Federal Railroad Administration
Research and Development
Program Review

Highlights of R&D Activities for PTC Implementation

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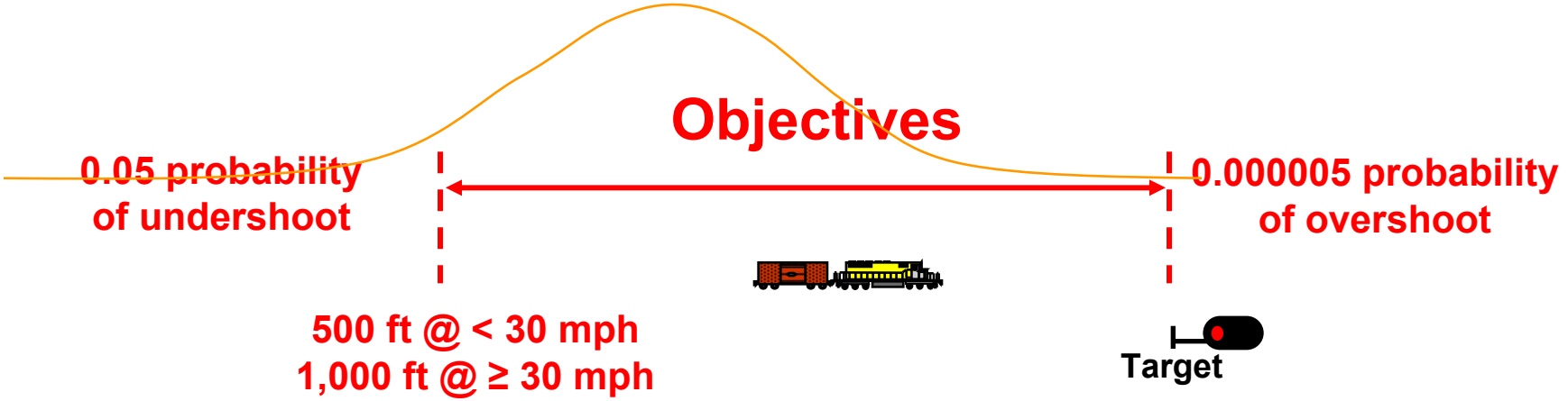
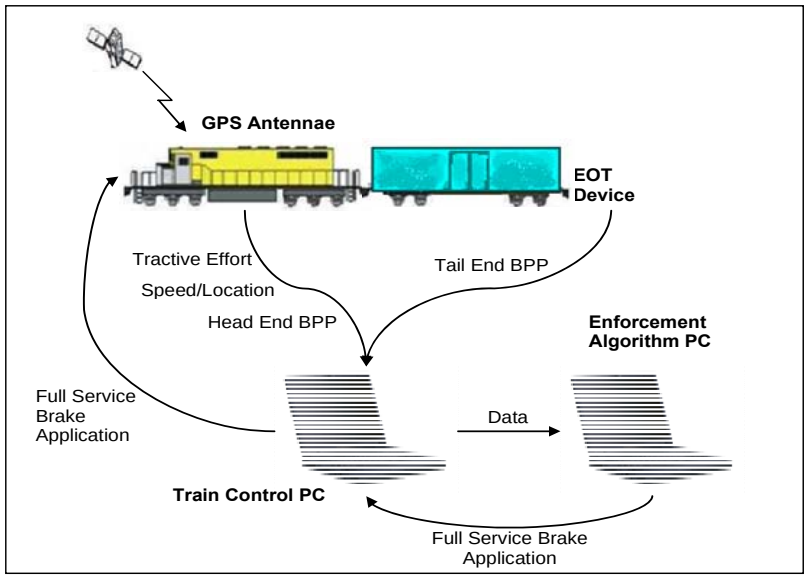
PTC Implementation Related Projects

- Adaptive braking algorithm
- Employee-in-charge portable terminal
- Support for communication spectrum and throughput improvement
- Communication protocol testing
- Interoperable communication-based signaling project
- Data security
- Universal on-board platform
- High accuracy GPS tracking
- Risk assessment methods

Adaptive Braking Algorithm

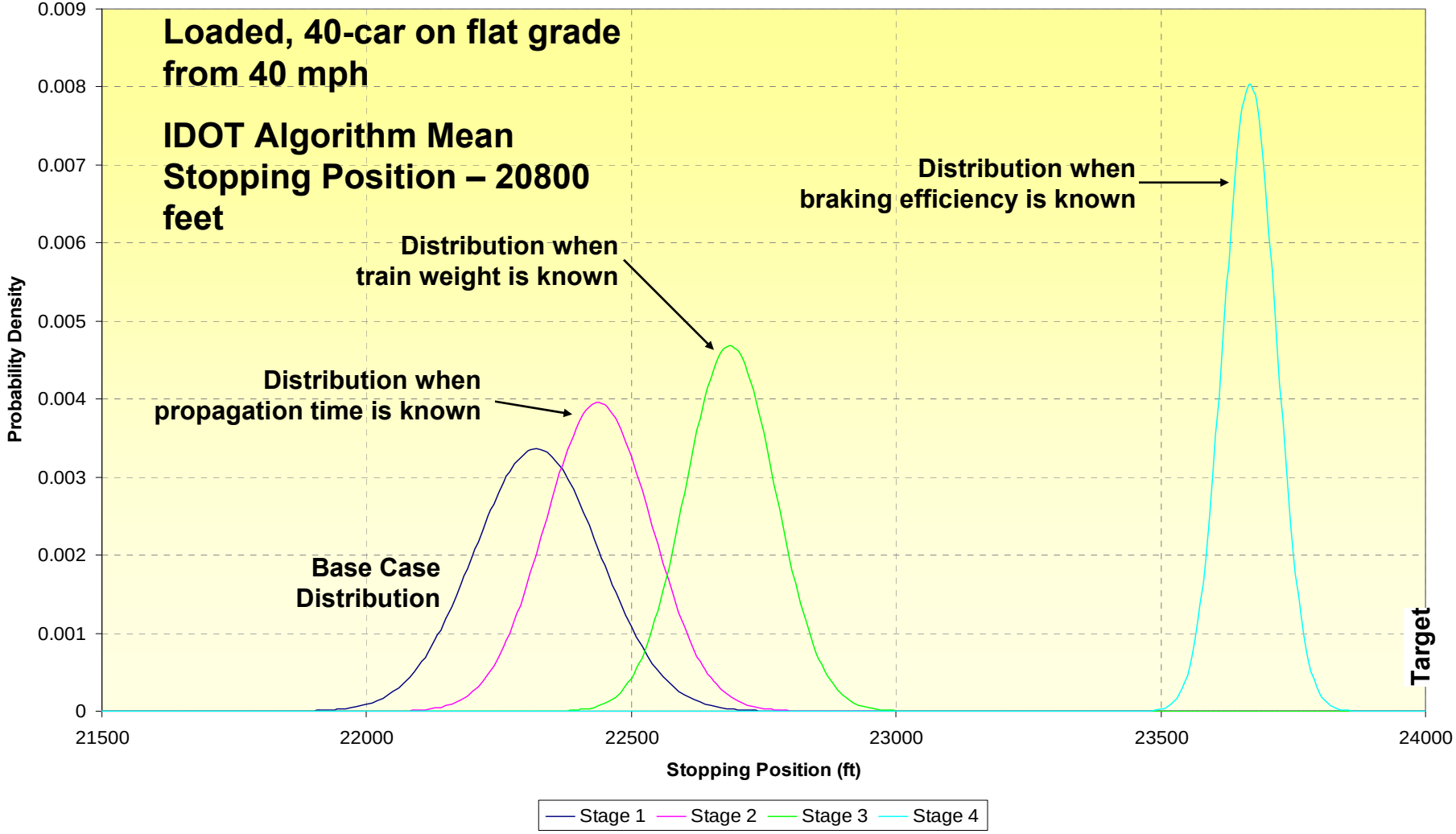




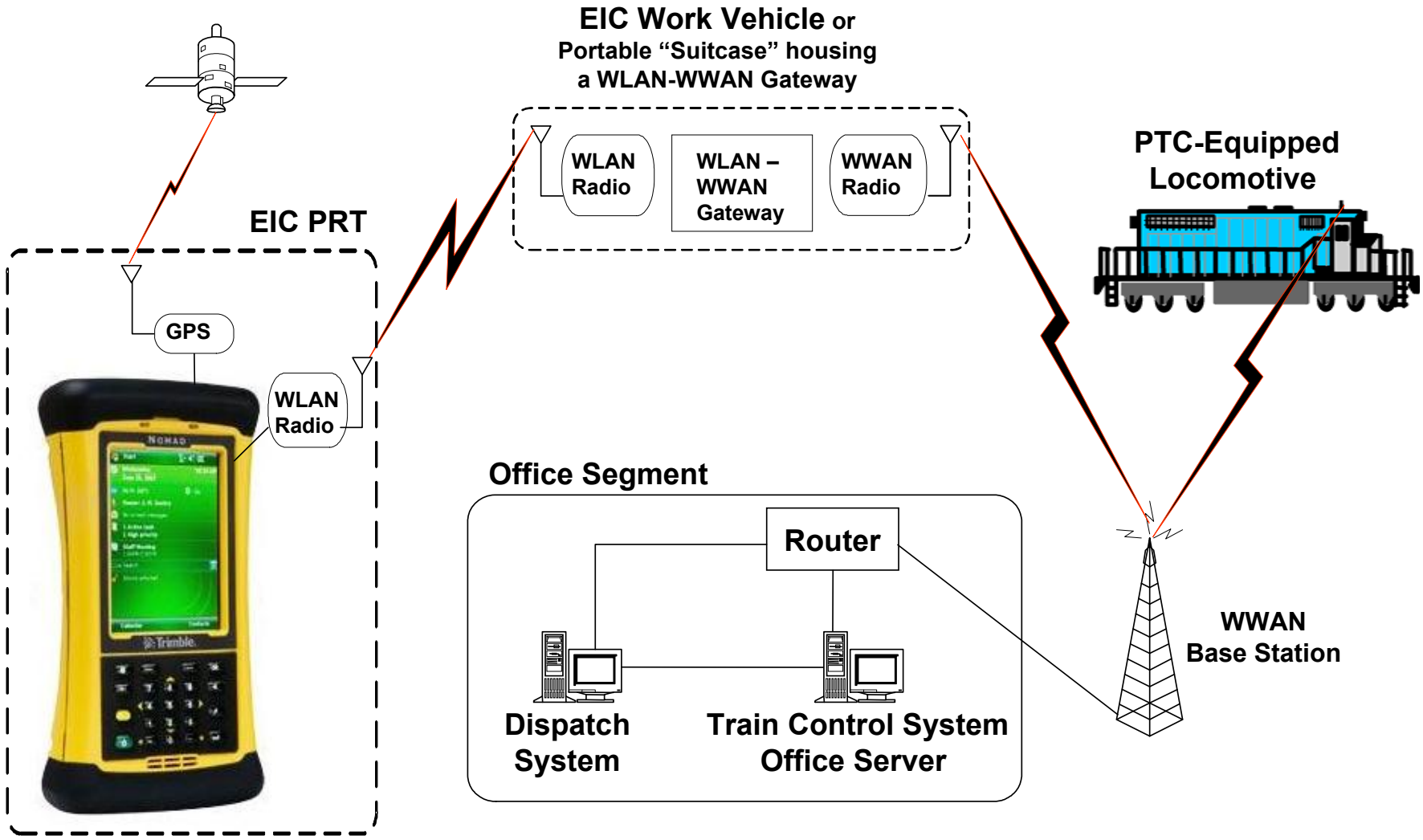
With Close-loop Iterations, zero-in

-Brake Propagation Rate
-Accurate Train Weight
-Brake Efficiency

Adaptive Braking Algorithm



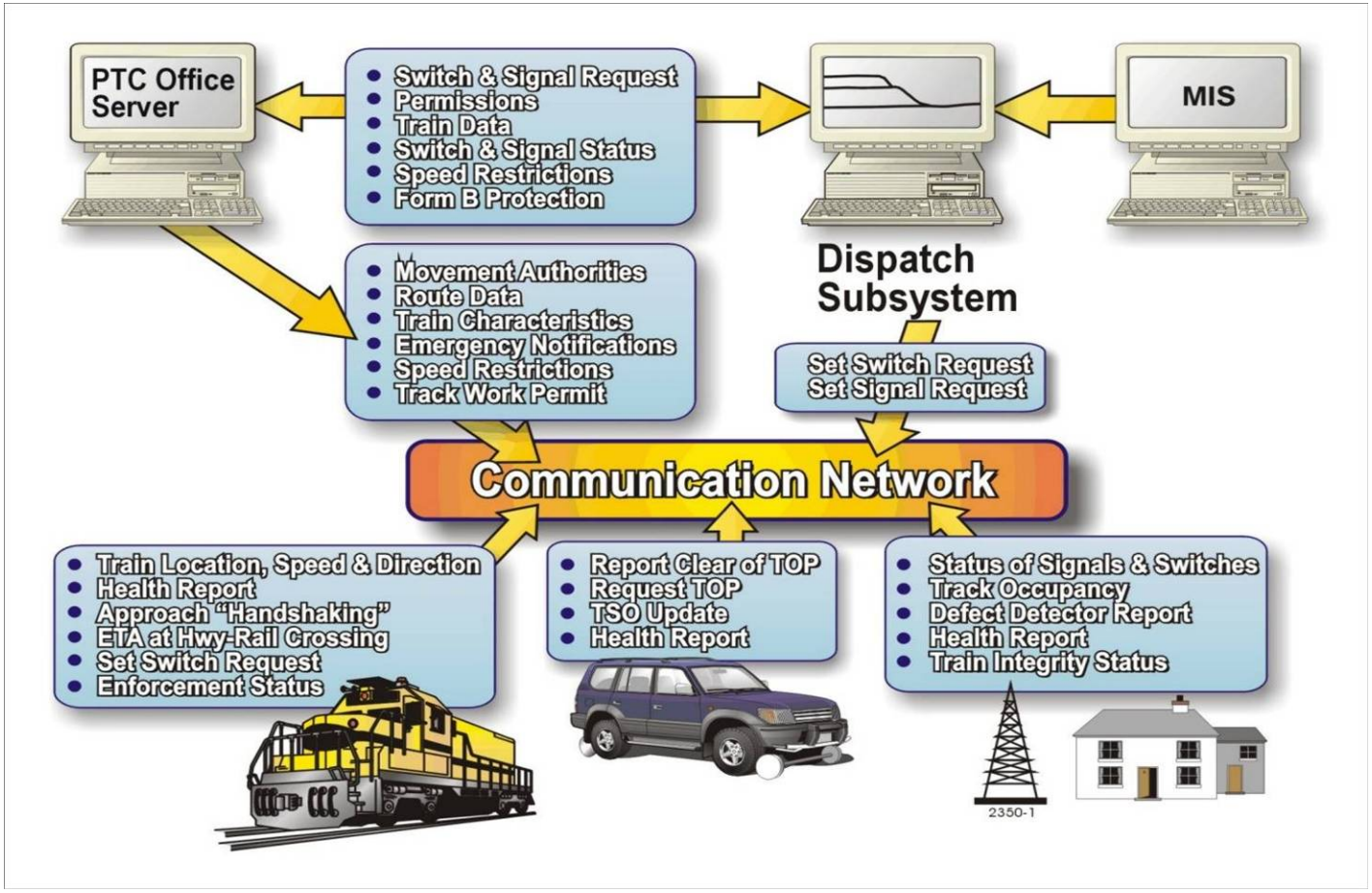
Employee-in-charge Portable Terminal



Employee-in-charge Portable Terminal

- Proposed Subpart I governing mandatory PTC 2015 deployment states one of the requirements for PTC is to reliably and automatically prevent incursions into established work zone limits – EIC PRT will fulfill this requirement.
- Pilot project will be initiated to interface with BNSF ETMS II System.
- Software is to be portable so that it can be installed on a laptop, a tablet PC or a PDA. The communication link between the gateway and locomotives is system specific.
- Safety analysis in the form of Subpart H PSP is completed.
- Demonstrated with PDA in RSAC PTC Working Group meeting on February 25 and AAR WCC/RESC on March 11– received very well by the railroads and the labor groups.

Communication Spectrum and Throughput

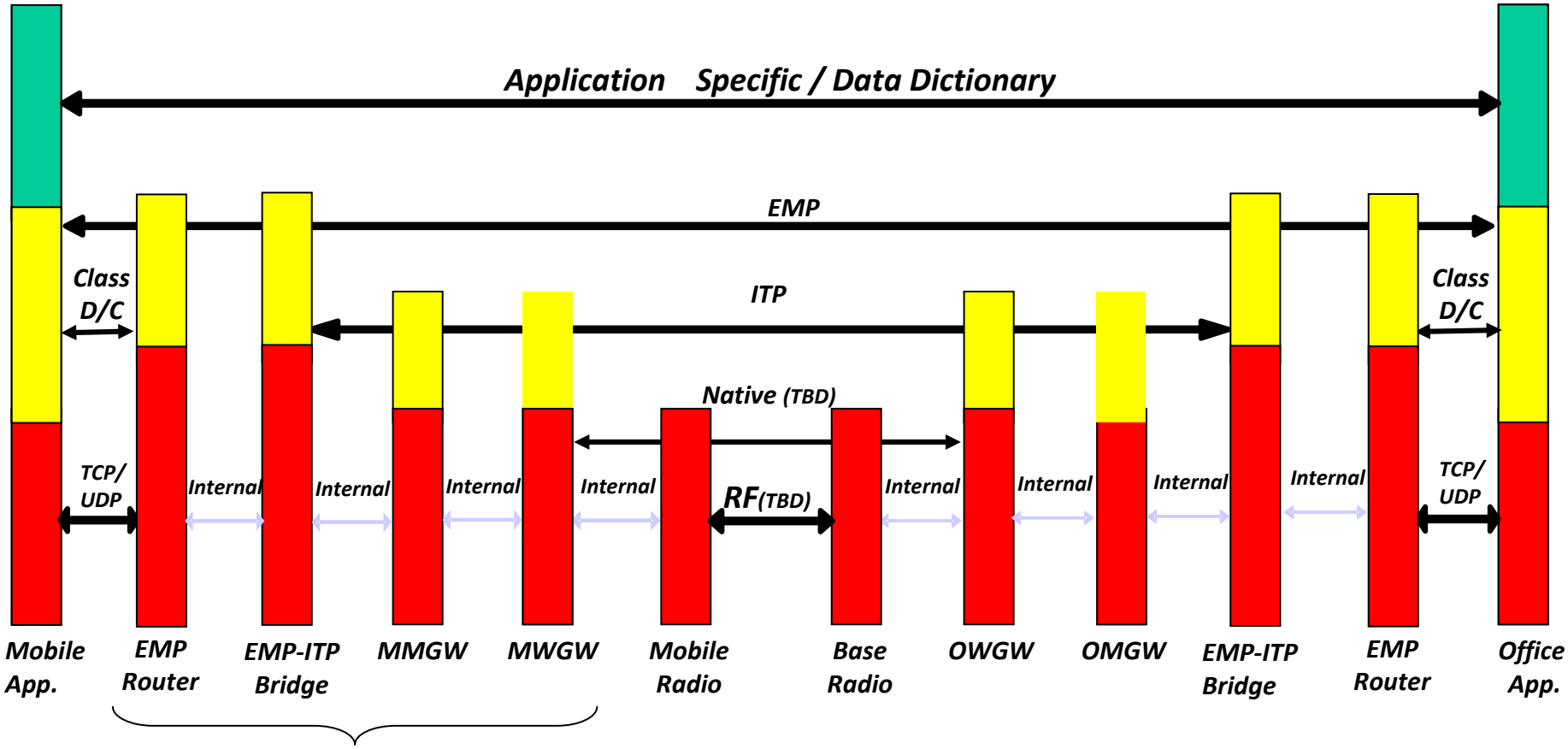


Communication Network is the backbone of PTC systems

Communication Spectrum and Throughput

- Assist railroads to petition FCC for waivers of “build or lose” provision for the 220 MHz spectrum. (UP and NS have acquired 5 channels of 25 KHz each)
- Conduct RF demand study using a basic territory model of a metropolitan area and based on the newly defined messages. (to be completed end of March)
- Develop other measures to improve throughputs and channel use: concatenate messages, use directional antennas, limit power etc
- Continue the development of HPDR (Higher Performance Digital Radio) with MeteorComm.
  - 12 Phase 1 MeteorComm HPDR Radios received at TTCI for testing
  - MeteorComm continues on schedule on Phase 2 development

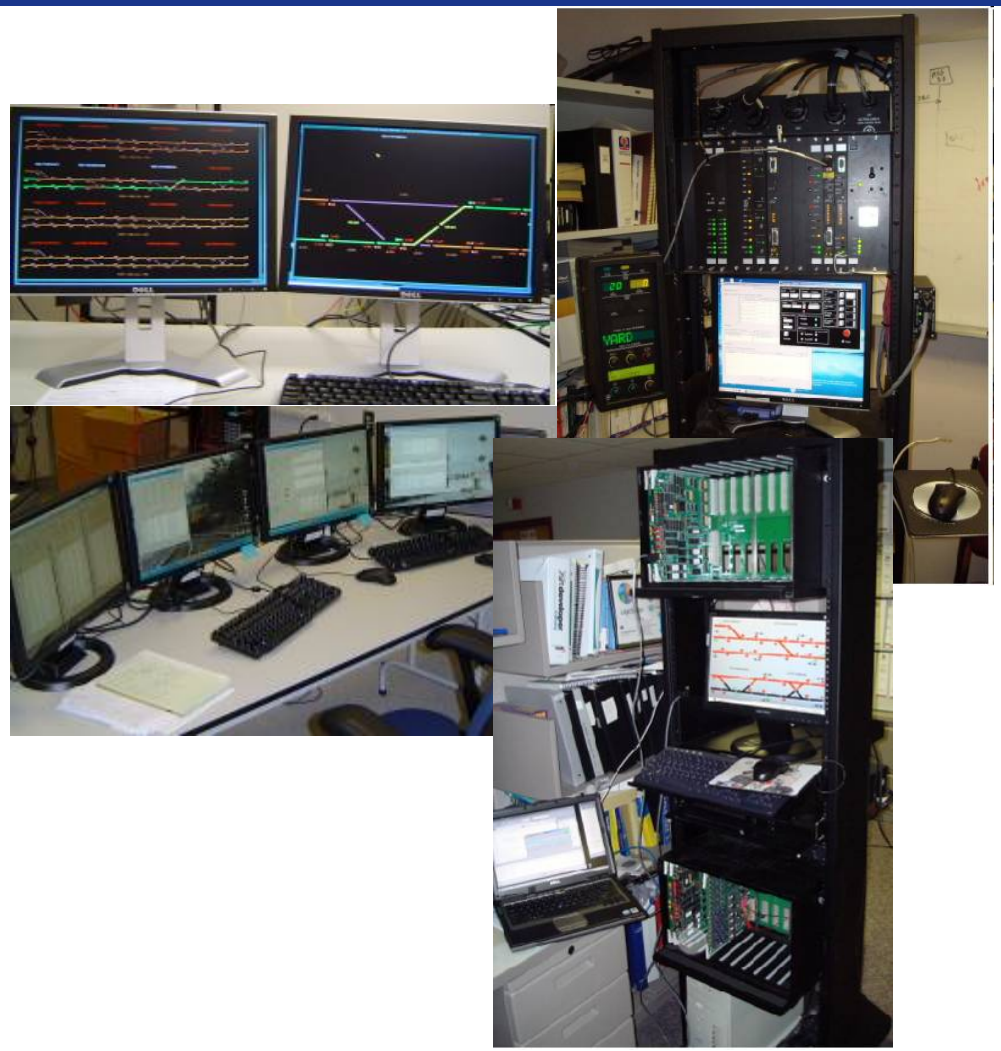
Communication Protocol Testing



Communication Protocol Testing

- ITP – Interoperable Transport Protocol
  - A proposed upper-layer, routable transport protocol
- EMP – Edge Message Protocol
  - A proposed upper-layer message envelope
- Class C
  - A proposed IP-based multicast protocol
- Class D
  - A proposed TCP/IP-based point-to-point protocol
- Standard architectural components:
  - MWGW – Mobile Wireless Gateway
  - MMGW – Mobile Message Gateway
  - OWGW – Office Wireless Gateway
  - OMGW – Office Message Gateway

Interoperable Communication-based Signaling (ICBS)



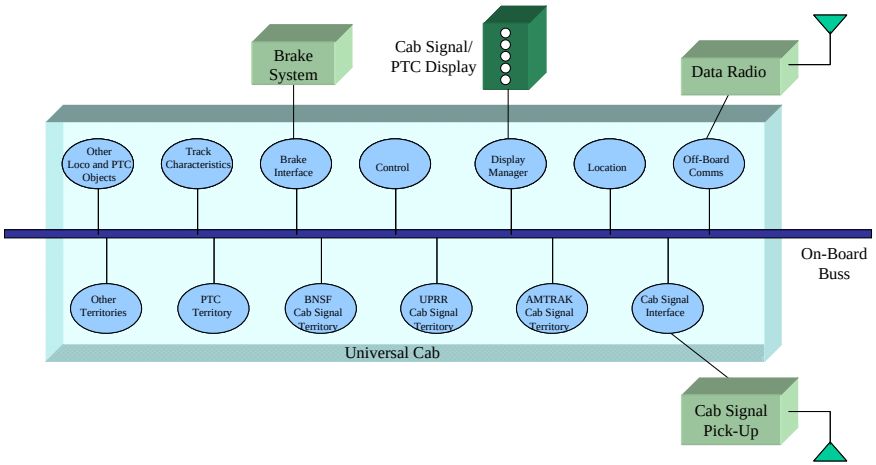
Communication–based on-board and wayside signaling equipment from four suppliers interoperable with each other

- Demonstration in Syracuse, NY attracted 50 attendees in January 2009
- Presented to RSAC and the railroads in February 2009
- Experience learned can be applied to the Interoperable PTC testing
- With the railroads, evaluating the potential of replacing form authorities with vital virtual signaling in dark territories

Data Security

- Proposed Subpart I will require data security to insure authentication and integrity of communication data.
- Confidentiality will be optional.
- Minimum expected would be MAC and HMAC schemes – but any algorithm recognized by National Institute of Standards or other standards organization will be acceptable.
- Pending BAA submission by universities/railroads partnerships to address reducing message overheads, increasing throughputs and key management.

Universal Onboard Platform



- Joint Project with AAR Locomotive Committee and the Railway Electronics Standards Committee
- Develop a common on-board architecture, standard data messaging, and standard protocol for command/control services

- Develop a set of data elements to be used in this environment.
- Cooperating with Locomotive OEM's to enhance this data element list.
- Final goal is to develop a cost-effective platform to integrate and maintain on-board applications including PTC within the locomotive LAN environment.

High Accuracy NDGPS

- Evaluate High Accuracy NDGPS methodology for suitability for track discrimination with probability of success greater than 0.999999 in PTC implementation
  - GPS – 15 meters average accuracy
  - DGPS – 3 to 5 meters with 95% confidence
  - HA-DGPS – 10 cm to 30 cm resolution
- Upgrade Pueblo NDGPS base station site to be functional equivalent of the first operational High Accuracy Nationwide Differential GPS (HA-NDGPS) site in North America
- Conduct demonstrations & tests to show potential benefits for train control, track database maintenance, and other railroad applications
- Project will proceed when Coast Guard approves the Engineering Change Request (ECR) for the Pueblo upgrade. The approval of ECR is expected to be in April, 2009

Risk Assessment Methods

- A Practical Risk Assessment Methodology by Union Switch & Signals
  - Start with Tolerable Risk Level (TRL) based on the Base Case
  - Iterate the design of the new system until TRL is reached
  - 4 page Research Results and a detailed report are under review and to be published soon
- A Generalized Train Movement Model by DecisionTek, Inc
  - Phase 2 close to completion – pending addition of a few minor features which arose from discussion with BNSF on the Beardstown Subdivision (ETMS I territory) simulation results
  - Phase 3 will soon initiate to incorporate failures and hazard event simulations