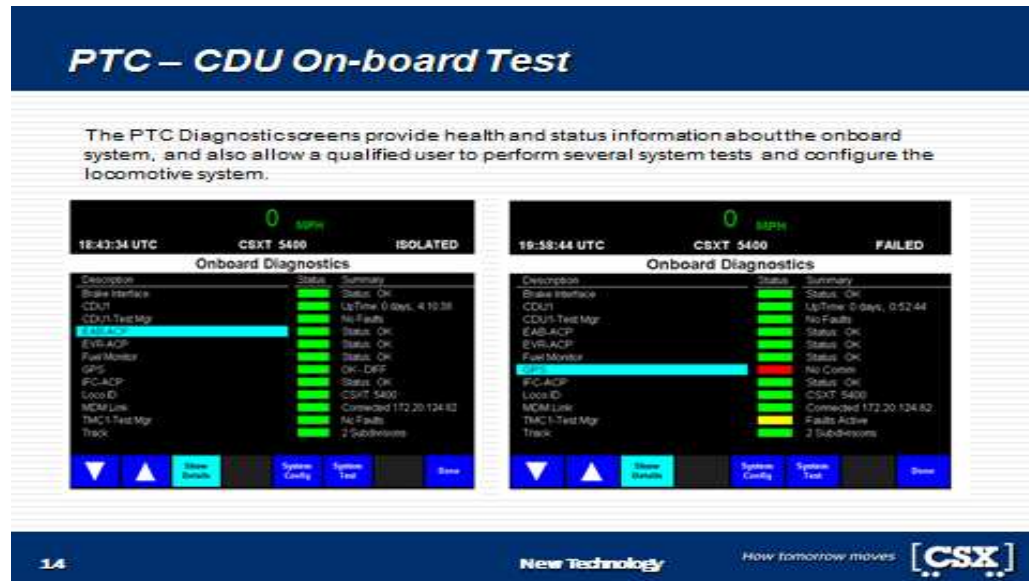
monitor and identify potential conflicts between signals and switches, train orders issued to the train, and train orders other trains are using, authorized speed and maximum speed possible on that sector of track. If any conflicts or potential conflicts would be detected, PTC will immediately apply corrective action as programmed for that event, slowing down or stopping the train, and notifying the engineer, dispatcher and train control computers.

PTC consists of several components and systems. The back office system has to be accurate with information such as timetables, dispatcher bulletins, track, switches and signals. This information is in the railroads back office server system and must be kept very accurate.

On- Board the locomotive there is a Train Management Computer (TMC) and Cab Display Unit (CDU). Both components are provided by Wabtec. The TMC and CDU work together. The TMC known as the brains of the system communicates to the CDU. The CDU communicates with the Engineer. The interactive screen has soft keys where the Engineer can acknowledge new or modified authorities electronically. See Figure 1 below



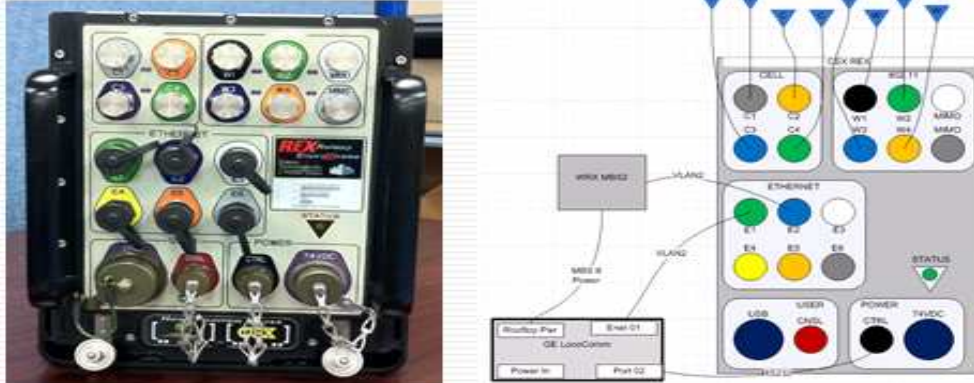
The Engineer will log in to the CDU prior to movement. Once logged in the system will do a test providing the engineer with a status of the complete system. In Figure below you will see a good test and a failed test. Engineer is required to complete a full test prior to departure.



Notice the interactive keys at the bottom of the screen for navigation.

Another component on-board the locomotive is the communications box. The Railroads are using several different varieties of options to provide this important piece to the PTC system. The communications box will provide several ways for PTC messages to traverse to the back office of the railroads. CSX has 802.11 WiFi, two cellular and a 220 Mhz radio for transport of PTC messages. The figure below is what CSX is using for communications.

Communications for PTC



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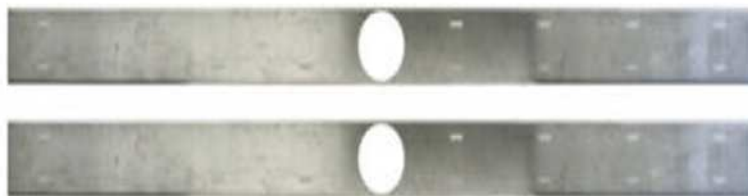
How tomorrow moves



The communications box is connected to an antenna array located on the top of the roof of the locomotive. Each RR installing PTC can choose how the antennas will get installed. The part that is common among the railroads is how the messages are being sent. Priority 1 is Wifi 802.11, Priority 2 is through cell. When all communications paths are not available the 220 Mhz radio is used. See figure below of the CSX Antenna's



P/N AD-1060 Antenna Bar - 2 each



The 220 MHz radio is the last resort for sending a PTC message. The skate looking antenna is the 200 radio antenna. The objective is to not have a single point of failure. If all communications paths are down, the system is configured to where PTC still can operate by sending messages through the 220 MHz radio.

Wayside Equipment and Fault Equipment Detectors: All

wayside/trackside equipment will be continuously monitored by PTC, which will automatically query equipment ahead and behind the train. PTC will issue alerts in cases such as when an automatic crossing gate is not working or a hot box detector reports some axles slightly above a certain temperature level. It will also apply corrective action in cases such as when a track integrity monitor reports a possible track breakage due to floods or extreme heat, or a hot box detector reports an axle in the train with a temperature exceeding safe operating levels, or a flood warning sensor detects the presence of water on the tracks.

PTC is a very detailed design. All parts of the system have to work together. The track, switches, grade, milepost, signal systems, back office and on-board devices have to work together. With PTC if one component changes, it's very important that approved testing in a lab is done prior to putting into production.