EMC & The Rail & Transit Industry

“A Growing Awareness”

Presented By:

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Outline

- Some History
- Trends & New Systems of Importance
- The EMI Model, Challenges & EMI Problems
- Typical EMC Compliance Programs
- Utilized Standards

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Some History

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- Very Electro Mechanical Device Dependent
- “Big Motors and Big Relays”
- And very reliable (something to remember moving forward)

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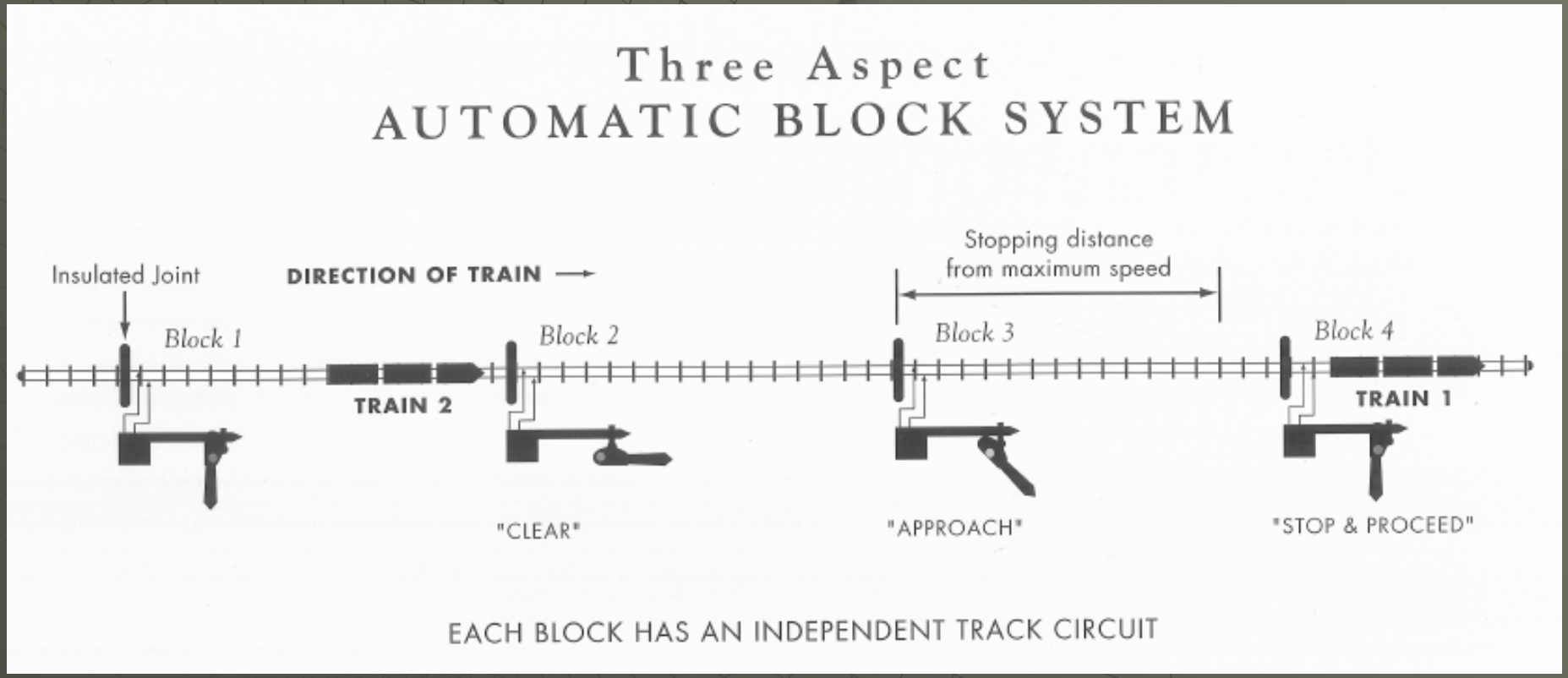
Signal System Simple & Effective



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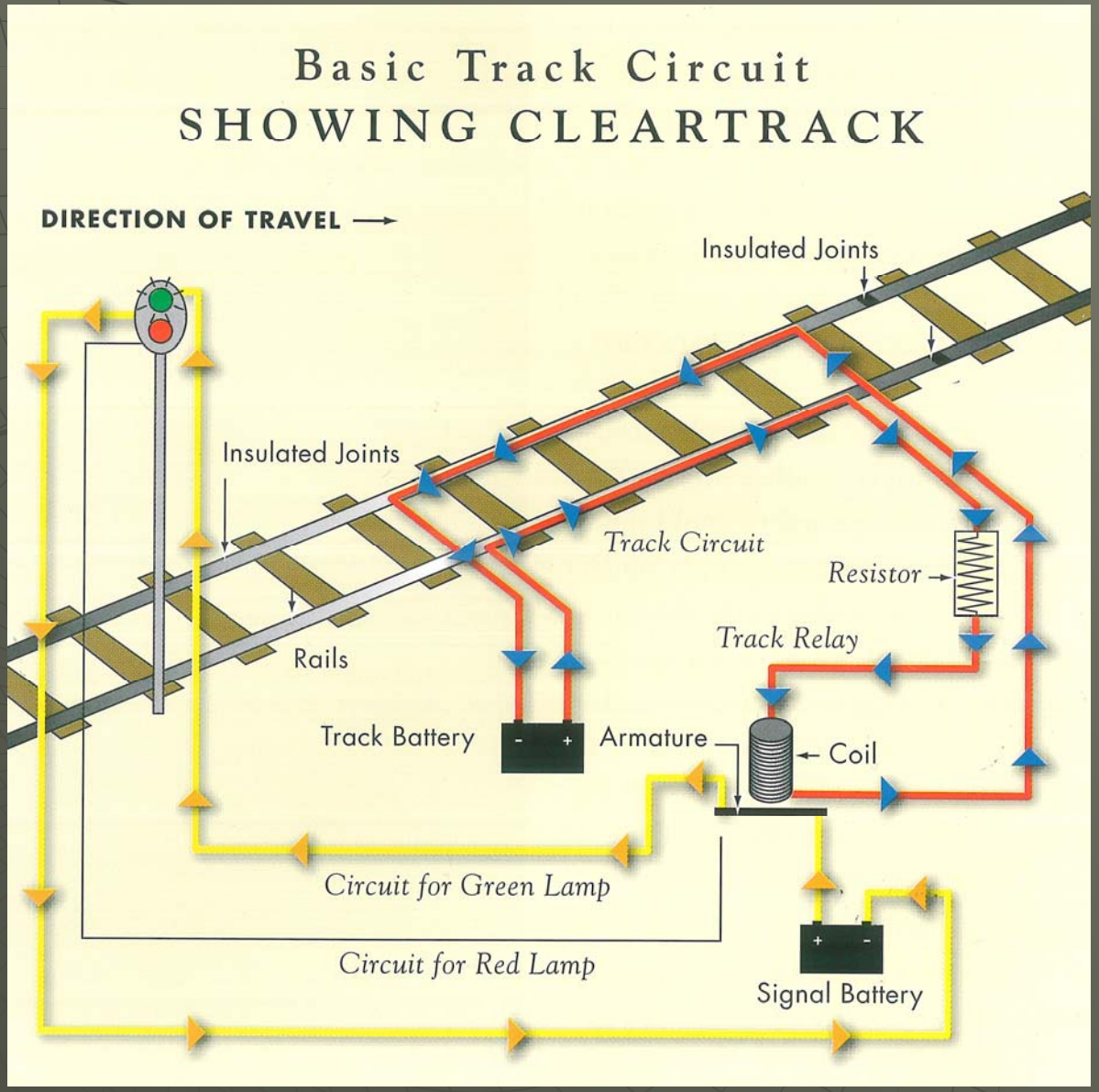

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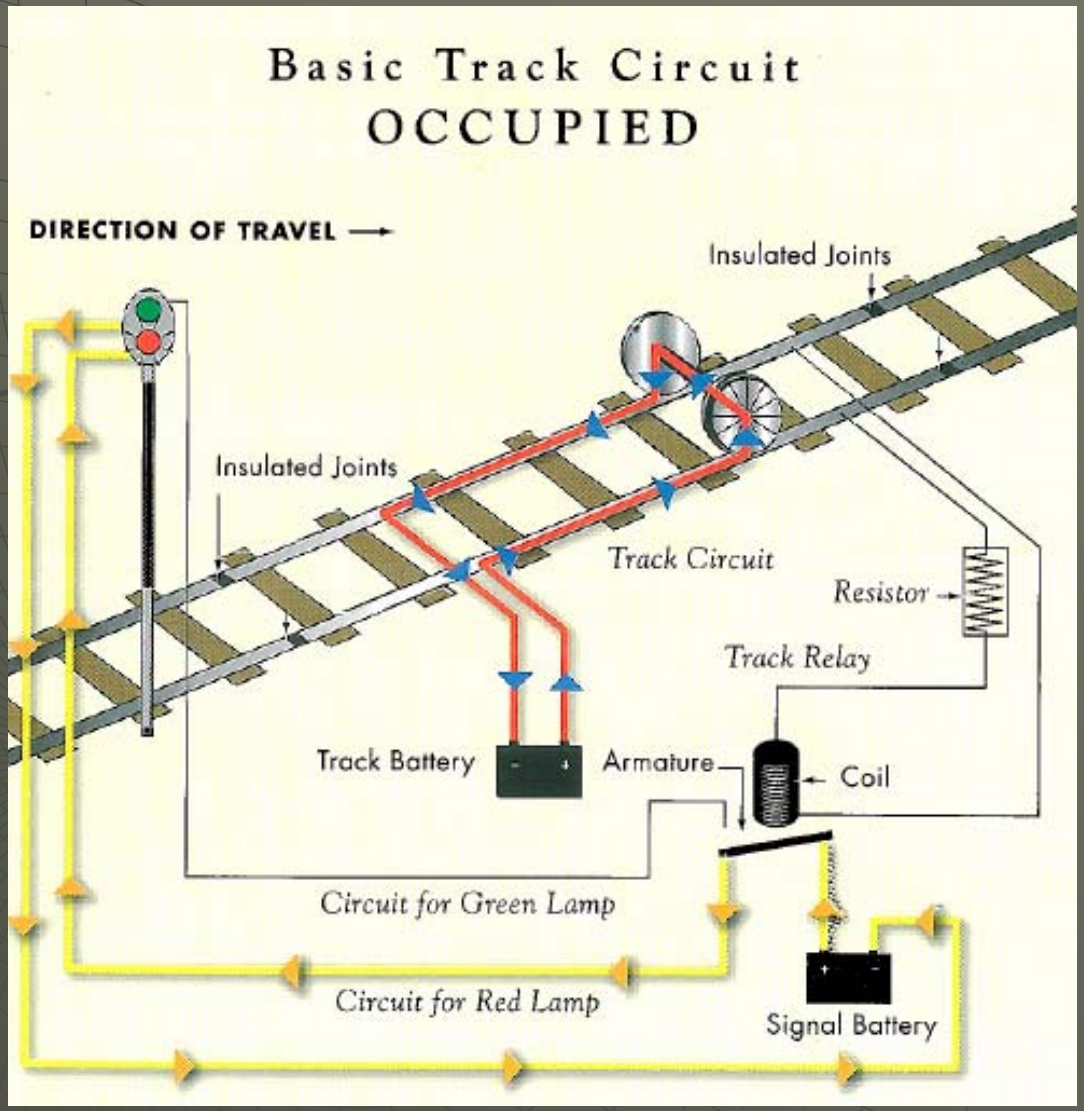

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The brains behind a signal system may be many miles from the hardware in the field. Banks of relays are required to make a signal system work. Some relays generate codes; others send commands to signals, switches, and other equipment in the field. Although modern signal-control equipment has been moving toward solid-state components, the proven reliability of traditional relays still makes them preferred equipment in many situations. Relays can function reliably for decades with minimal maintenance. Brian Soloman

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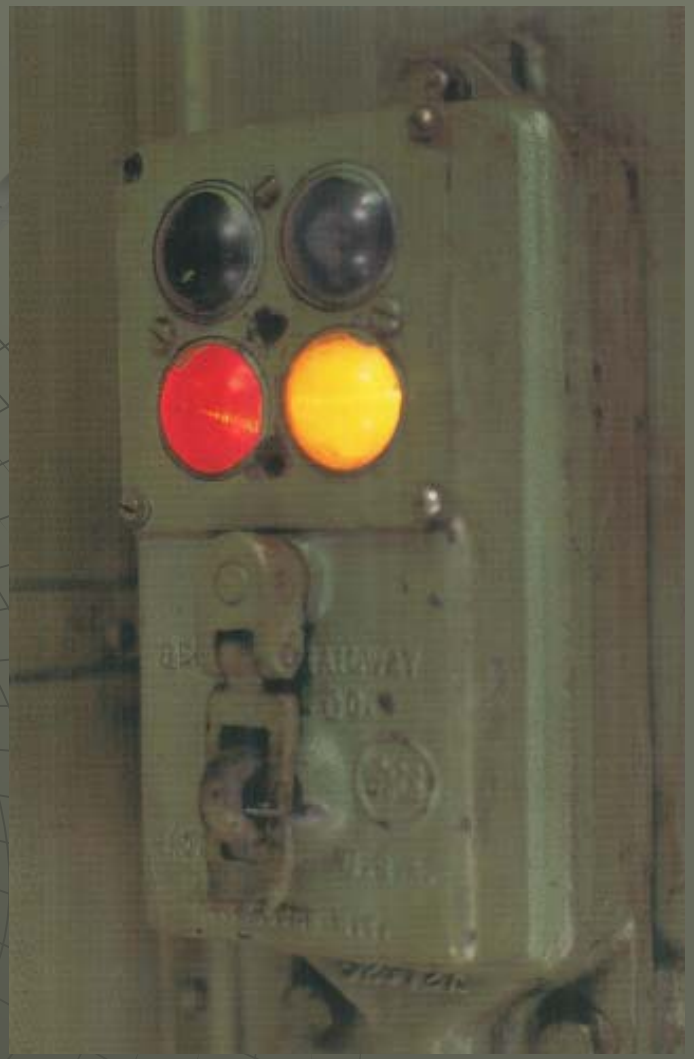
Early Improvements

Cab Signaling

- Established in the late 1920's
- Brought the signals into the cab
- Eventually matured into a speed control system
- Still in use today
- Signal code inductively coupled from the track circuits to sensors on the locomotive



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Cab signals have several benefits, including continuous signal visibility to a locomotive engineer, which greatly reduces the chance of a wayside signal being overlooked or misread. It gives the locomotive engineer peace of mind while constantly reminding him of the speed he should be traveling. In this case, a Metro-North GENESIS locomotive engineer is running on Rule 106, "Medium Cab." The cab signal indicator is the vertical white box on the beam between the windshields to the engineer's left. Inset: A Metro-North cab signal displays rule 105, "Limited Cab," which indicates "proceed at limited speed" (45 mph). With MN cab signals, engineers are not provided with route information and are expected to operate their trains in accordance with the speed dictated by cab signal aspects. In most places, the only wayside signals are at interlockings and terminals. Patrick Yough

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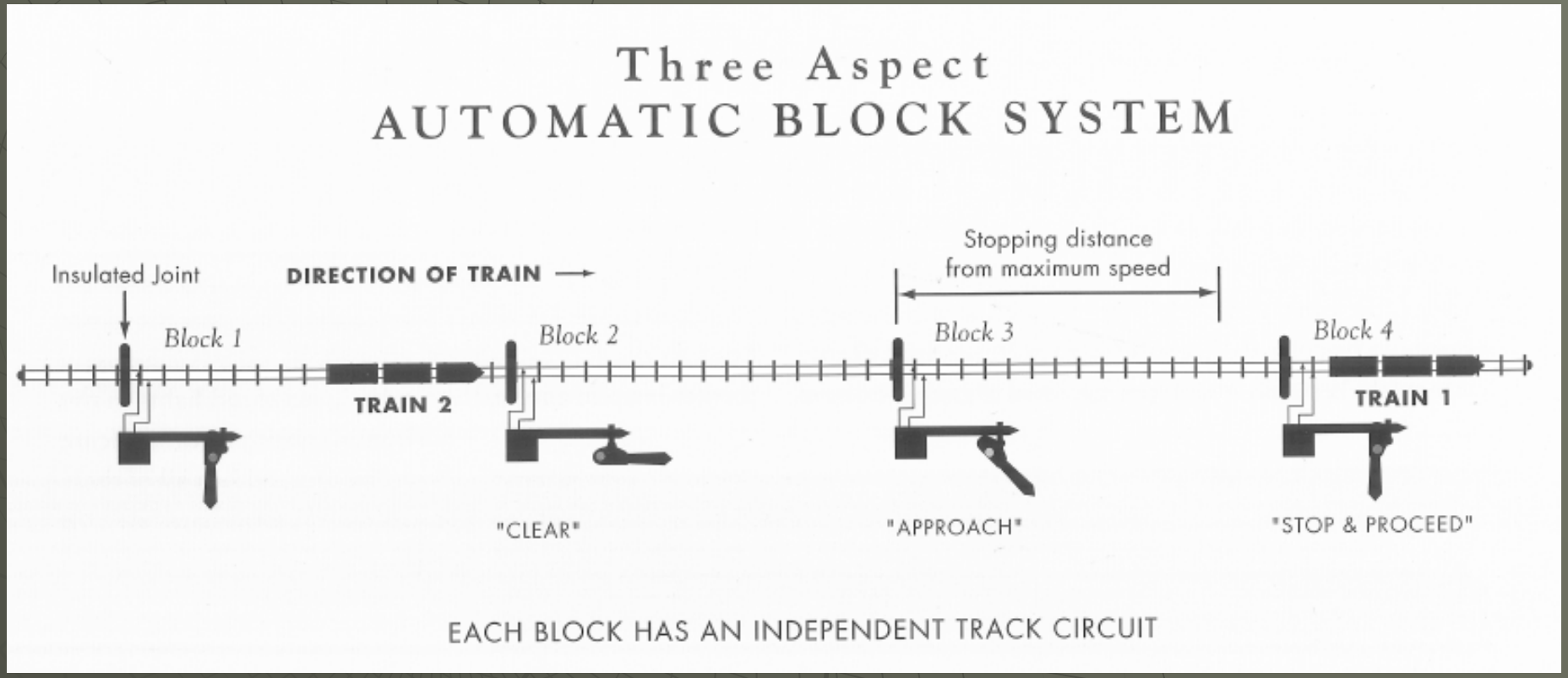
While Effective It Is The Problem



The Blocks Are Fixed

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New Systems of Importance & Technological Trends

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Solutions to “Fixed Blocks”

- Positive Train Control
- Communications Based Train Control

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Positive Train Control

A wireless train control system which controls "movement authority" ensuring train separation and collision avoidance, providing speed restriction enforcement.

(*Most Based on GPS Technology)*

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Communication Based Train Control

An automated control system for railways that ensures safe operation of rail vehicles using data communications between various control entities that make up the system

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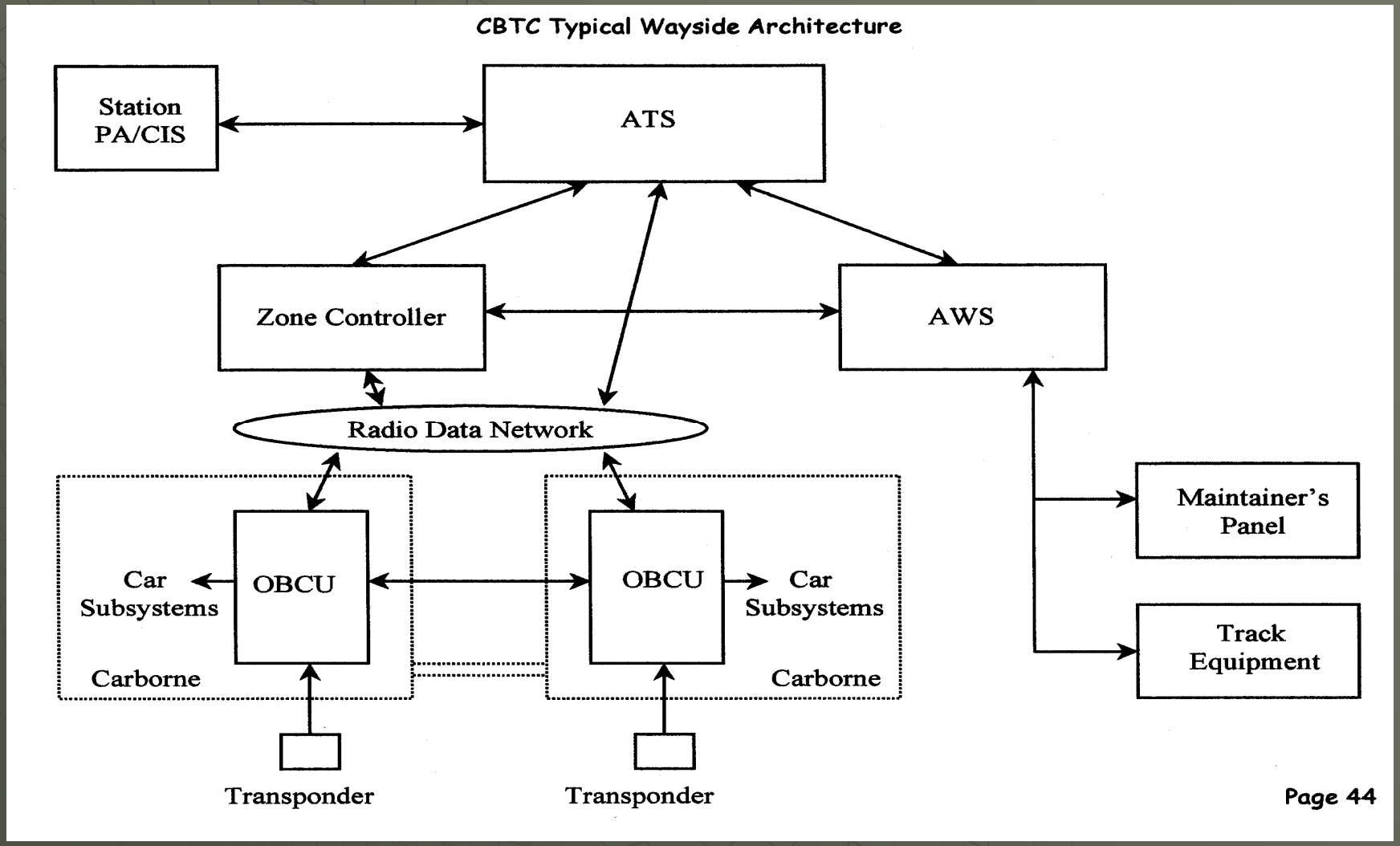

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Ongoing Technological Improvements

Trains Jan. 2009

>> TECHNOLOGY BRIEFS

FRA issues rules on ECP brakes

On Oct. 15, the Federal Railroad Administration issued a final rule on electronically controlled pneumatic brakes that establishes performance requirements and encourages implementation. ECP technology provides simultaneous and graduated application and release of brakes on all cars in a train, resulting in shorter stopping distances and enabling railroads to run longer trains that can operate at faster speeds.

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Ongoing Technological Improvements

Trains Feb 2009

Chillin' out en route

A cold, hard look at the progress of railroad refrigeration technology, inside and out

TrinityRail's TRINCool refrigerated car, inside and out. Note the Carrier refrigeration system unit (above). Two photos, TrinityRail

Refrigerator cars kept cold by ice were the norm when hauling fruits and vegetables by rail in the era long before the Interstate highway system gave an advantage to trucks. Railroads were unable to compete on service and, even after they upgraded from ice to mechanical refrigeration, refrigerated boxcars sat idle by the 1980s while trucks took the traffic.

Railroads attempted repeatedly to regain traffic, but were unable to overcome trucking's advantages: quicker transport and constant monitoring of the cargo. Truckers also didn't face the yard delays that railroads did.

But, in the '90s that disadvantage started to change through technology. Reefer manufacturer TrinityRail began contracting with air-conditioning giant Carrier Corp., which developed its Advance microprocessor to monitor and maintain temperature, airflow, and fresh air inside a railcar. Conditions for different commodities are pre-programmed, so at the warehouse, an operator uses a keypad to scroll to the name of the commodity, such as celery, push a button, and the system automatically provides optimal temperature and air distribution for that product.

It also enables two-way remote communication via satellite or cellular towers so that a shipper or a receiver thousands of miles away can check on and adjust temperature, airflow, and manipulate fresh air vents inside a car.

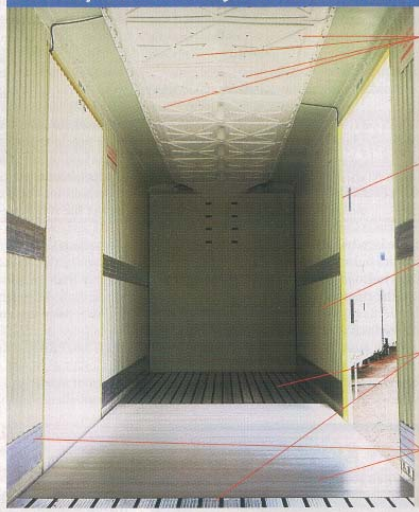
Here's how it works: Shippers at a new Railex warehouse in Delano, Calif., load peppers, grapes, or celery — all products that didn't travel by rail for half a century — into a unit train of Trinity's refrigerated boxcars. An operator selects the commodity loaded in each car from a list of options on a small keypad and moves on to the next car.

Once loaded, the train heads east over the Union Pacific. External temperatures can vary 60 degrees or more as the train leaves California's heat and passes through the cool mountains of Nevada and Utah, but the car's outer white reflective coating and its urethane foam insulation helps maintain temperatures inside without taking up a lot of space. The car's interior (shown above) is designed to keep air flowing, which enables tighter temperature control — to within 2 degrees of standard.

Once the train reaches Chicago, it's handed off to CSX, which hauls it to a Railex refrigerated warehouse in Schenectady, N.Y., for regional distribution. The cars continue to transmit information to shippers via wireless technology. Should temperature or any other of a number of measured parameters fall outside of acceptable limits, the system responds to restore ideal refrigeration for that programmed commodity.

So while today's reefers are giving trucks a run for their money, future railcars are just going to get cooler and cooler.

TrinityRail's refrigerator car features



- Small holes in the plenum direct high velocity airflow through and around commodity.
- Urethane foam creates thermal barrier without sacrificing inner space.
- Corrugated walls increase air circulation.
- Slotted floor increases air movement, minimizing contamination from prior loads between clean-out.
- Interior surfaces resistant to fork or clamp truck and pallet impacts.

Wireless technology enables remote communication between a railcar and shippers via the Advance microprocessor. Carrier

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The EMI Model, Challenges & EMI Problems

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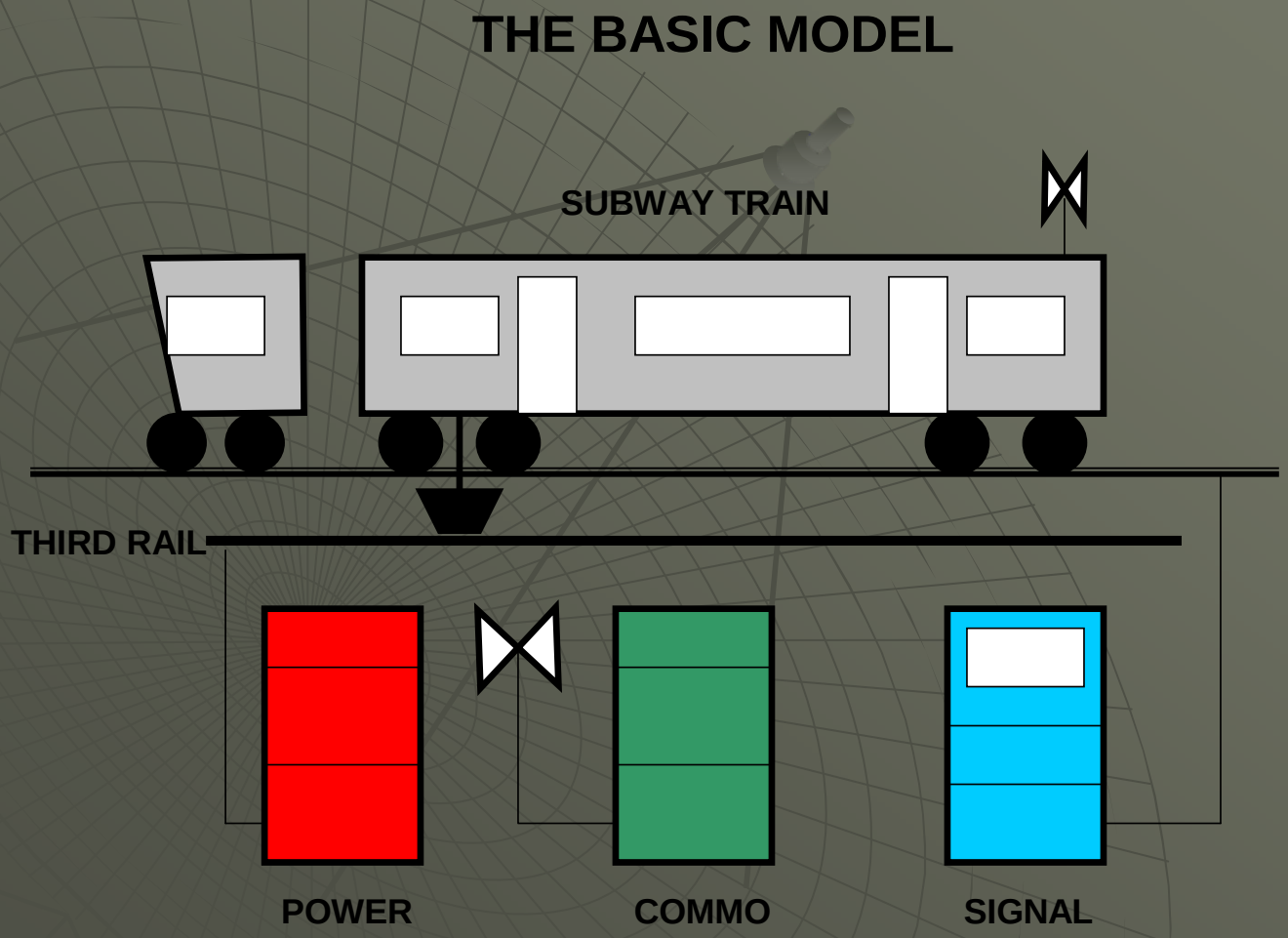

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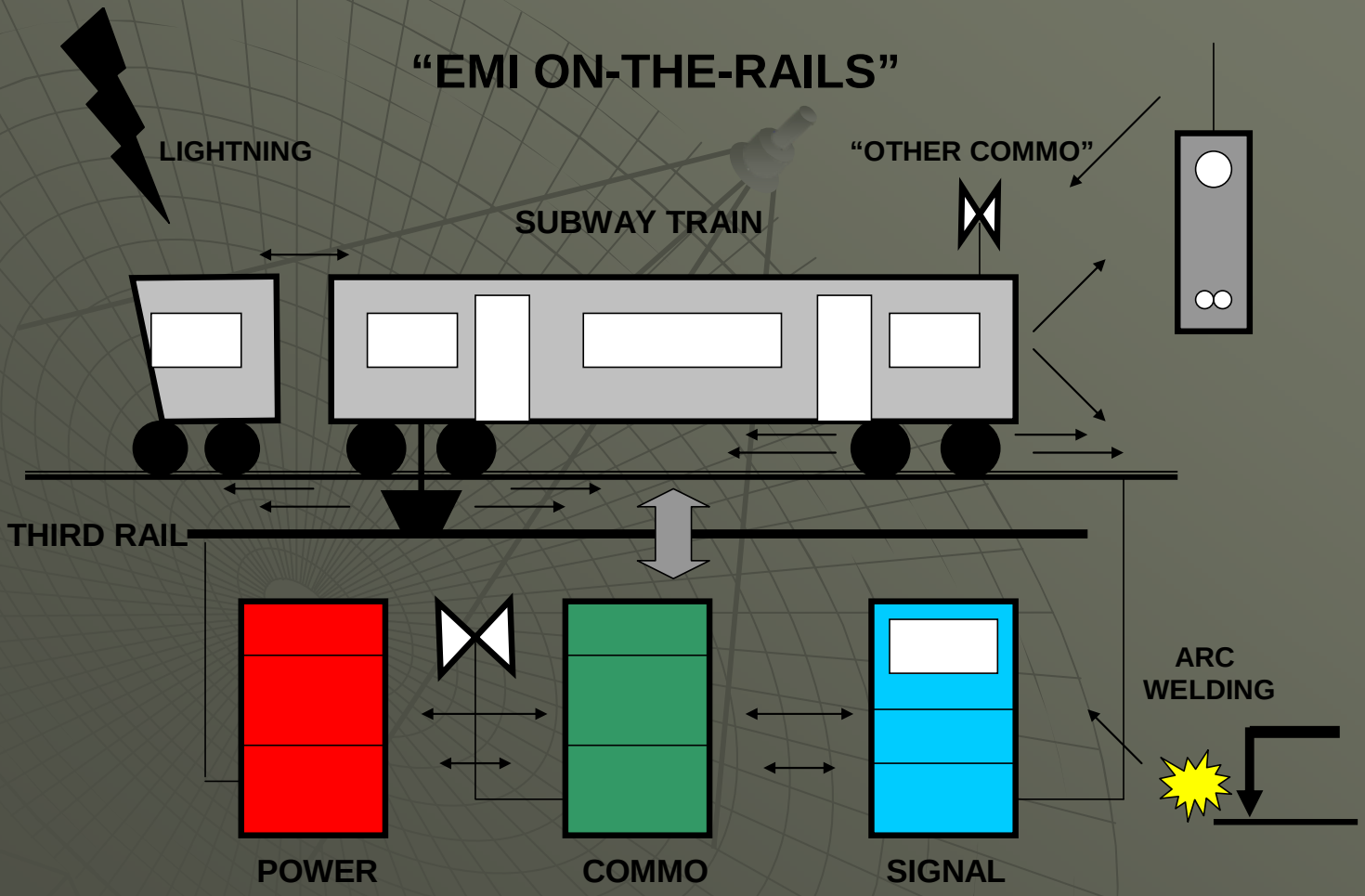

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EMI Problems

- Display Monitors in NYC Financial District being impacted by passing NYC Subways.
- New Electronic Speed Controls on Light Rail cars interference with signaling circuits.
- Power transfer switches being tripped with walkie talkies

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EMI Problems

The Examiner

Metro set to fix doors on oldest, 'uncrashworthy' rail cars

By: Kytja Weir
Examiner Staff Writer
September 23, 2009

Metro is planning to spend more than a half-million dollars and take more than two years to upgrade the doors of a series of rail cars that federal investigators told the transit agency to get rid of three years ago.

The agency needs to hire Alstom, which made the cars' automatic train controls, to add some hardware to stop electromagnetic interference that caused the doors to open when running in automatic mode, he said. The trains have been operating manually since the crash.

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EMI Challenges

- Harsh industrial environment – vibration, metal dust, salt fog, urban issues
- Many known radiators – police & fire communications, arc welding, ISM issues on or near the property
- Ongoing maintenance issues that can defeat EMI controls, such as proper grounding and shielding
- Lack of EMI awareness

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What has the industry done?

- National Associations (AREMA) has become more active and established committee and is involved in standards writing activities
- FRA also involved with Federal Rule Making
- The American Public Transportation Association (APTA) has developed a standard for EMC Compatibility Plans
- BUT NYCT has been in the lead.

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Typical NYCT EMC Compliance Program:
Based in:

- “Forced” Awareness
- Site Surveys
- Laboratory Testing
- On Site Compliance or Compatibility Testing
- Education

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Forced Awareness:

- Assignment of a EMC Project Engineer
- Development of EMC Documentation

1. Management Plans
2. Implementation Plans
3. Control Plans
4. Grounding, Shielding, Filtering Plans
5. Site Survey, Laboratory & Final Compatibility Test Procedures

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Site Surveys

Site Surveys are performed primarily for use in evaluating and potentially modifying laboratory test limits.

Both Radiated and Conducted Measurements are taken

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Typical Site Survey Test Setup

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Typical Site
Survey Test Setup

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Laboratory Testing

Testing has been based in three areas:

- Mil-Std-461E (Army Ground Support)
- FCC Part 15
- IEC ESD Testing

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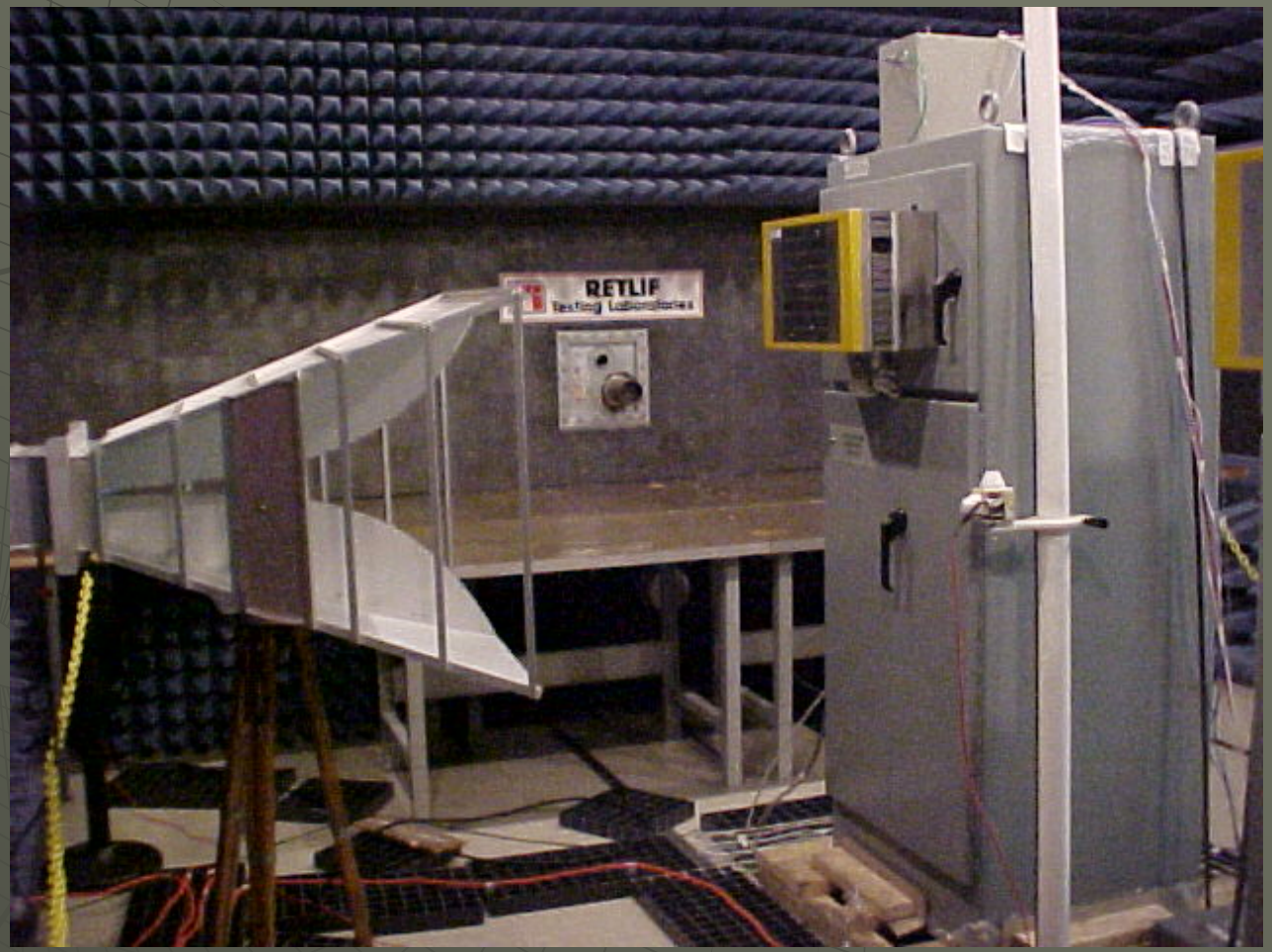
Typical Mil-Std Test Setup



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On-Site Compliance/Compatibility Testing

Based Primarily on the compatibility of the installed systems with various forms of NYCT and “other” communications

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Forms of Communications Used:

- NYCT Maintainers Radios
- Traditional Cell Phones
- “Potentially” Police and Fire Radios

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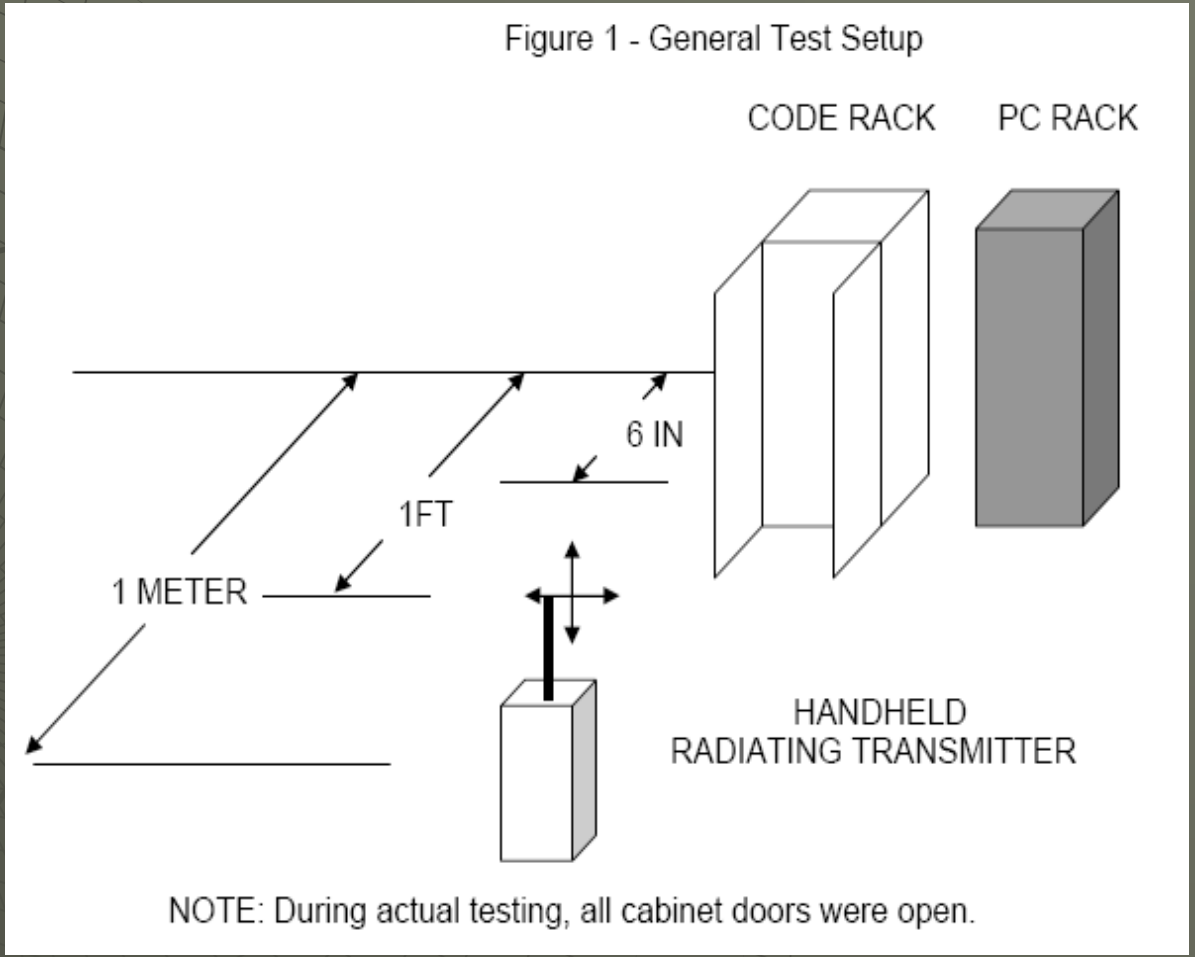
Final Compatibility Test Setup



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Typical Final Compatibility Test Frequencies

Table 2 - Test Transmitters

OPERATING FREQ (MHz)	MODEL NO.	MANUFACTURER	DESCRIPTION	POWER OUTPUT
154	MT1000,33GCU7100AN	MOTOROLA	VHF COMMUNICATIONS	5.0 W
460 - 470	JBX-455	RITRON	UHF COMMUNICATIONS	5.0 W
806 - 825	i90c	NEXTEL	CELL PHONE iDEN MODULATION	0.6 W
806 - 821	MTX 8250	MOTOROLA	UHF COMMUNICATIONS	2.5 W
1900	VI660	SAMSUNG	CELL PHONE DIGITAL	0.293 W
2400	27925GE3-A	GENERAL ELECTRIC	WIRELESS PHONE SPREAD SPECTRUM	0.05 V/M @ 1 meter
5800	25838GE3-A	GENERAL ELECTRIC	WIRELESS PHONE SPREAD SPECTRUM	0.5 V/M @ 1 meter

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Typical Test Points For Final Compatibility Testing

Table 1 - Test Scans

Test Surface	6 Inch Scan	1 Foot Scan (If necessary)	1 Meter Scan (If necessary)	Threshold Distance (If necessary)
Code Cabinets	X			
PC Cabinets	X			
UPS Racks	X			
Maintainers Panels	X			
Automatic Transfer Panels	X			
Power Racks	X			
Ground Detector Racks	X			
Master Tower Control Panel	X			
3rd Rail Indication Panel	X			
Trouble Indication Panel	X			
Dispatcher Indication Panels	X			

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A Quick Comment on Locomotives & Powered Units

Urban Mass Transit Association (UMTA) Standards

- Track and Radiated Measurements to ensure no interference with track circuits and wayside
- “Of late” include Final EMC Compatibility Testing with Communications Equipment

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Education:

- There is an EMC educational component in each and every NYCT signal equipment upgrade contract.
- It mandates training for both NYCT and Vendor personnel.

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Education:

Sample NYCT Contract Requirements

2.9 EMI/EMC Training Course

a. The EMI/EMC engineer or his approved representative, shall conduct a course on EMI/EMC control, design and the EMI/EMC requirements, to designated personnel of each of the organizations performing design work and installation work on this Contract and 35 Authority personnel.

b. The EMI/EMC engineer or his approved representative, shall conduct a two (2) day course on Testing and Certification of Wireless Devices given by National Technical Systems, to designated personnel of each of the organizations performing design and installation work on this Contract and 35 personnel from the Authority.

b. The Course shall be conducted on two days, one day for the Authority personnel and one day for the Contractor personnel. The course shall be given at a Contractor provided location within New York City, within 120 days after the notice of award.

c. The training program shall consist of all major topics that are included in the EMI/EMC Compliance Program. Furnish four (4) instructor's guides for NYCT's future training requirements in accordance with Sections 17C and 17V. Furnish a participant's guide to every attendee in accordance with Sections 17C and 17V. The instructor shall use audio/visual training aids, as well as lecturing the trainees. The training session shall also include hands-on training for all specialized equipment and procedures required to perform EMI/EMC field and laboratory testing.

d. The Contractor shall furnish training in accordance with Sections 17C and 17V. The Contractor's attendance list, location and dates of the course shall be submitted with the EMI/EMC Compliance Program for approval of the Engineer.

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Education

Sample NYCT Contract Requirements

2.10 EMI/EMC Video

a. The Contractor shall prepare a thirty (30) minute video DVD on EMI/EMC fundamentals. The training video shall explain:

1. The dangers of no EMI control.

2. Threats from electronic terrorism.

3. Benefits of EMI control.

4. General EMI/EMC Concepts.

5. EMI/EMC Program Requirements:

- EMC Management
- EMC Control
- EMC Implementation
- EMC Testing
- EMC Grounding
- EMC Cable Routing

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Some Closing Thoughts:

1. Economic, Cultural and Regulatory Needs will continue to pressure the Rail and Transit sector.
2. Technology will continue to impact this industry sector as the need for improved technology increases.
3. EMC “issues” will continue to grow, however awareness will also grow.

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Some Recommended Reading:

Railroad Signaling

By: Brian Solomon

MBI Press

A Recommended Course: (3 day)

Engineering Fundamentals of

Rail Transit Passenger Systems:

Light Rail, Commuter Rail, Rapid Transit

University of Wisconsin, Madison

Department of Engineering Professional Development

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Thank You!!!

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