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LonWorks® Networks Keep Acela Zipping Along

Flying the U.S. Northeast Corridor at speeds of up to 150 mph, the glistening Acela trains from Amtrak are projected to shrink the Boston to Washington rail trip from about eight to six hours. Amtrak hopes Acela will revolutionize U.S. rail travel and save the company. To pull it off, Amtrak will initially invest $800 million in 20 trainsets from Bombardier/ALSTHOM, the manufacturing consortium, who relies on LonWorks platform, developed by Echelon, to oversee critical train systems.

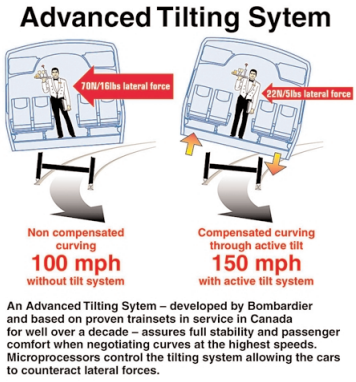
One Acela trainset is made of two power cars and six coaches. The train holds 260 coach and 44 first class passengers and offers many new features like a very smooth ride, more comfortable, adjustable seating, electrical outlets and conference tables. Acela hopes to attract businesspeople seeking an alternative to the discomfort of car and air travel. Acela, however, presents many challenges.

Making a Successful Bullet—Orchestrating the Systems

To begin with, Bombardier, the Canadian manufacturer, has to ensure safe and optimal operation at high speeds, maximize train uptime, and enhance communication with passengers. Next, even though Amtrak installed new rails, Bombardier has to run high-speed trains on lower-speed rail paths. This means adapting to railway turns not designed for high-speed. So Bombardier uses technology that tilts the car as it goes through a turn to compensate for lateral acceleration, and thus, keep passengers unaffected. According to Alain Poirier, project engineer at Bombardier for the Acela trains, "You wouldn't be able to walk inside the train unless you had the tilting."

"As well as tilting," says Poirier, "each car uses another 15-20 systems that require constant monitoring and periodic maintenance such as braking, doors, HVAC, speed sensing, speed limitation, fire, integrated truck surveillance, low voltage battery charging and more." For example, the Amtrak ACSES system enforces speed limitation at specific points on the track. "If you have a curve or tunnel where you want to limit the speed, there is a transponder on the track, installed by Amtrak. We have an on-board system that detects those transponders," explains Poirier.

"With so many systems, Bombardier required an efficient, very reliable monitoring network for Acela crews. While designing the network, Bombardier also needed to simplify communication specifications to its many train systems vendors," says Poirier. Having used it extensively on other projects and feeling it's the right fit, Bombardier relies on LonWorks solutions to meet the Acela requirements.



An Advanced Tilting Sytem – developed by Bombardier and based on proven trainsets in service in Canada for well over a decade – assures full stability and passenger comfort when negotiating curves at the highest speeds. Microprocessors control the tilting system allowing the cars to counteract lateral forces.

LonWorks Networks Drive the Acela Nerve Center

As the scenery hurtles toward Acela, the engineer and assistant rely on a LonWorks monitoring network for the train. They continually consult two LCD screens showing speed, pre-departure tests, brake gauges and alarms. They also have a third screen with a schematic of the train and options that give the status of any system in any part of the train to any level of detail desired. Using a keypad, the crew can activate menus to obtain instantaneous information, critical for safe and efficient operation. In addition, using the LonWorks network, the crew can control air dampers on the train, such as when entering a tunnel.

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Since all systems are monitored by the LonWorks platform, access to maintenance information is exceptional. Poirier explains, "Maintenance information generated in each car is sent to the central monitoring system within the car and also wayside. The maintenance facility can have access to the train information—online—even when the train is running. They can prepare for the train arrival and get the spare parts to get the train up and running again."

Maintenance and operations are not the only ways that LonWorks touches passengers on Acela. Before boarding the train, passengers read the external LC display signs on the side of every car. These provide basic train information such as the destination. Once aboard, they can refer to general information LCD displays for messages from the crew. Lastly, if they are curious about their progress on the journey, they can look at another LCD display in their car. All signs in all cars use information provided by LonWorks networks and can be controlled from the crew office in the Café car using a LCD display with a keypad.

Key Benefits

- Eased system integration
- Simplified the design process
- Simplified vendor interface validation
- Improves maintenance and proactive measures
- Eases the installation and removal of nodes

Each system/node on each car, such as brakes, a screen, or a keypad, sends information and receives requests via the LonWorks system. Each node connects to the Car Monitoring Unit PC (CMU) within its car via an Echelon FTT-10A Free Topology Transceiver interface over twisted pair to another FTT-10A in the CMU. Within the CMU, these signals—LonTalk® protocol—are processed by the LonWorks MIP DPS software and used by the Bombardier Car Network Manager (CNM) software that translates them into an inter-car protocol. Next, the CMU sends this protocol over the Bombardier inter-car communication network that connects all cars and their CMUs. This protocol is then received and processed by other CMUs to be translated back into LonTalk using their CNMs and MIP DPS software. These messages are finally sent to their intended nodes.

LonWorks Networks are Right on Track

Besides meeting the requirements for a powerful monitoring system and reducing wiring costs, the LonWorks system gives excellent integration benefits to Bombardier. Poirier explains, "The big interest in LonWorks is the ease of integration for the different equipment supplied by vendors. You just have to define the parameters you want the system to send or to listen to, and then you can bind those variables as you wish. This can evolve during the course of the project. You can change very easily without having to go back to the supplier, which is a great benefit in terms of cost and time." "Furthermore, LonWorks simplified and expedited the design process," says Poirier. "You limit the risk because you don't have to make a decision too early in the project. You know that you will need some information, but you do not have to know exactly who (which node) will be using that information. If you were using another standard approach, you would have to know exactly who is using what at the beginning of the project. This is very hard when you have 20 different nodes and maybe 12 suppliers: This is a nightmare."

Amtrak, too, will see many benefits from LonWorks. Poirier predicts a reduction in maintenance costs and easier fixes. "Through the Car Network Manager software we developed, you can do live installation," he explains. "If you remove a piece of equipment and you install a new one, it will automatically be installed in the car network management tool. If a system fails, then you can just unpower it and put a new one in. It will be installed on the network, and—boom—you're ready to go again. This is a great benefit."

Poirier points out that Bombardier is through the learning curve on LonWorks and will continue to use it for other projects. Now, Bombardier's client, Amtrak, is in its own learning curve—the Acela trains. If all goes well with the Acela Boston to Washington run, Amtrak will roll the program out nationwide and spend $10 billion over 10 years to create 10 high-speed rail corridors in 28 states. As travelers and crew enjoy the grace and comfort of the new Acela trains, the crew will have something else to appreciate —LonWorks.

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