

Interoperable Communication- Based Signaling (CBS): Vital PTC

Midwest Regional Rail Initiative

PTC Symposium

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Topics

- ◆ Update MWRRI on status of project to specify and develop an Interoperable Communication-Based Signal System (ICBS)
 - Background
 - Development of AREMA Manual Parts
 - Basic System Architecture and Operational Goals
 - Federal Railroad Administration Demonstration and Test Project

AREMA

- ◆ American Railway Engineering and Maintenance of Way Association
- ◆ Communications and Signal Group is responsible for Manual of Recommended Practices published annually
- ◆ Richard Bowden (Asst Director of Signals, BNSF) is C&S Group Vice President for AREMA

AREMA Committee 37 (Signal Systems)

- ◆ The purpose of AREMA Committee 37 is to continually review current and new technology addressing the design, installation, testing and maintenance of signal equipment and systems and develop recommended "industry practices" with the overall goal of improving the safety and reliability of train operations.
- ◆ Chaired by Vic Babin (Chief Electrical Engineer, NICTD)

Background

- ◆ Roundtable discussions at 2005 AREMA C&S show generated request for interoperability guidelines for radio-based cab signal systems
- ◆ Assigned to Committee 37-3

Preliminary Meeting

- ◆ Assignees invited AREMA members to explore potential of defining interoperability.
 - Suppliers who have demonstrated desire for safety-critical (vital) radio-based signal systems with aspect display onboard
 - ◆ Alstom (Atlas), GETS (ITCS), Safetran (vTc), US&S (AKRR CAS).
 - Was there any hope of achieving consensus on architecture and interoperability?

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 - **AMAZINGLY, YES**

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 - GETS, Safetran and US&S decided to actively support development of manual parts

Group Members

◆ Safetran

- Jim Hoelscher (Staff Engineer), Bill Petit (VP Technology (at the time))

◆ GETS

- Jeff Baker (Product Mgr Adv Train Control), Daryl Seck (Product Mgr)

◆ US&S

- Chinnarao Mokkalapati (Chief Technologist), Denny Pascoe (Chief Technologist)

Group Recommendations

- ◆ Develop recommended practices for interoperability of communication based signaling systems based on signaling philosophy and practices consistent with other sections of the AREMA manual.
- ◆ Allows an opportunity for existing projects (e.g. overlay systems) to integrate with an interoperable vital signal system
- ◆ Committee 37 approved plan to develop a series of proposed manual parts related to CBS at Spring 2006 meeting.

Proposed Manual Parts

- ◆ 23.2 CBS System Requirements
- ◆ 23.3 CBS System Design Guidelines
- ◆ 23.4 CBS System Interoperability Requirements
- ◆ 23.5 CBS Infrastructure Database

Section 23.2

- ◆ 23.2.1 Recommended Functional Requirements of a CBS System.
 - Define the recommended system functional requirements.
- ◆ 23.2.2 Recommended RAMS, Environmental and Other Requirements for Signaling Systems Using CBS Architecture.
 - Define the recommended reliability, availability, maintainability, and safety (RAMS), environmental, electromagnetic compatibility, and quality assurance requirements.

Section 23.3

- ◆ 23.3.1 Recommended Design Guidelines for a CBS System
 - Define the recommended system architecture and interfaces based on conventional signaling principles.

Section 23.4

◆ 23.4.1 Recommended Communications Protocols for a CBS system

- Define the recommended system communication protocol (based on ATCS addressing and datagram)

◆ 23.4.2 Recommended Communications Messages for a CBS System

- Define the recommended standard messages for communications between CBS subsystems

Section 23.5

- ◆ 23.5.1 Recommended Onboard Database Guidelines for a CBS system
 - Define the recommended structure and content of the onboard database

Status

- ◆ Drafts of the proposed new manual parts have been developed.
- ◆ Provided to Committee 37 for full review at Fall 2006 meeting. Comments were collected and reviewed.
- ◆ Committee agreed to send drafts for ballot at Fall 2007 meeting (currently being balloted)
 - Will be published in Fall 2008 if approved.
- ◆ Committee also approved sharing drafts with AAR committees working on interoperability



Basic System Architecture

What is CBS?

Defined Communications Based Signaling as 'a radio based cab signal system'.

- Operate the same as a conventional Cab Signal System with enforcement. Onboard aspect display instead of wayside signals
- "Virtual" Block Occupancies used instead of physical track circuits.
- Train location determination done by on-board equipment (Definition of how to indicate a block is occupied, not how position is determined).
- Communication, including cab signal aspect transmission from wayside to trains, via a digital data communications network.

What is CBS?

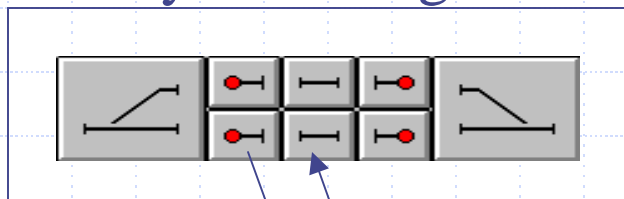
- ◆ CAD operation (i.e dispatching) is the same as in conventional CTC system.
- ◆ Signal Logic Processor (SLP) does all the vital logic and sends controls to wayside appliances and signal aspect info to the On Board Logic Processor (OBLP).
- ◆ OBLP provides signal aspect and speed limit info to train operators, and performs vital overspeed protection and signal enforcement.
- ◆ SLP also processes Bulletins received from CAD via Form Translator, and communicates them to various OBLPs.
- ◆ Interlocking logic is done in SLP or locally at the wayside.
- ◆ Communication follows ATCS protocols over a wide variety of transmission media

Existing cTc Territory

Control Office

Controls and Indications

Wayside Bungalow



CBS in existing
Dark Territory



Control Office

Controls and Indications

Proceed Aspect

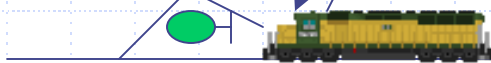
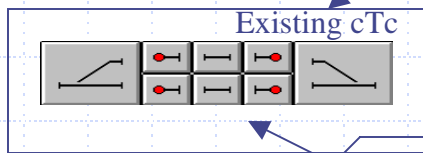
Occupying Block 123





CBS overlaid on
cTc



Control Office
Controls and Indications





Basic System Operational Goals

Key Goals and Benefits of CBS System

(Highlights Only – See AREMA paper on www.BillPetit.com for complete list)

- Improve Safety
- Reduce Cost
- Interoperability
- Based on Signaling Principles and Existing Vital Platforms
 - ◆ Each RR defines their own operating scenarios through application logic
 - ◆ Regulatory Acceptance
- Not dependent on underlying method of operation for safety – allows change in method of operation
- Common, well known method of operation across entire territory

Enhanced Safety Features

- ◆ Continuous overspeed protection
- ◆ Safe movement of trains throughout the territory
 - Route protection based on signaling principles
 - Vital monitoring of all wayside appliances
 - In-cab display reduces wayside signal reliance due to weather, etc
- ◆ Reduced train collisions
- ◆ Protection of roadway workers
- ◆ Reduces human error from movement authorities / train orders / track warrants
- ◆ Incorporate other wayside elements into signal protection system

Reduced System Costs

Reduced Equipment Costs and Reduced Labor to Operate, Install, Maintain and Test

- Cost-effective upgrade of currently non-signaled territory to radio-based cTc operation.
- Cost-effective upgrade of wayside signal systems to onboard displays with enforcement.
- ◆ Ability for shorter virtual blocks allows better following moves, improved throughput
- ◆ Enhanced Number of cab signal aspects allows better movement control and throughput.

Interoperability

- ◆ Industry association (AREMA) defined and maintained
 - Defines interfaces between equipment and basic system architecture, not form or fit.
- ◆ Developed jointly by multiple suppliers, consultants, users and regulatory representatives through Industry committee
- ◆ Availability from multiple suppliers
- ◆ Open Interface – no barriers to entry
- ◆ Based on existing open ATCS protocols (upper layers, not physical or network specific)
- ◆ Open system with multiple users leads to stable operation and increased functionality
- ◆ Maintains cost competition from multiple suppliers

Use of Signaling Principles and Existing Vital Platforms

- ◆ Operations controlled by each railroad
 - Application Logic is written by each railroad according to their own preferences.
 - Minimizes training and rule changes
- ◆ Not dependent on underlying method of operation for safety
 - Change underlying method of operation
 - Pathway to replacement of wayside systems as they become life expired

Use of Signaling Principles and Existing Vital Platforms

◆ Regulatory Acceptance

- Ability to qualify under 49CFR part 236, including subpart H
 - ◆ Based on proven and accepted signaling principles
 - ◆ Based on proven and accepted safety-critical platforms
 - ◆ Use of existing principles reduces HF issues
- Builds on existing knowledge base of S&C employees
- Familiarity of concepts



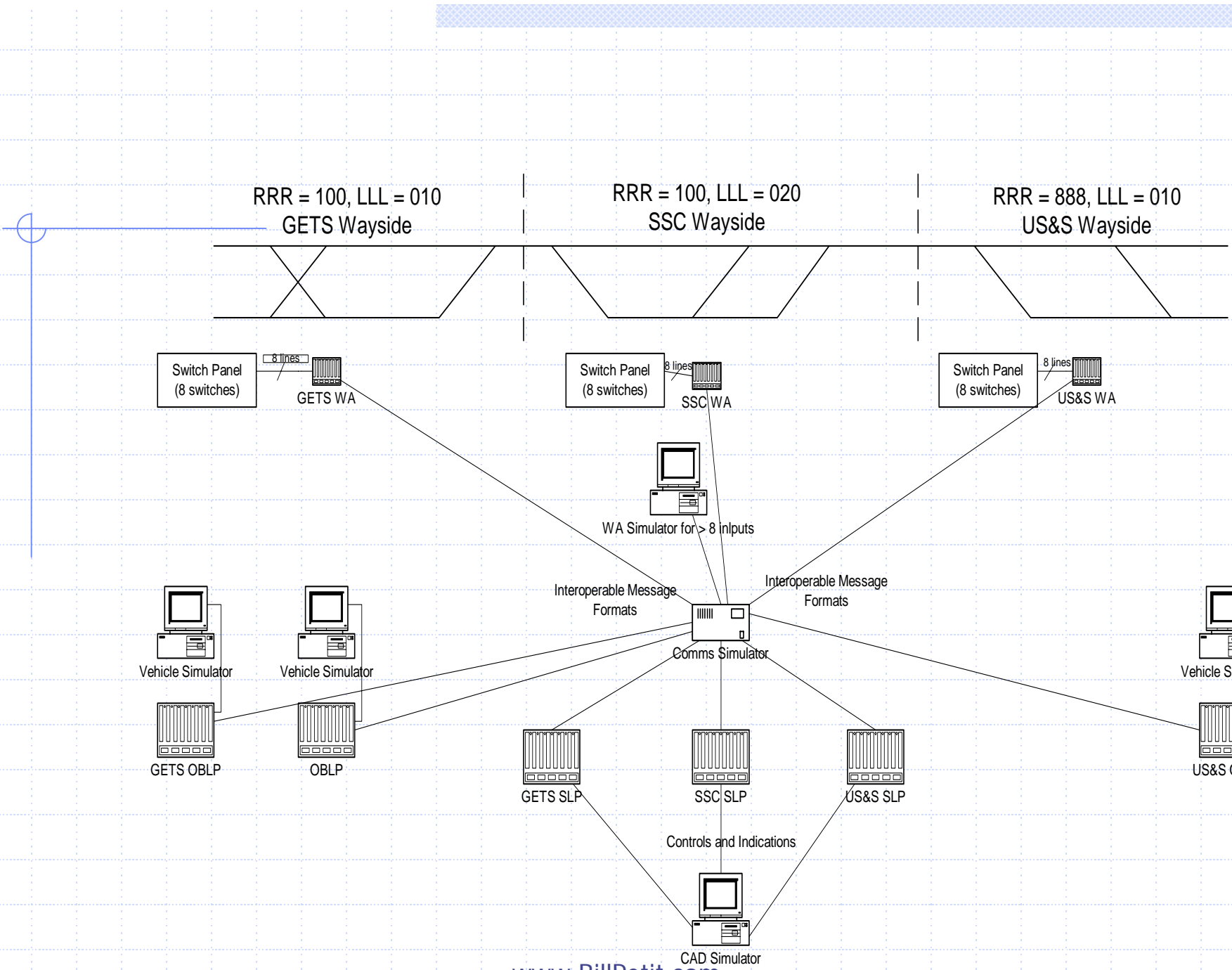
Interoperability Demonstration Project

FRA Interoperability Tests

- ◆ Note that this is independent of AREMA
- ◆ FRA Office of RR Development approved grant to further the goals of ICBS
 - Verify interoperability MP's and demonstrate overall system operation
 - Being done through a Cooperative Agreement through FRA and Railroad Research Foundation (RRF)

FRA Interoperability Tests

- ◆ RRF has subcontracted the following efforts
 - Project Management – Bill Petit
 - Test Environment – Critical Link
 - ◆ Simulators and Overall Test Environment
 - Equipment Supply
 - ◆ GETS, Safetran and US&S will each modify their own products to demonstrate interoperability.
 - ◆ Alstom will participate at their own expense.
 - Testing scheduled for completion end of 2008



Questions / Comments ?

"I was gratified to be able to answer promptly, and I did. I said I didn't know."
(Mark Twain)

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