

# LEADING THE WAY IN PTC

**BNSF has completed installation of all mandated Positive Train Control (PTC) infrastructure on its network. BNSF was already developing and testing PTC technology years before the Congressional mandate. From the outset, when BNSF helped develop the prototype of this key safety technology, BNSF has been a pioneer of PTC. While continuing to test and refine the system and resolve technological challenges, BNSF has operated more than a million trains with PTC as it moves toward meeting the 2018 deadline.**



## What is PTC?

PTC is technology that overlays existing train hardware and software. As mandated by law, PTC is intended to prevent:

- > Train-to-train collisions.
- > Derailments caused by excessive speed.
- > Unauthorized incursions by trains onto sections of track where maintenance activities are taking place.
- > Movement of a train through a track switch left in the wrong position.

PTC uses GPS, Wi-Fi and high-band radio transmission to:

- > Ensure the train does not exceed its authority.
- > Determine the location, direction and speed of the train.
- > Warn the train crew of a potential problem.
- > Take action by stopping the train if there is not a response by the train crew.

There are three main elements of a PTC system, which are integrated by a wireless communications system:

- > **Onboard Locomotive System:** Monitors the train's position and speed and activates braking as necessary to enforce speed restrictions and unauthorized train movement into new sections of track.
- > **Wayside System:** Monitors railroad track signals, switches and track circuits to communicate movement authorization to the locomotive.
- > **Back Office Server:** The storehouse for all information related to the rail network and trains operating across it. It transmits the authorization for individual trains to move into new segments of track.

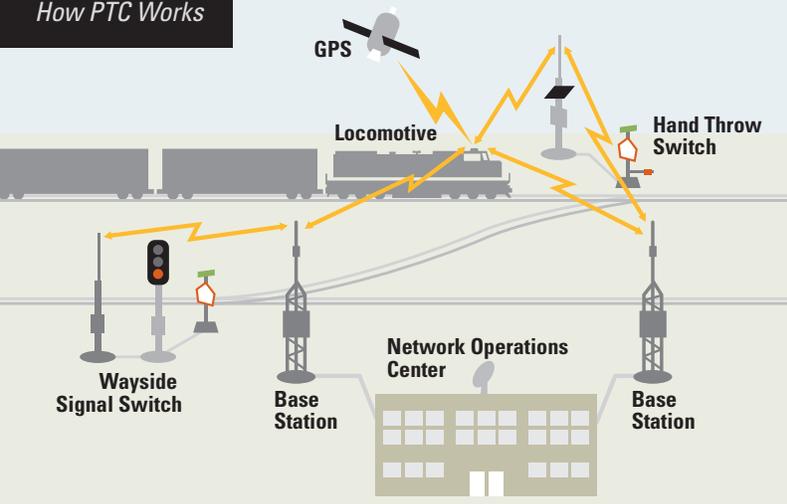
## Meeting the Mandate

BNSF has achieved several industry firsts in PTC, and while a lot of work remains before the system is fully implemented, BNSF has reached a significant milestone in its journey that began well over a decade ago. As per the federal mandate, BNSF has installed the PTC infrastructure on all 88 required subdivisions, covering more than 11,500 route miles and 80 percent of its freight volume. BNSF is currently running hundreds of trains daily with PTC as it tests operating in revenue service across its entire mandated territory.

## Advancing Interoperability

BNSF is also leading the North American rail industry with PTC interoperability. In cooperation with Metrolink in Southern California, a PTC-equipped train can now begin its journey on BNSF and seamlessly transition to Metrolink territory. Metrolink can do the same with BNSF – an important achievement since one of the primary purposes of PTC is to provide protection where railroads run freight and passenger service.

### How PTC Works



### BNSF PTC Progress

These metrics represent where BNSF stands in some key areas as of December 31, 2017. They are derived from BNSF's quarterly PTC progress report to the Federal Railroad Administration (FRA).

**21K+** BNSF employees trained to operate and maintain PTC trains and equipment



**100%** Locomotives equipped with PTC technology (5,000 locomotives)



**100%** Route miles of PTC infrastructure installed (11,500+ route miles)



**100%** PTC radio towers installed (6,000+ radio towers)



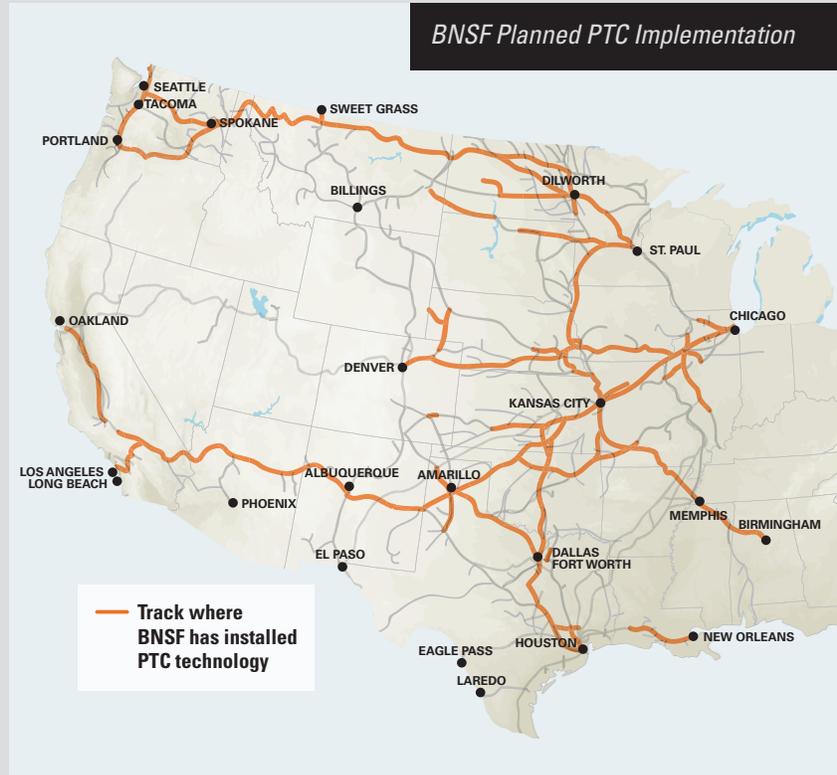
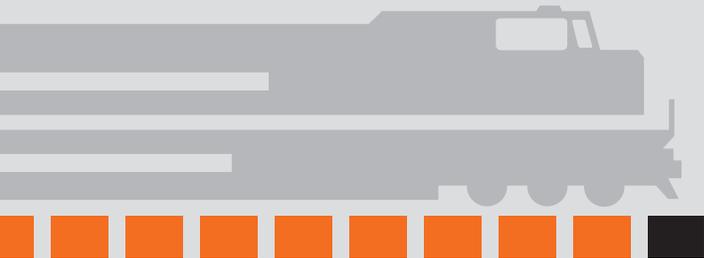
### PTC Milestones Achieved

BNSF completed the installation of PTC on all its federally mandated subdivisions. Across BNSF's required subdivisions:

**1 million+** revenue service trips have been operated using PTC (as of January 2, 2018)

**80%** of freight volume is moving on PTC routes

**11,500+** route miles of PTC infrastructure have been installed



### On Track for Success

As BNSF moves toward meeting the 2018 deadline, it will continue to test and refine this highly complex system that must work as designed to support safe, efficient train operations 24/7/365. BNSF continues to work through the technological and hardware challenges that arise from such a complex system as it drives toward complete implementation.

### Looking to the Future

The system cannot be considered fully implemented until each railroad's PTC system works interoperably with one another. This means another railroad's locomotive can access another railroad's network and still have PTC protection. Interoperability of PTC systems between Class I, commuter and short line rail carriers is a vital concern. BNSF is unable to test interoperability on a wide scale until other railroads have also completed their infrastructure installation. BNSF looks forward to working with other railways to expand interoperability and with the FRA to ensure PTC enhances rail safety wherever it operates.