The Next Generation in Train Control Systems

ACORN

Acorn A-Z

Innovative system architecture
By leveraging the power of technology, Acorn is able to offer the same IEEE controls as industry-standard CBTC systems, while reducing infrastructure requirements. It accomplishes this by virtualizing IEEE controls within each train, rather than relying on wayside controllers.

Installation and maintenance made easy
Acorn is safer and easier to implement and maintain than conventional CBTC.

Installation benefits
- Acorn's system architecture overlays existing signaling systems to ensure continuity of service throughout implementation
- Trackside infrastructure requirements are confined to the installation of Acorn tags at regular intervals along the tracks

Interoperability
- Designed to overlay existing train controls systems, Acorn can be used as a standalone product or work in tandem with other signaling systems

Maintenance benefits
- "In the background" software updates occur with no discernable disruptions to service
- Trackside maintenance of the system is limited to the replacement of Acorn Tags every 3-4 years. Replacement can be completed by a team of five at a rate of 2 miles per hour, after minimal training.
- System components and software are available through multiple vendors, opening up the supply chain

Improved reliability and performance
Acorn's pioneering block tagging system provides train operators with continuously updated information on train locations, speeds, and projected arrival times. This information allows drivers to quickly adjust to real time conditions and reduces unnecessary interruptions to service. The flexibility provided by Acorn keeps trains on schedule and offers riders more peace of mind.

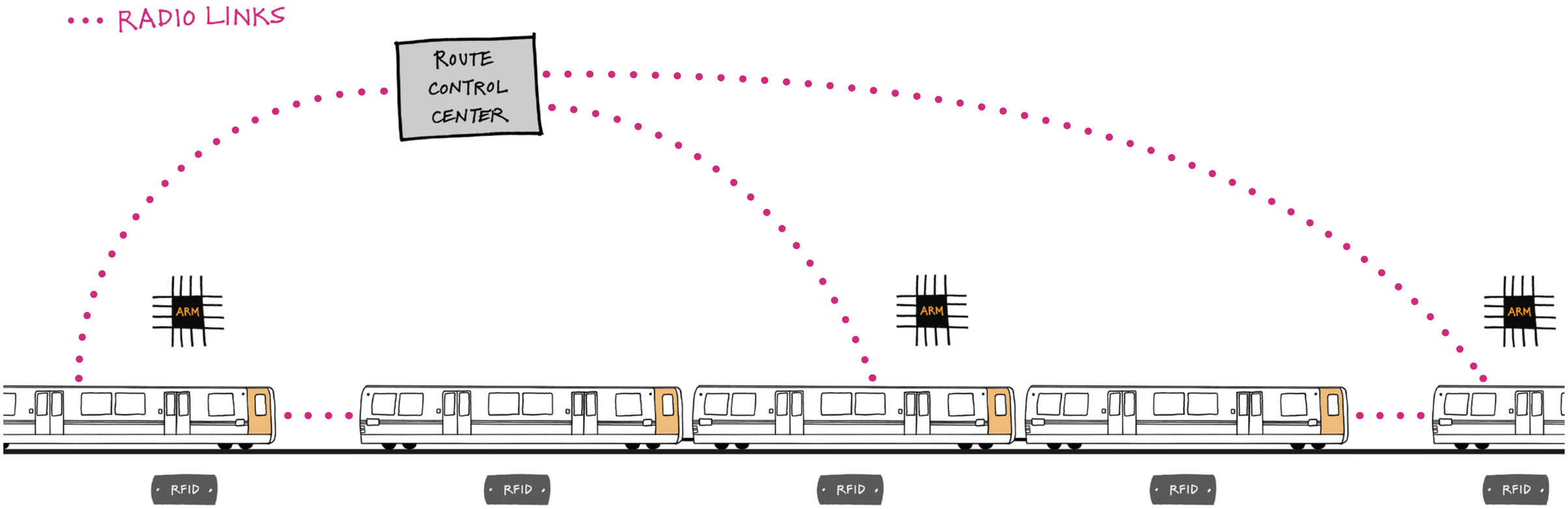
The next generation in train control systems

Acorn is the next-generation in train control systems. Acorn's state-of-the-art system architecture leverages advances in technology to help rail systems cut the cost of installation and maintenance, while achieving new standards of efficiency.

A finalist in the 2018 MTA Genius Transit Challenge, Acorn's innovative design moves train control systems into the digital age.

The Acorn advantage

User-friendly Interface	Digitally-rich cab designed with drivers in mind
Performance Optimization	RFID tags provide steady stream of data to help keep systems running smoothly
Superior Connectivity	Frequent updates between trains and the route control center (RCC) allow trains to quickly respond to real time route conditions
Safer, Easier Installation	Minimal trackside infrastructure expedites implementation and promotes trackside safety
Enhanced Cyber Security	Multi-vendor sourced system architecture guards against common mode failures
Compatibility	Overlay design allows Acorn to work in tandem with existing signaling systems



How it works

The Acorn Tag is an RFID tag installed at regular intervals along the train line. When a train passes over the tag, it reads and writes a range of performance data to support quick adjustments in operations.

Unlike much of the infrastructure required to support industry-standard train control systems, the Acorn Tag is inexpensive and easy to install.

Acorn in Action

Acorn improves system performance by making trains more agile and responsive.

As a train passes over the Acorn Tag, its onboard ARM CPU writes a host of performance-related data to the tag. The train also extracts information written to the tag by the train ahead of it. This data is used to determine the leader train's location so that the system can continue to operate even if communications between trains, or the trains and the RCC, drop out.

Enhanced safety and resilience

A safer system

The installation of standard CBTC systems requires extensive trackside work. Acorn's virtual distribution model eliminates many of conventional CBTC's trackside components, like the wayside controller, thus improving safety.

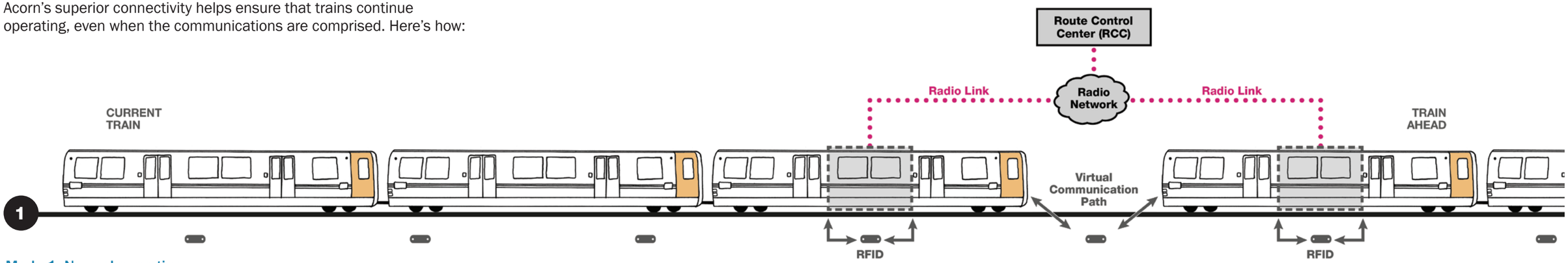
When trackside work is required, Acorn helps keep personnel safe by enabling temporary speed restrictions to be initiated via the onboard track database and by trackside workers themselves.

Cyber security

Acorn's advanced system architecture allows clients to achieve a level of cyber security not easily reached by standard train controls systems. The system's components and software are sourced from multiple vendors, thereby limiting the risk of a vendor hack revealing system-wide vulnerabilities. If one component of the system is compromised, Acorn immediately isolates the affected software or hardware and alerts the driver.

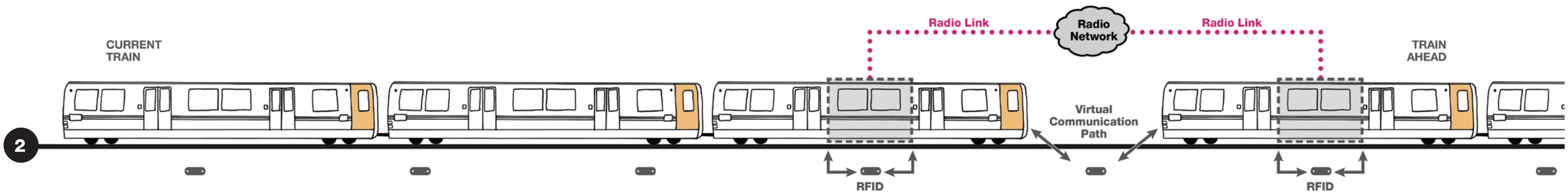
Keeping trains moving

Acorn's superior connectivity helps ensure that trains continue operating, even when the communications are comprised. Here's how:



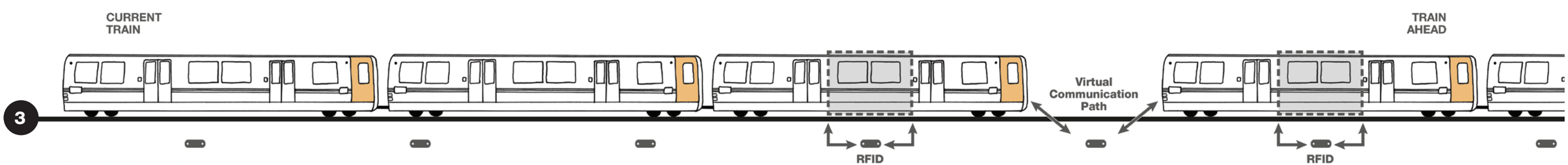
Mode 1: Normal operation

Trains maintain communication with the RCC, with other trains, and with the track-mounted RFID tags. All of these communication paths are used to determine train locations and to plan train behavior accordingly.



Mode 2: Reduced operations

In the event that trains have lost communication with the RCC, train-to-train communications and data from track-mounted RFID tags are used to determine locations and maintain service.



Mode 3: Degraded operation

In the event that trains have lost communication with both the RCC and with other trains, track-mounted tags continue to provide data that can be used to determine train locations and plan accordingly.

"By harnessing the power of proven technologies, Acorn virtualizes CBTC functions across the entire rail network. Acorn's virtual distribution model not only improves system availability to support autonomous train operation, it also dramatically reduces trackside infrastructure requirements, thereby cutting the cost and labor associated with the installation and maintenance of conventional CBTC systems."

Ken Garmson, Acorn's inventor

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