Intelligent Transportation Systems and Their Implications for Railroads

Proceedings of A Joint FRA-ITS America Technical Symposium
Washington, DC - June 4 and 5, 1997

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U. S. Department
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**Federal Railroad
Administration**

Intelligent Transportation Systems and Their Implications for Railroads

Office of Research
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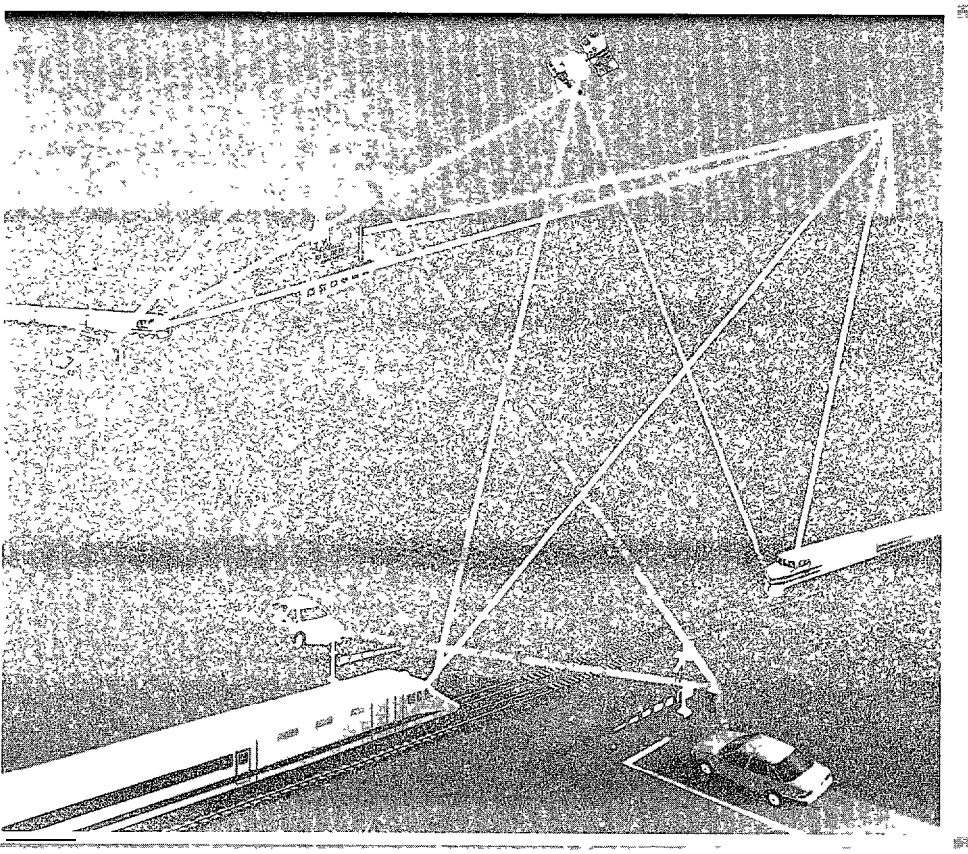
Washington, DC 20590

Proceedings of
A Joint FRA - ITS America
Technical Symposium
Washington, DC
June 4 and 5, 1997



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The Federal Railroad Administration and the Intelligent Transportation Society of America (ITS America) convened a joint Technical Symposium on June 4 and 5, 1997, on the subject "Intelligent Transportation Systems and Their Implications for Railroads." The Symposium was held in conjunction with the ITS America Annual meeting in Washington, DC at the Sheraton Washington Hotel. The Symposium addressed a number of issues of interest to freight, intercity passenger, and commuter railroads, railroad suppliers, states, and ITS suppliers. Some of the issues addressed included the newly developed Highway-Rail Intersection (HRI) User Service #30 architecture for ITS applications, the future direction of communications-based Positive Train Control (PTC) and plans for the implementation of the Nationwide Differential Global Positioning System (NDGPS) network to provide positioning data for PTC. This report encompasses the proceedings of the Symposium.

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Preface

On June 4 and 5, 1997, the Federal Railroad Administration (FRA) and the Intelligent Transportation Society of America (ITSA) hosted a joint symposium on current and future applications of intelligent transportation systems (ITS) to the railroad industry. The symposium, which was held in Washington, D.C. in conjunction with the ITSA Annual Meeting, provided a forum for senior executives from both the railroad and ITS communities to discuss currently available ITS products and services. These include the Global Positioning System (GPS), vehicle tracking and tagging, and collision notification systems. ITS technologies can be applied by freight and passenger railroads to improve safety, increase capacity, and improve equipment management and field communications, thereby providing a host of opportunities to railroad operators, suppliers, and customers.

Specific objectives of the symposium included:

- Increase railroad awareness of and participation in ITS activities.
- Disseminate to the railroad and supply communities the recently completed Highway Rail Intersection (HRI) User Service and Architecture.
- Accelerate transfer of recent ITS technological developments to railroads.
- Alert the railroads to the efficiencies that their competitors will gain from applying ITS technologies.
- Promote consensus on the future direction of positive train control (PTC).

Steve Ditmeyer, Director of the FRA Office of Research and Development, was the master of ceremonies. Federal Railroad Administrator Jolene Molitoris was the keynote speaker. ITSA President Dr. James Constantino welcomed the participants. Federal Highway Administration (FHWA) ITS Joint Program Office (JPO) Director Dr. Christine Johnson gave an overview of the ITS Program. Other speakers included Lee Simmons and Michael Onder of the FHWA ITS JPO; Steve Crane of the FHWA Office of Motor Carrier Safety Technology; Paul Pisano of the FHWA Office of Safety and Traffic Operations Research and Development; Richard Shamberger of the FRA Office of Research and Development; Dr. Richard Hooper of Rockwell International, Bruce Eiienhart of Lockheed-Martin Federal Systems; Steven Roop of the Texas Transportation Institute; Thomas Keller, Esq., of Verner, Liipfert, Bernhard, McPherson, and Hand; Thomas Humphrey, a consultant to US DOT; and Robert Gallamore of the Union Pacific Railroad.

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TRANSCRIPT
of
STEVE DITMEYER

Director of the FRA Office of Research & Development

OPENING REMARKS

OPENING REMARKS

STEVE DITMEYER Good morning. My name is Steve Ditmeyer. I'm Director of the Office of Research and Development for the Federal Railroad Administration. I'm pleased to welcome you to the FRA/Intelligent Transportation Society of America Joint Symposium on Intelligent Transportation Systems and Their Applications to Railroads. This is the first time at an annual ITS America meeting that there are sessions devoted exclusively to railroading.

This morning you're going to hear a series of presentations to help you understand what the ITS program is all about. You're going to hear Chris Johnson, the Director of the program, talk about its history, where it stands now, and where it's headed. You're going to hear about the ITS architecture process and how it's aimed at making sure that all of the myriad technologies being developed are able to interoperate. You're going to hear about the architecture process and how it applies to railroad grade crossings, and you're going to hear about some specific grade crossing projects.

I'm now pleased to introduce to you Dr. James Constantino, the President of the Intelligent Transportation Society of America. He is an old friend and an alumnus of the Department of Transportation. He was the second Director of the Volpe Center in Cambridge, Massachusetts. He came to Washington as a professor at George Mason University. For the past few years, he has been head of the Intelligent Transportation Society of America.

TRANSCRIPT
of
JAMES CONSTANTINO

ITSA President

WELCOME

WELCOME

DR. JAMES CONSTANTINO: Thank you very much, Steve. We're delighted to have you all here and certainly are delighted to welcome you to this meeting.

ITS America has been associated with the railroad industry for a long time, ever since its inception. As a matter of fact, one of the major people, who was one of the founders of ITS America early on, a group called Mobility 2000, was Bill Harris. I don't know if any of you know Bill, but Bill had spent much of his lifetime in railroads. He has been the creator of many of the things that you see in ITS. This whole World Congress business that we had down in Orlando originally was going to be called the International Conference. He said, "oh no, you don't want to do that." He said if you call it the World Congress you'll get a lot of people to come and be interested. It sounds good in the international forum. And he was right, and the international-the World Congress right now, which used to be thought of as the International Conference-is one of the great things that's going. In Orlando, you may know, we had about 5000 people.

So, we're delighted to have had this early start with ITS, with the railroads and ITS. I remember we had lent our conference room to Jolene after she first came here so that she'd be able to do some original thinking about where she wanted ITS, where she wanted the Federal Railroad Administration to go vis-a-vis many things, including ITS. You may know that we also have another link with the railroad industry in Chuck Detmann, who is with the Association of American Railroads. He sits on our board of directors so that we can get input directly from him as to what the railroads may be thinking at any particular time. And at one point we had Union Pacific Railroad, which was a member of ITS. I think when Chuck came on board they thought that he would be sort of a representative.

ITS America at one time was called IVHS America; I think you know that. The "V" and the "H" stood for vehicles and highways. And after several serious discussions and sometimes almost coming to blows, we changed the name to ITS, which really is intermodal. Several people said, oh yeah, IVHS is inter-modal too. The vehicle could be a rail car or a subway car or whatever the case is. But we changed it. ITS is a multimodal organization. That's why I'm so delighted to see everybody here.

The Federal Transit Administrator was most happy to kind of campaign for that inside, even though all the legislation was written IVHS. It took a lot of memos, pieces of paper, messages to Congress, and so forth to change it. But we were serious that ITS is inter-modal, multimodal, and that's really what we wanted and that's the kind of society we have here today. So, take a look at what's on the agenda, and take a look at the exhibits. I hope you go down to the exhibit halls. There are 150 exhibits down there. They are in two sections in this hotel, kind of limiting to exhibitors. But if you go in both of those sections and see what's there and then compare it with all we had out in Reston, Virginia just six years ago, in 1991, you'll really be amazed. There were only 12 tabletop exhibits. There really wasn't anything that anybody was willing to produce or show in this country.

So, we're ITS, we're intermodal, we're multimodal, and we mean it. One of the key things about intelligent transportation systems is location of vehicles. With that, the satellite systems that are up there, the GPS, are used extensively in surface transportation, and we support that kind of activity and urge that along. When I was in DOT 25 years ago, we were talking about making it available for civilian use. We very much support the use of differential GPS.

I'd like to finish by saying that those of you from the railroad industry should really think about getting more closely involved with us. This is not exactly a pitch for membership, but think about what Woody Allen once said. He said, "The world belongs to those who show up." So if you'd like to join with us this is a good time to do it. Thank you.

TRANSCRIPT
of
THE HONORABLE JOLENE MOLITORIS

Federal Railroad Administrator

KEYNOTE ADDRESS

Introduction
by
Steve Ditmeyer

KEYNOTE ADDRESS

STEVE DITMEYER: I'm now very pleased to introduce our keynote speaker. In 1993 she was appointed the first female Federal Railroad Administrator by President Clinton. Under her leadership the first ever U.S. rail summit was convened to address rail safety issues by freight, passenger, and commuter rail interests. As an advocate for rail safety first, she has been actively involved in achieving partnerships between government and industry, resulting in numerous infrastructure initiatives and the movement of FRA itself toward a more customer-driven and efficient agency.

Her list of accomplishments are many, and her legislative successes are many. She's not only one of this country's most able visionaries and administrators, but a great person to work for. Please give a warm welcome to Jolene Molitoris, Federal Railroad Administrator.

JOLENE MOLITORIS: Good morning. I guess the world belongs to us because we showed up. In terms of this extraordinary and historic meeting, we really are in a historic place at a historic time. Because Jim is very correct. I remember clearly thinking what a hospitable gentleman Jim was when he welcomed us to the IVHS Center. I had become acquainted with Jim through a presentation by then Federal Highway Administrator Rodney Slater. I remember being so struck by this presentation of IVHS. One of the things, of course, that was so compelling was that it was about the future.

It was about this 21st century that we're all getting ready for. It was about new ideas and vision. It was exciting. But the other thing that was really compelling to me is that they never mentioned railroads. I said part of the reason the President asked us to be here was because his vision of the 21st century was about either a national transportation system or an intermodal *system,* or whatever *term you* might use. His vision was for a 21st century transportation system. So I knew that IVHS really meant a national transportation system. That's what it really was about.

So Jim is right. We did begin the conversations together. How can we make this communicate to everybody in America that we're talking about technology that's going to drive us and carry us safely into the 21st century in a way that really makes us globally competitive, that gives us the very best transportation system in the world? How are we going to do that?

Well, we all know that communications is sort of the foundation stone for success. We know that people who advertise on television spend lots of money figuring out how they can get their idea into the mind of the American people. We moved to ITS America. What is more compelling than that? ITS America is what America will be about in the 21st century. To go from 12 tabletops to that phenomenal exhibit that we have here today really tells me what the spirit of America is all about with regard to technology.

One of the exciting things, I think, for all of us is the whole NEXTEA proposal. We know about ISTEA. We've had a good foundation laid throughout the last six years about planning and thinking and working as a national transportation team. But the President's bill that went to Congress recently, called NEXTEA, is a testament to the kind of commitment that the President has to technology and the kind of understanding that he has about the role that technology plays in a vital 21 st century American economy.

In that bill, there is a minimum of $600 million specifically for development of ITS America in the NEXTEA bill. I think that's only a foundation because the other part of NEXTEA is the President's message to all that we're looking for partnerships to marry public money of all sorts, Federal, state, and local, with private investors to build the transportation system of the future. That's why it's so great to be here. I look out and see a lot of familiar faces, who already have made decisions about partnering with the Federal Railroad Administration and the DOT in investing in technology development of the future.

We know that advanced train control systems have moved some during the last few years because of partnerships. But before we get to that let me mention a couple of things. First of all, . before we go any farther let's remember what today is. It is 940 days until the 21st century, 940 days. It's not very long. We have a sign in our lobby, for any of you who have been to the FRA recently. It says "Countdown to the 2 1 st Century," and it has the numbers, and every day we change it. Somebody said to me once well, why is it there?' I said, first of all, it's an interesting

question that somebody would wonder. But secondly it's really for me a very plain answer. I want to stay focused. You know, sometimes we wonder if what we do every day makes a difference. When you think of it in the context of the 21st century, I mean for me this is such an exciting thought. We're going not only to be part of the 21st century, but we have the opportunity to shape it and create it to be the kind of world we want it to be. We have that chance. I know that today. I only have 940 days left.

So, I hope that that's a compelling reason for you in this industry to think about the invitation Jim just gave you. About being more vitally involved in ITS America. I mean who could resist that invitation'anyway, Jim? Who wouldn't want to be part of something that's called ITS America? But in addition, think about your industry, our industry, and what opportunities it has. I was, I guess the day before yesterday, at the Argentine yard dedication in Kansas City and saw all the new technology and saw all the things that came out of recycling. It was sort of a menu of low tech and high tech investment.

It's very exciting because that's a $100 million investment that 20 years ago railroads would have never, ever thought of making. And I think as we see ourselves more integrated into this national transportation system, as we see ourselves more vigorous as competitors, as we understand that the technology of ITS America applies to railroads and their customers, just as much as it applies to anybody else, then I think there is a tremendous urge to think clearly about how we should be involved, what our role should be and how we can be more competitive as an industry by being partners with all the other elements of ITS.

Jim, I want to thank you for your leadership over these years. Because it isn't easy to start with an idea and with tabletops. I think the kind of support that you have gotten really is a testament to the kind of leadership you bring to your job. And I thank you and I salute you on that. We look forward to opportunities to work with you. And I have to tell you, Jim, it was a great day for me when I was invited to be part of your board because that meant to me that we could be part of the vigorous and exciting debate about how this organization works and how we go forward.

Christine Johnson isn't here, I don't believe, but she is somebody who I think, I hope, all of you will get to know. She has been a tremendous leader. She is focused on ITS in the Department, she's head of the office, and she had done an extraordinary job of reaching out to new partners to become part of this transportation team. Steven Ditmeyer, if there was ever a reason why you came back to the FRA, I don't think ITS America has a peer in terms of its results that we've seen because of what you've done. Jim and Christine both have let me know how important your role has been, and I want to recognize it and thank you very very much.

I'm excited about this conference because the motto or the theme itself is really quite extraordinary: merging the transportation and communication revolutions. I don't know about you, but I like being part of revolutions. You know, the railroads were always part of revolutions. They revolutionized the history of this country when they got built. They revolutionized the way people moved, the places they could go, the dreams they could achieve. Today they're revolutionizing the idea of what a railroad is because a railroad is a transportation company. A railroad has partners that we never would have thought of.

Who would have ever said trucks and trains would be business buddies? I think it's a pretty extraordinary feat in the last ten years to see that new concepts and new ways of reaching out make money for everybody. Win/win is what transportation can be. I think that when we begin to think of transportation and communication as integral parts of the same revolution, I think we have an idea of what the 21st century can be about. So, I think this symposium is not only historic, but it is one that can net us revolutionary results.

There are many people that I see in this room who have already sort of made the leap into that kind of thinking. I'm excited to hear what you will be talking about, the kinds of ideas that might merge and actually result in extraordinary new initiatives.

I think it's important to mention, because it's important to me and to our country, that the President's commitment to technology is not only firm but is very deep. Perhaps in the whole panoply of budget discussions that you read about in the newspaper, it isn't evident quickly that over the past four years this Administration has invested 20 percent more in transportation than in the years before. In a venue that's about the business of reducing the deficit over 50 percent during this same time, it's a pretty big indicator to me that this President understands the

extraordinary connection between technology advancement, technology development, and the economy that we all want to be so vital.

We're experiencing an extraordinary, solid growth that is often described as a booming economy. I think the investment in technology for the future is crucial to keep that going. The President has made several speeches lately that continue to stir this kind of thought. I think there was one that he made recently at Morgan State that said it for me. He said, "If we're, all of us, to make the most of this new century, each and every one of us, regardless of our background, must work to master the forces with vision and wisdom and determination. The past half century has seen mankind split the atom, splice genes, create the microchip, and explore the heavens. We enter the next century propelled by new and stunning developments." I believe that some of the most extraordinary developments will come out of ITS America.

ITS America to me is more about safety than it's about efficiency. Of course it's going to help congestion. Of course it's going to help manage our systems so they work at peak performance. But most important to the people of this country, it's going to make sure that they have, use, and are part of the safest transportation system in the world. When it comes to railroads, and I think we all know this, over 90 percent of the fatalities in our industry occur at an intermodal location. That's where trains and trucks and cars intersect at grade crossings.

Now, we have been focused on this at the Department in a very special way over the last two and a half years. Last year, in 1996, we achieved an increase in safety that was greater in one year than has ever been achieved since they started measuring those things. That was something that didn't happen because of the Department alone. It happened because we had partners like the ones in this room, because we had Operation Lifesaver, because we had railroads, because we had citizens, and because we began to reach out to trucking companies, and to enforcement officers-all of the people who have to be part of this push if we're going to protect drivers of trucks, of trains, of cars.

Once we got ITS America, instead of IVHS America, we were on the right track. The next thing that was very important to us was the new category called "User Service Number 30," which was recently created to focus and deal directly with grade crossing issues. We think this is an extraordinarily important piece, and we thank you, Jim, for your support of this and for all the board's support.

Not only last year did we, when we averaged all the numbers, increase safety by 20 percent, in some states we increased safety by numbers like 59 percent. I don't know about you but that's just so compelling to me. It is such an indicator of what we really can do when we work together: the fact that they're not just statistics and they're not just numbers. They're actually people who didn't die. In addition to that we really can't calculate the ones who were near misses, who were saved. We can't really capture that for you, but we know there were many of them.

We all heard about Fox River Grove. That was a tragedy that touched everybody in America. Out of that came a new understanding of how important communication among all of our constituencies is: the suppliers, the maintainers, the railroads, the state highway and county highway officials. No matter how much ITS America develops, no matter if next year we have 300 displays in our wonderful area, the people can never be left out of the equation.

The communications which we used to talk about, maybe, and think about as a soft subject really become the glue that binds all of these new technologies together and makes them work the way we all want them to work. During the last several years, there has been a commitment at the Federal Railroad Administration to focus on advanced train control systems. It has been an area that has been on the National Transportation Safety Board's most wanted list for I think over 15 years. We have made progress, and people in this room have helped us do that.

For example, Michigan and Amtrak are installing a high speed positive train control system on the corridor between Detroit and Chicago. Illinois is working with us on a positive train control system from Chicago to St. Louis. We're working in the Northwest with Washington and Oregon. And, of course, especially-on all of these projects but particularly in those projects-UP and BN have invested about 37 million dollars to help us make this work.

You didn't think that I was going to forget to say that did you? I see our partners out in the audience. Recently, we have just signed a grant agreement with three more railroads: Conrail, CSX, and Norfolk Southern. Does that sound like it goes together? I don't know. We actually started talking about this before something else occurred. They will be working with us over the next two years to develop a system between Harrisburg, Pennsylvania and Manassas, Virginia. This is a fairly significant piece of railroad in terms of its use by commuters and Amtrak, and also by the freights themselves.

We're in the final stages of looking at two other important projects. Corridor risk assessment and business benefits have come out of advanced train control systems. If any of you looked at and read our report to Congress on this in 1994, you know that these were commitments we made and we are keeping. We will be moving in 1997. Quite frankly, we're hoping there will be more decisions by railroads soon to make more commitments about advanced train control systems. And we will be working with them, and we will be deciding internally what kinds of regulatory initiatives we will be making in this area during 1997.

In fact, this afternoon I'll be meeting with Congressman Oberstarr, who is certainly a leader in our industry and a leader in our committee. He and I will be talking about some of that today.

Another technology that the FRA has focused on and is very involved in is the differential GPS network. Some were concerned in the railroad industry about its accuracy, and they wanted to see FRA expand the Coast Guard's DGPS network of ground stations across the nation so that the level of accuracy could be increased to the level that they felt was needed for the positive train control systems. And we have been able to do just that, and we're pleased about that.

Steve and the staff at the office determined that the Air Force was decommissioning some of its ground wave emergency networks, or GWENs, and that the towers and the equipment would be a way to lower the cost to fill out this DGPS network. The first of the GWEN towers, at Appleton, Washington, is actually now broadcasting the DGPS signals. My understanding is it's really working; it's performing well. A task force in the Office of the Secretary is now at work looking for possible ways to fund this activity, to really increase its effectiveness nationwide. You'll hear tomorrow from Dick Shamberger, from the FRA, who will give you more details

about it. But I think it's a very very exciting possibility. This could be a key part of the nation's transportation information infrastructure.

It won't have value only for railroad train control, but for a myriad of other transportation and non-transportation uses as well. It will provide precise positioning information from groups as diverse as emergency responders and precision farmers. This could also be one of the major Defense conversion projects. 'Again, I think many of our suppliers should become very involved not only in waiting to see what happens but being part of the team that helps us decide what will happen and how it will happen.

Just as the President talks of a new century made brighter by the promise of science and technology, Secretary Slater talks to us all the time about a Department that's vigilant and visionary. With that being only 940 days away, if our transportation system is safer and more efficient because of ITS America's work and because of your involvement in that, I think all of us will be well served. I think it's a win/win opportunity for all of us. I hope you all know what Operation Lifesaver is. It's a national volunteer organization to raise awareness and educate the American people about responsibilities at grade crossings and trespassing on railroad property. It is a wonderful organization, and they have a motto that is "look, listen and live." I think we could adapt that just for today and tomorrow and say "look, listen, and learn." There's so much to learn from each other, from the displays, from the colleagues that you will meet. I think it is an exciting opportunity for us ah.

I am pleased, very heartened by the kind of response we've had. Steve, it is heartening indeed. Thank you for your leadership in organizing this. Jim, thank you for encouraging it and helping us make it happen. And I look to feedback from all of you on what was valuable, how we can do better, and how in 940 days we can all stand and cheer about the kind of communication system and the kind of transportation system that we all helped build. Thank you very much.

TRANSCRIPT
of
CHRISTINE JOHNSON

FHWA ITS Joint Program Office Director

THE ITS PROGRAM

THE ITS PROGRAM

LEE SIMMONS: It's my pleasure to introduce Christine Johnson. When she came on board, the Federal Highway Administration and DOT broke out for the first time a program office for ITS and made Dr. Christine Johnson the director of that office.

DR. CHRISTINE JOHNSON: Thank you. What I want to do in welcoming this community to the ITS family is to kind of keep us all on the same songsheet. Wanted to give you a little bit of an overview of what ITS is, what the program is like, and then where are we going. I'm aware that within this audience there are some of you for whom ITS may sound like a new language. I don't know how it was. If Lee Simmons preceded me, I dare say he used some vocabulary you may not have understood.

But let me step back and for some of you this is old hat to, I apologize, and then give you a sense of where I think the program is going and a role that I see as vital for you to play, as well as some vested interests that I think you, as an industry, will get out of ITS. We started with a vision. If you kind of trace the roots of ITS back, it was IVHS. By the way, vehicle highway communication was sort of the heart of the vision. When ISTEA was being formed, when all the coalitions were being formed, there was a set of folks that said there is a future there that is not being recognized. That is, a future that is an intelligent highway system because a lot of work had been done on making a highway smart. Similar work had begun to be done in the vehicular industry. And they said, you know, in the 21st century this stuff is going to pop out at us and we're not seeing it recognized in the legislation.

Well, that vision did tend to rest on the communication between a smart highway and a smart vehicle, initially in dynamic route guidance. The idea was you could get in your vehicle and not only have navigation, such as you have on your boat or in an airplane or in a number of other mobile devices, but you could also be told where the congestion was and what the best route was. The closest analogy that I could come to is what I envision actually goes on between a pilot and air traffic control, though I have never been in the cockpit of an airplane. That analogy could be extended to a fully automated system.

Now I go into some detail with this because I have to believe there are at least some smiles in this room. If there are not, you're missing the whole point here. Because as folks started talking about the vision of a fully automated highway system, I kept coming back to these guys. I was sort of on the outside then. And I said "you know, this is sounding an awful lot like a train"-dedicated right-of-way, vehicle-to-infrastructure communication, positive control, all of those kinds of things, knowing where platoons are. You know the concept of platooning blocks of vehicles on a very high speed right-of-way. So this is getting more and more like mass transit all the time. So that was the initial vision.

We have come a long way since then. We have come a long way in knowing what we can and can't do but are also broadening that vision. This meeting today, I think, is exemplary of broadening that vision. Through the first two or three years of the program, it was incorporated in ISTEA, and it was funded at a little over $100 million a year. Now, for any of you who really watch budgets we have actually added to that budget level between $100 and $125 million, from what are called essentially operating expenses. So they've been matched at about a $200 million program every year.

The first three or four years we tested a number of technologies. Everybody had a technology that we could apply in transportation. That alone tended to stretch the umbrella, but it had not stretched it into the world that we're in today. It tended to be traffic control things, some in vehicle, the navigation-type things, mayday-type things, where there would be an automatic call if you got in a crash.

As we had what I call the popcorn bowl effect of just spewing out lots of ideas and trying them out, there increasingly came a call from this body for an architecture. That's what you heard in Lee's talk about the initial national architecture. That was quite a risk that the United States took relative to other sorts of economic blocks that are also working hard in this area.

We have taken a very systemic or systematic approach to this and sort of defined functions and functional requirements and have completed it by the way, to Lee's credit, on time and on schedule. And we did launch that long term vision of an automated highway system with a totally new way of doing business. Where we said yes, DOT needs to be a part of this but so does Detroit and so and does the supplier community, through the Bechtels **and** Parsons of the world.

We've put them altogether in a ten organization consortium and said, if this is ever going to be a reality, we've all got to come together and work on the development as a company. So, we formed a consortium where that has been going on.

Now, in about that five-year time as a result of the architecture, as a result of learning a lot of things, we have defined two concrete systems that we think are solid enough to begin recommending on a national scale to deploy. One, for shorthand purposes, we call centrally the Metropolitan Travel Management System. The easiest way to think of it is ground traffic control analogous to air traffic control, the purpose being the same in trying to manage a very scarce resource, both in transit and in highways, and communicate ultimately to the driver what's going on. But you first need a solid infrastructure that is equivalent to radar to know what's going on. Now in the rail community that may, to some, seem like old hat. It is new in the highway community-honestly being able to know what's going on, on the highway system. We do not have that infrastructure in place in our metropolitan areas. And until we do, we can't seriously talk about managing the system, and we can't seriously talk about using a scarce resource much more efficiently than we do today.

So that is one system that we have put in place. Now, a piece of that system is the highway rail grade crossing. There is a metropolitan piece that we actually formally incorporated into the architecture which Lee talked to you about. We are going to require that folks who want to buy a signal system, if there is a highway rail grade crossing in the immediate metropolitan area, have at least enough of a plan for ultimate electronic linkage that we don't end up with an incompatible situation and force them to plan and think in that way. That's in practical terms what the architecture will do.

The second system that we have come out with in this five-year period is what we call C-Vision, C-V-I-S-N: Commercial Vehicle Information Systems and Networks. I'm going to use a shorthand analogy. Some of you who are in the freight community know that commercial vehicles, I know that's a competitor but increasingly a collaborator, are regulated by four or five entities. We don't really do that much regulation at a national level. It's done by four or five entities within each state. Each of those states have their own databases, and those databases neither talk within one another or across boundaries. My best analogy to that is I was responsible

for building one of those pullover stations on the Delaware River in New Jersey. Right across the river was a similar one. I was taking hell from the communities that didn't want to have a back up of trucks. It never occurred to me, by the way, in my state mentality that I could just use the information that they got on the other side of the river. That would make my life easier, that would make the truck's life easier, and all I had to do was get an electronic link. No, I didn't do that. I went through the full nine yards and have scars to show for it.

What we're trying to do is build and centrally link a number of systems into one system that functions similar to a truck Internet so that data on a vehicle is available wherever you want it and whenever you want it. This would allow sort of one-stop shopping-a very fast weigh-in motion, a safety check, and that type of thing. Now, I've grossly simplified it but that's the second system. And now we are working, as we move into the next five years, among other things, on a series of rural applications.

But the other thing that we are launching, and that I think is where this meeting comes together, is both looking at our relationship with the rail community (the long distance rail community) and intermodalism. I'm going to spend a little bit of time on the intermodal opportunity. I can short circuit the first one, and I'm sure that Steve will go into this a little bit more, in saying that we have begun to define a research agenda together that not only will flesh out some research in the highway rail grade crossing area making it more automated and more efficient, but also some of the enabling elements of positive train control and other sort of electronic and communication underpinnings of operations.

But I wanted to spend some time in this audience, because I have done so in a number of other audiences, with planting an idea with you. Since you're new to it I may have a better opportunity. ITS is a number of things. It ranges from things that you all as citizens know as advanced signal control to navigation using GPS, which I know some of you do use in your operations, to very sophisticated sensing devices: the short range communication that you use on container tracking for example.

It is also an opportunity. We can, in fact, look at them, at that whole what I call the popcorn bowl full of technologies. Gee, we can apply this one here, and that one here and it will make our lives better in each of our modes. I would rather think of it as an incredible opportunity

to make our rhetoric about intermodalism somewhat more of a reality. The fact is if you go back as far as our canal systems, they were built to serve a group of clients. It wasn't made to serve the whole United States. They were made to serve a group of clients and a group of investors.

Our railroads were put in place to accomplish a mission, as well as a return on an investment. Our highway system was then laid on top of that, and it had a mission of, believe it or not, connecting our major metropolitan areas. Then our aviation system was laid on top of that. The underpinning of all of that was our little streets and byways that started out as cow paths.

I think of our system today not as one system but as a geographic information system with multiple layers on top of it. But the problem is there is not the electronic linkage between those layers, which we have managed to achieve in some of our geographic information systems. So, while we talk a lot about intermodalism and we use that even in the title of it, I am not as convinced as many people are that we can execute it. The analogy that I make is you could talk forever about a global economy. I mean put yourself back at the end of World War II for example. We had just executed a war, and we were working on a global framework. But we did not have a global telephone network, and we really did not have a global aviation system. And until those two things were in place you really could not talk about a global economy.

I am going to draw the same analogy to the ITS system. Until we have at least among other things-now, I do not deny the need for physical connections that we still need to put in place and will be a part of the NEXTEA package-an electronic information and communication system, I don't think we can seriously talk about intermodalism. Those systems are separate, and ITS presents an opportunity. You can think of it as a glue or a spanning umbrella that can span the different modes and bring them together on the superstructure of communications and information. It might then be physically possible to track what was in a container, where it was ultimately destined, how it was loaded on a ship, and where it was going in the transfer off to the apron-on a rail container car, to a truck facility, or to a warehouse--on a common information system, not necessarily with everyone knowing every piece of it, but with a need to know you could track it. This means some common information standards and some common protocols could weld our system together in a way that would maintain competitiveness and would make us all, as a nation, far more productive.

But there is also a risk behind ITS, and that's the other twist that I wanted to leave with this audience. ITS is still that popcorn bowl full of technologies, individual little kernels that we can put on our containers and track to make this company more successful. And somebody else using GPS can make their company more successful. And the Port Authority of New York and New Jersey can put together their information tracking system on the port. And, by the way, it doesn't communicate with this company and this marine company. That's the risk.

The information and communication revolution is upon us. It is of the magnitude that the agricultural revolution was three or four centuries ago. It is of the order of magnitude that the Industrial Revolution was. Our generation is at the leading edge of the information revolution, by the way, because our children and our grandchildren grow up with it, almost like it is in their genes. I am frightened by that. So, they will be in it and that will be home to them.

It's a question of what we are going to leave to them. Are we going to leave to them the sort of Apples and IBMs and Betamaxes and so on, just as as our professional predecessors left to us the aviation system and the rail system and the highway system which we are now trying to fix in the communications system?

The risk is that we deploy the electronic revolution or the communication revolution that is upon us in our old paradigms the way we were brought up to think about a rail industry, a carrier industry, a passenger industry, an aviation industry. Or will we have the courage to see 20 years from now the opportunity of a real breakthrough-a breakthrough in the way that the transcontinental railroad was to the opening up of America? I really see it being that big of a breakthrough if we have the power to break the mental paradigm that we have right now. And that would mean let us think about what we're doing within our own companies and how that might relate to a larger transportation world that we are all a part of creating, in 5, 10, and 15 years from now.

My argument is that it is fluid now but within five years the die will be cast. Too many information systems will be in place to change. They will either be in stovepipes or we will have seized the opportunity for truly using ITS as an intermodal bridge or an intermodal opportunity that will make us all more competitive. Now, I have argued to the passenger side-and I work with both the passenger side and the freight side-that actually the freight community, I think, has

recognized this opportunity as a competitive edge far more than sort of the other side of the coin, with the vertical integration of both their physical systems, their company systems, and their information systems. But there is more to be done.

We are as an organization doing some. But the charge that I hope to leave as you join the ITS family is to now help us take the little bit that we're doing, with highway rail grade crossings, and some of the enabling elements that we're doing within FRA, and expand that research agenda and begin to help us define that intermodal paradigm for the freight community such that we can conceive of a structure that preserves competitiveness within modes and companies and yet allows the productivity that information flow across the modes and across companies could honestly provide to each one of you. I challenge you with coming in and defining how we can help and defining how the industry can work together to make this the breakthrough that your industry was to America about a century ago. Thanks.

STEVE DITMEYER Chris, thank you very very much for a very important message. I really appreciate your support of this symposium and the support of your whole office. We couldn't do it without you.

PRESENTATION

of

LEE SIMMONS

FHWA ITS Joint Program Office

THE NATIONAL ITS ARCHITECTURE PROCESS

PRESENTATION

of

BRUCE EISENHART

Lockheed-Martin

and

RICHARD HOOPER

Rockwell International

SUPPORTING HIGHWAY-RAIL INTERSECTIONS IN THE NATIONAL ITS ARCHITECTURE

Supporting Highway-Rail Intersections in the National ITS Architecture

Bruce Eisenhart

Lockheed Martin Federal Systems

Richard Hooper

Rockwell International

Why Address HRI?

+ **Serious existing safety concerns at Highway-Rail Intersections (HRI)**
+ **Risks associated with High Speed Rail Corridors**
+ **Opportunity to use technology to help address the needs**
+ **Strong bipartisan interest in developing solutions**

Why Put HRI Support in the National ITS Architecture?

- **The National ITS Architecture creates an opportunity for an Integrated Solution**
  - Across Modes
  - Across Jurisdictions
  - Between Systems
- **HRI is now part of this Integrated Framework**
- **The Framework is a basis for planning, design and implementation of ITS**
  - HRI joins transit and other multimodal services as a part of the ITS toolbox

Who are the Users of the National ITS Architecture?

+ **The National ITS Architecture provides a Framework that directly supports:**
  + Transportation Planners
  + Infrastructure Deployers
  + Standards Development Organizations
  + Government Agency Programs and Planning
  + Private Industry
+ **The Goal of the Framework is to**
  + Facilitate Interoperability
  + Aid integration and coordination nationally

The National ITS Architecture: Consensus Process

- **The National ITS Architecture is based on *Stakeholder Consensus***
- **Developing HRI consensus:**
  - Architecture HRI Kickoff and Special Program Review (FRA, FHWA, FTA, Volpe, AAR, Canac, American Shortline Railroad Association, NCDOT, AASHTO, ITE)
  - Site Visits (Union Pacific, Norfolk Southern/NCDOT)
  - Key Meetings (HRI Technical Working Group, TRB HRI Session)
  - Direct Discussion and Feedback (Volpe, Canac, AAR, TTI, UP)

HRI User Service Requirements

- **User Service Description developed by FRA, Volpe, and JPL**
- **User Service Requirements**
  - Derived from User Service Description by FRA and JPL
  - Consensus review and revision
- **Key areas of User Service Requirements**
  - Types of Users
  - Interfaces
    - Non-Real-time
    - Real-time
  - Active Warning Systems
  - Standard Crossing
  - Advanced Crossing
  - Collision Notification

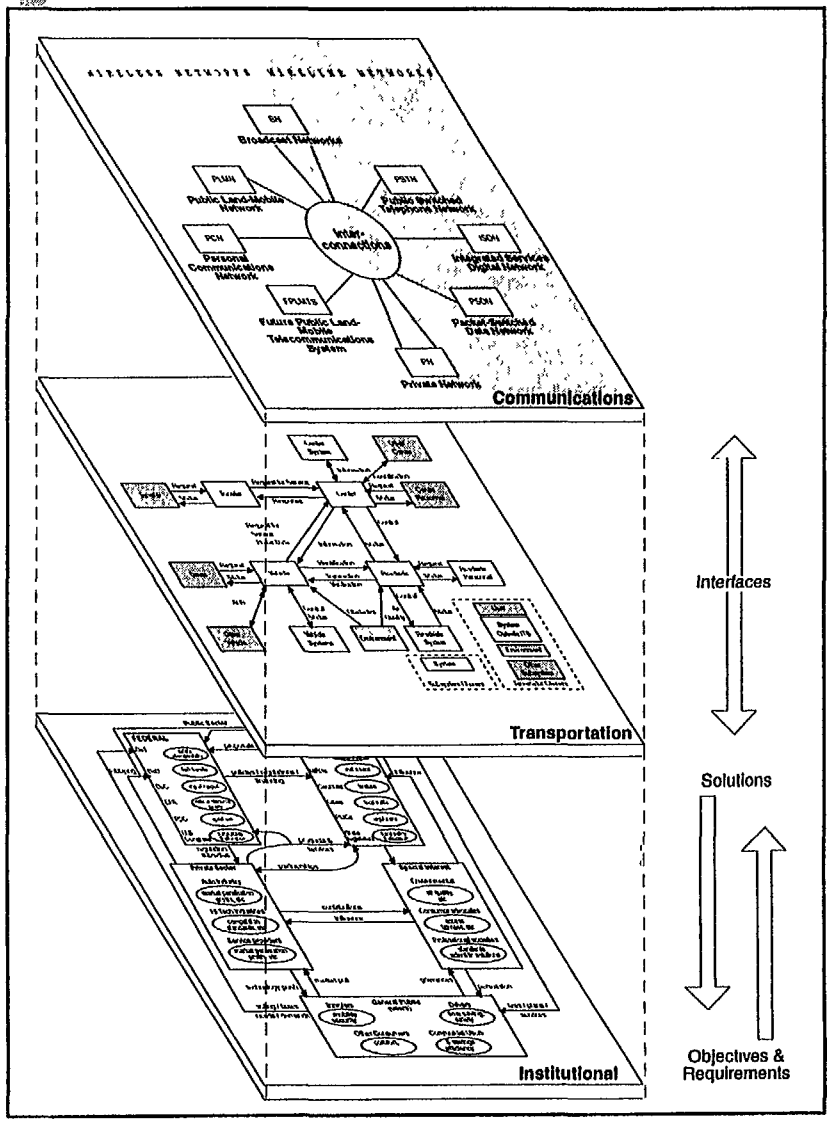
The National ITS Architecture: Overview

The HRI User Service has been propagated throughout the National Architecture and its documentation

- 3 Layer Architecture
- Logical Architecture
- Physical Architecture
- Equipment Packages
- Market Packages
- Document Set
- Web Site
- CD-ROM

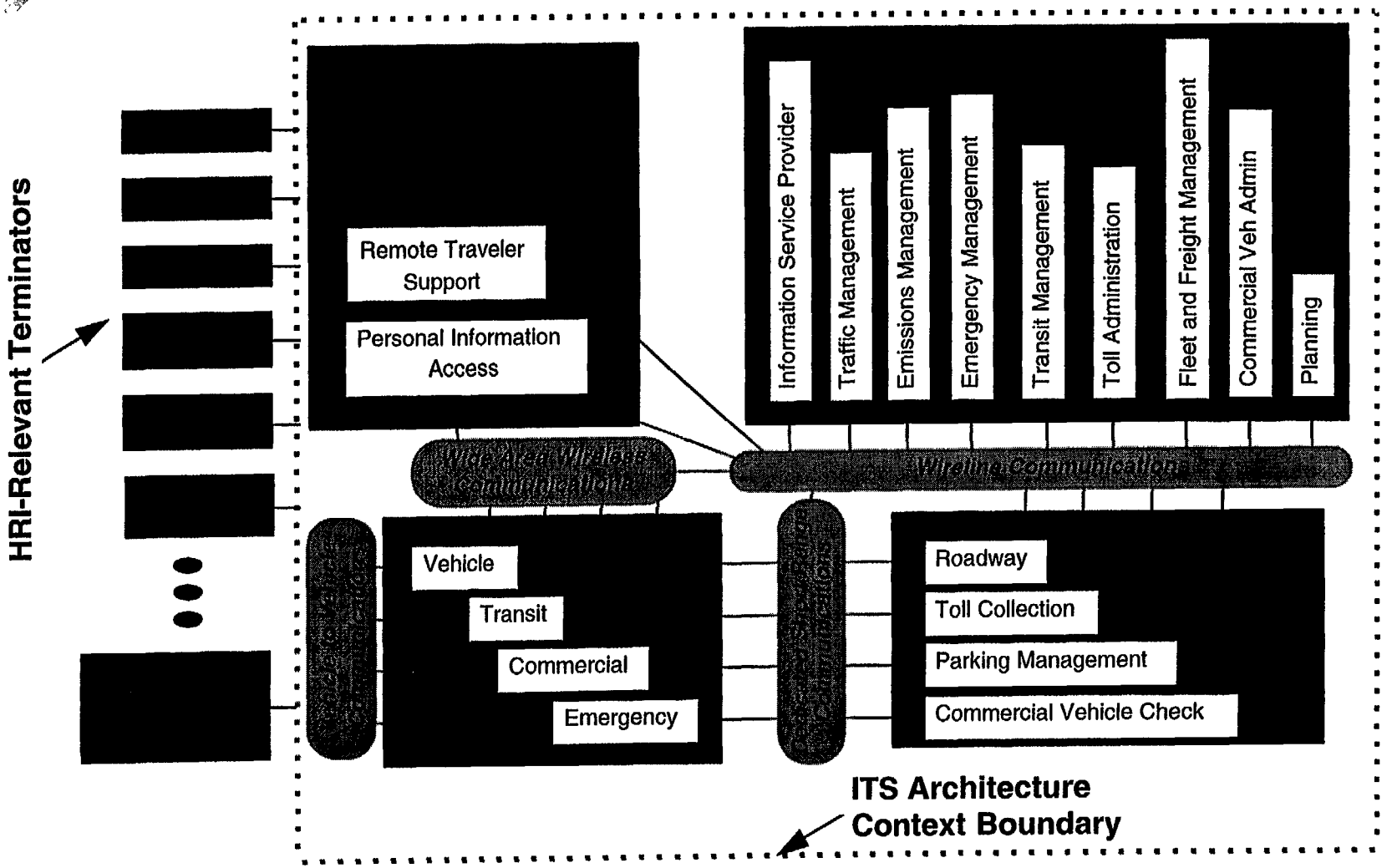
An overview of the HRI impact is most easily seen in the Physical Architecture

The National ITS Architecture: 3 Layer Architecture



- **Communications Layer**
  - Communications Document
  - "How is information transferred between Transportation Systems?"
- **Transportation Layer**
  - Physical Architecture Document
  - "What Transportation Systems transfer what information?"
- **Institutional Layer**
  - Implementation Strategy Document
  - "How can these new Transportation Systems be implemented over time?"

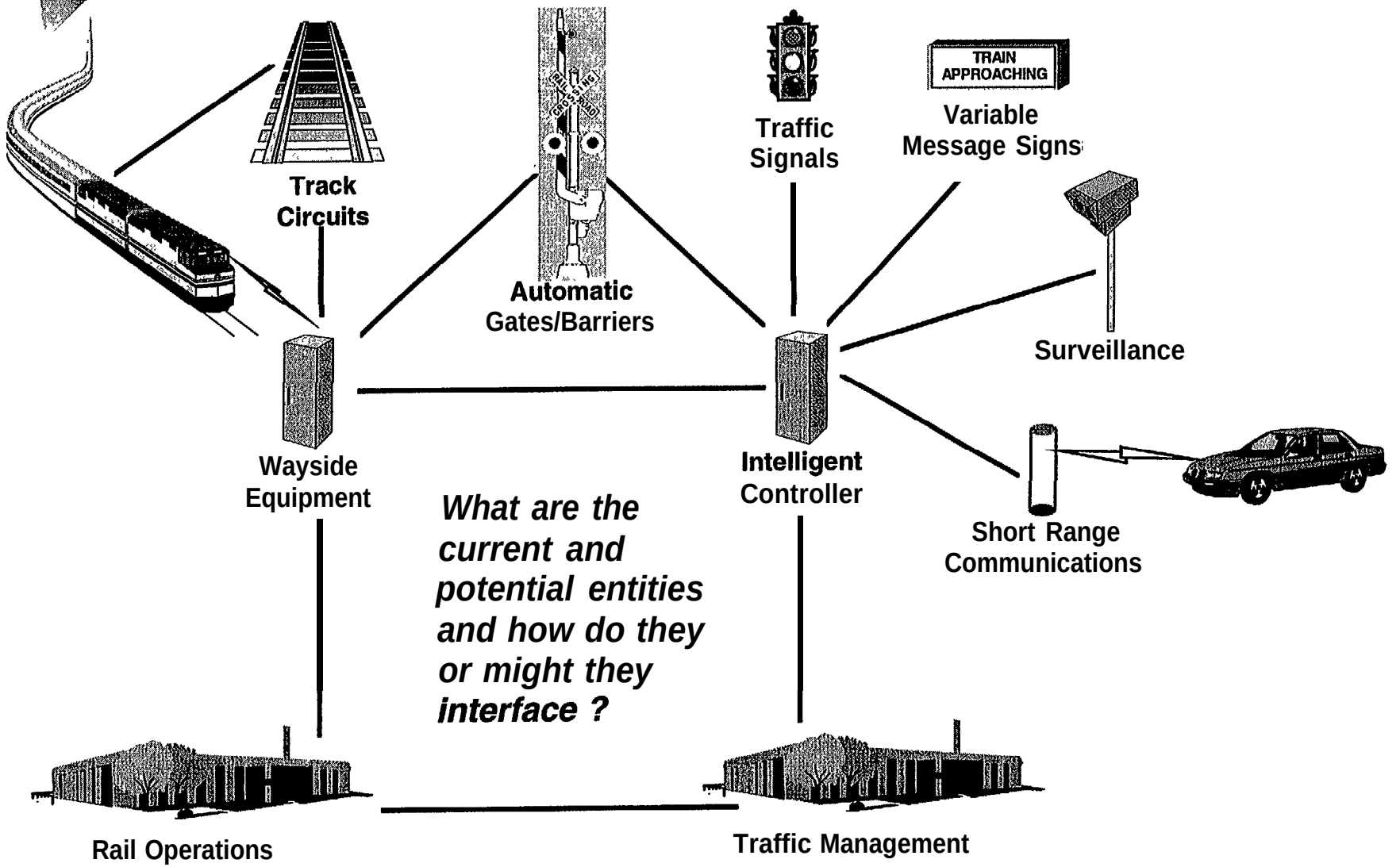
The National ITS Architecture: Baseline Physical Architecture



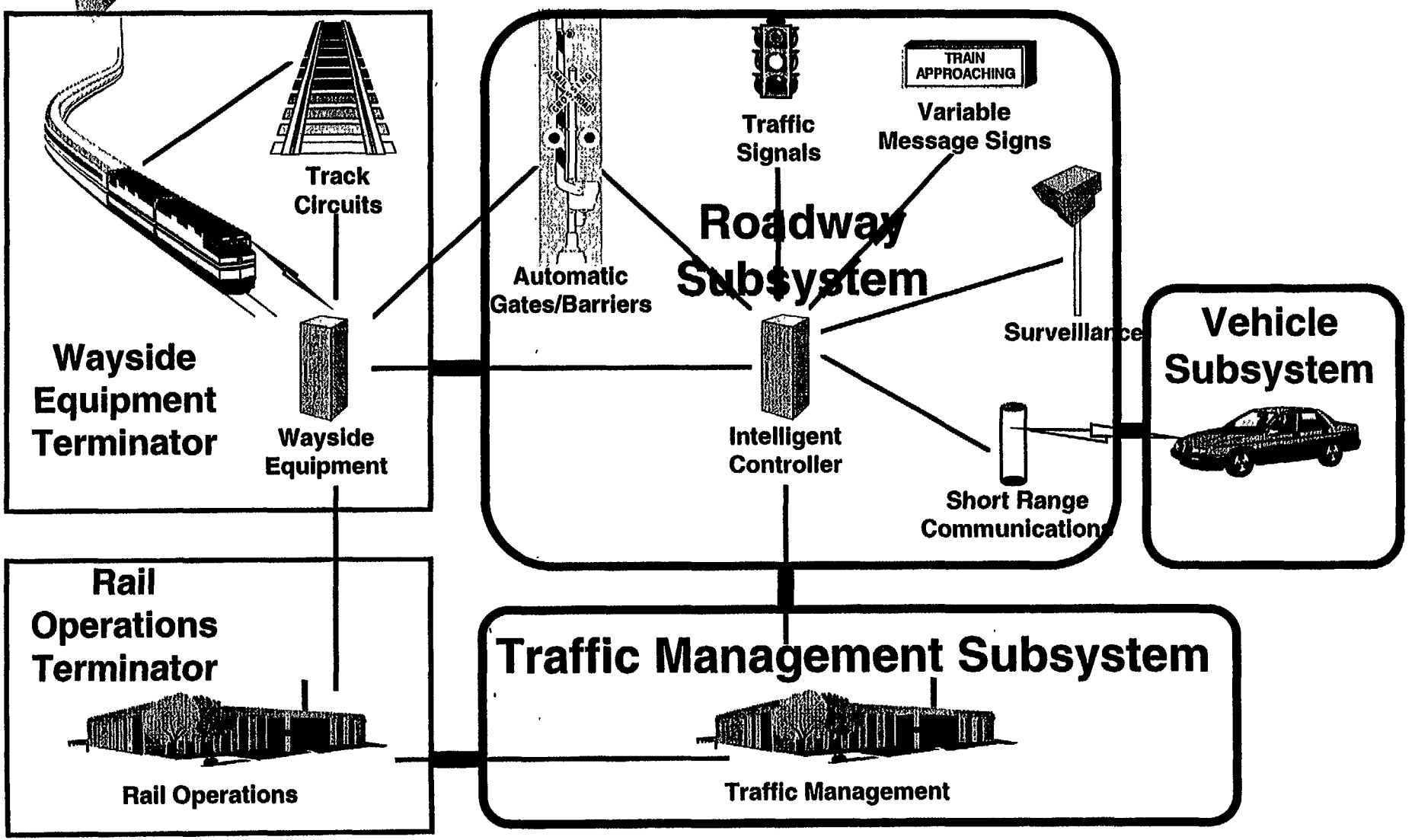
Some Drivers for Physical Architecture Decisions

- **What are the Existing System Boundaries?**
- **What are the Crucial Interfaces?**
  - Does the Interface:
    - Span Agencies?
    - Connect Public and Private Sectors?
    - Require Broad and Interoperable Implementation?
  - Are (1nter)National Standards Desirable?
- **Where are the Key Performance and Functional Requirements?**

The National ITS Architecture: HRI User Service Addition ***(1)***



The National ITS Architecture: HRI User Service Addition (2)



The National ITS Architecture: ***HRI*** *Update Summary*

- **Rail Operations and Wayside Equipment Added as Terminators**
- **Augmented Traffic Management and Roadway Subsystems**
  - New Traffic Management Equipment Packages
    - HRI Traffic Management
    - Rail Operations Coordination
  - New Roadway Equipment Packages
    - Standard Rail Crossing
    - Advanced Rail Crossing
- **Architecture Flows Defined and Mapped to Communications Interconnects**
  - New Flows Identified (e.g., Rail Operations to Traffic Management)
  - Existing Supporting Flows Reviewed (e.g., Roadway to Vehicle)
- **Communications and *Cost* Analysis Reviewed/Revised**
- **Result: *HRI is now an Integral Part of the National ITS Architecture and will be reflected in all guidance; maintenance, and support efforts***

Applications of the HRI Additions to the Architecture are underway ...

- TTI has established a public/private partnership to establish an ITS research facility
- One area of interest is in developing an experimental HRI at the AAR-TTI Rail Research Lab for further R&D

TransLink
http://translink.tamu.edu

TransLink Program
Texas Transportation Institute
College Station, Texas
77843-3135

Railroad Subsystem

Research

Lab Development:
Railroad Subsystem
Emergency Services
Transit Information
Transportation Center

Partners

Houston Metro
Rockwell Intl
TxDOT
TTI
U.S. DOT

Papers

Contacts

Train operations cause thousands of hours of vehicle delay nationwide each day and frequently disrupt emergency vehicle operations and transit service in most urban areas. Recent changes in railroad operations will only compound these problems. Recent mergers and consolidations in the rail industry will result in more frequent, longer, and higher speed trains operating in some of the nation's most congested rail corridors. As the highway system heads toward gridlock, trains will carry more and more freight.

"... a two-way information link ..."

In addition, thousands of motor vehicle-train accidents occur at highway rail crossings each year. Often, these incidents are only disruptive, but illustrated by a recent train passenger transport accident in Ft. Lauderdale, Fl. that resulted in six fatalities. Accidents, such as this one, have prompted Secretary of Transportation Pena to call the highway-rail intersection one of the greatest safety problems remaining in the United States.

Ongoing Architecture Program

- **Architecture Activities**
  - Addition of New Services (Freight, Weather Information)
  - Architecture Maintenance
  - ITS Deployment Support
  - Support for Architecture Training Activities
  - Standards Development Organization Support

Architecture Maintenance

- **Address Updates, Consistency, Terminology and other Issues**
- **Levels of documentation change**
  - + Republish documents (When Major changes occur)
  - + Errata pages (Per Document as changes occur)
  - + WWW Files (Dated for each document or page)
    - + Web sites at ITS America and Rockwell
  - + Change Log

ITS Deployment Support

+ **Meet with State and Local Implementors (e.g. *MDI Sites,* *CVISN MDI Sites, Operational Tests and Demonstrations)***
+ **Make Architecture Tools Accessible**
  + National ITS Architecture Home Page
    + Provides a Hypertext Tool for Architecture Use
  + CD ROM Versions of Deliverables
    + Combines Documents and Hypertext Versions of the Architecture
+ **For HRI: Promote Integration and Deployment**
  + **ITS** America Annual Meeting special session
+ **Support JPO's development of ITS Guidance Documents**

Support for Architecture Training Activities

- **JPO Undertaking Development of Architecture Courses**
  - Courses address varied needs: planners to deployers
  - Part of overall ITS educational outreach
- **Architecture Team Developed Course**
  - Aimed at the System Engineer/Architect
  - Emphasis on National Architecture products as tools
  - Available July 1997

Standards Development Organization Support

IEEE

- *Message Sets for DSRC/AVI*
- Data Dictionary Specification
- *Message Sets for Incident Mgmt*
- Survey of Comm Technologies

SAE

- High Speed Subcarrier Message Set
- *Traveler Info Data Dictionary/Message Set*
- Location Referencing Specification
- Interactive Route Guidance Message Set
- Mayday Reporting Interface
- Safety and Human Factors
- ITS Map Datum
- ITS Data Bus

AASHTO

- *NTCIP*

National ITS Architecture

ITE

- *ATMS Data Dictionary*
- Transit Version of NTCIP
- *2070 Controller*
- *External TMC Message Set*

ASTM

. DSRC Level 1 and 2

Conclusion: Facilitating HRI Deployment

- **The incorporation of HRI in the National ITS Architecture complete**
- **Framework for integrating HRI into overall ITS efforts in place**
- **Consideration of HRI Interfaces by ITS Standards Development Organizations beginning**
- **ITS Deployment Support in place to promote integration and coordination**

Supporting Highway-Rail Intersections in the National ITS Architecture

Bruce Eisenhart

Richard Hooper

ABSTRACT

The National ITS Architecture has been established after years of development by the FHWA. During the last year, the National Architecture was revised in incorporate User Service #30, the Highway-Rail Intersection. The addition of HRI establishes a baseline from which new systems configurations can be built with greater integration between Rail wayside equipment and surface traffic management systems. This will improve the response time of both rail and highway systems to incidents and other traffic conditions. The HRI additions to the National Architecture resulted from extensive discussions with key stakeholders from industry and the public sector. The HRI additions will impact standards developments and future ITS systems design.

TRANSCRIPT

of

STEVE ROOP

Texas Transportation Institute

SPECIFIC APPLICATIONS OF ITS TO GRADE CROSSINGS

SPECIFIC APPLICATIONS OF ITS TO GRADE CROSSINGS

STEVE DITMEYER: Our last speaker this morning is Steve Roop, from Texas Transportation Institute. I think Richard here gave a few kudos to them. They're doing very interesting work and Steve is going to talk to you about it.

STEVE ROOP: We're going to try a modal shift here. Well, I have the pleasure of getting to speak to you a few moments about a practical application of a lot of the concepts we've been talking about this morning. The venue that we're operating in is in the Pacific Northwest, in conjunction with Burlington Northern Santa Fe and Union Pacific's positive train separation project. Dr. Gallamore who was here just a moment ago will, I know, speak more about that tomorrow and in greater detail and elaborate on PTS and how it will eventually form the basis of PTC, positive train control or precision train control.

Larry Milhon and John Hatton, two of our railroad supporters, are in the audience today. I'm pleased to see them. And, of course, our fundamental support comes from the USDOT, through FRA and FHWA. Our contract for this work, for the grade crossing component of the PTS project, is with the Washington State DOT on the Pacific Northwest high speed rail corridor. That's an area that overlaps with the railroads that are really fundamentally involved in the pilot project, looking at PTS technology which is an advanced train control approach to train control, train guidance, that's predicated on global positioning data.

The purpose of their project, first of all, fundamentally is to ensure the operational separation of equipment; trains, maintenance-of-way equipment, and trackside forces. PTS in its strict sense is viewed as a safety system. It obviously has vast and exciting potential for train control and for the management of assets far beyond what safety can do for their operation. And, as we've seen with the ITS User Service 30 architecture, there are a lot of ramifications at the highway-rail intersection.

A brief, rough schematic of the PTS system, I think this is fundamentally accurate, with onboard computers on the locomotives, GPS tracking, real time position information, a PTS controller that is a distributed communications systems along the wayside, and then a hard link

into the dispatching system of the railroads. In the case of Burlington Northern Santa Fe, that's in Forth Worth. In the case of Union Pacific, that's in Omaha. So, it's an exciting system in the sense that they will be able to gain very precise control over assets as far away as the Pacific Northwest and deal with them on this basis.

Now, we come to the highway-rail grade crossing. Some of the problems have already been alluded to. The cross bar is very typical of what the motorist sees at the highway-rail intersection. Motorists, and this is a sophisticated audience, but motorists are not always sure whether this is a logo or label or a traffic control device. As Dr. Gallamore pointed out it is a traffic control device. It varies from state to state but it does have some fundamental meaning to the motorist.

Then we have some other inconsistencies in the signing. These are your typical advance warning signs on highways. Here's what you get approaching a railroad, highway-rail intersection. It's round, the others aren't. And this is just tip of the iceberg in terms of the anomalies that you see in the highway-rail intersection. Then you have the odd configuration of devices that is really counter-intuitive in many respects. A dark signal at a highway-rail intersection is functionally equivalent to a green light at a highway intersection. And there are other problems; the flashing light obviously means stop at a highway-rail grade crossing. It means stop and then proceed with caution at a highway-highway intersection.

So, we're dealing with some of these things through the PTS grade crossing project. The anachronistic devices, driver expectancies and maybe another area that I thii ultimately is at the heart of the matter, that was touched upon briefly, is where the public safety interests are best placed. Right now they reside heavily with the railroads and that's by default. There are historical reasons why this has occurred and ITS, the ITS technologies, I think are beginning to provide a means where maybe a more appropriate reallocation of those responsibilities can take place.

We've already talked about User Service 30. I figured, being the last in the program, that this would be redundant. So we'll just skim through this very briefly. I want to point out the middle one, the IIC, intelligent intersection controller. That is what TTI is building for this

particular project. We are building an IIC and hope to test it in the Pacific Northwest in conjunction with the PTS system.

Some of the things that we are going **to** check. We are going to develop a link from this intersection controller to the train control center, to the traffic management center, and we're going to experiment with a little different dynamic display at the grade crossing. I understand that this project is a non-safety-excuse me, it's a non-vital safety overlay. So, we will be operating still with the safeguards that are currently in force at all these intersections.

You just saw this a moment ago, I won't rehash this. What we're trying to do is combine elements of ITS and PTS. Really, the railroad's version of ITS, which is a forerunner of ITS in many respects, advanced train control systems, is invited in the positive train separation project. The use of computers, data radio, positioning satellites are all hallmarks of an Intelligent Transportation System approach.

The other thing we're trying to do in the grade crossing project is move away from track circuitry, look for another train presence detection approach and another activation method for the grade crossing warning systems. We're going to test an array of warning devices with hopefully these benefits; reliability, improve it. The current activation methods are fairly reliable but not 100% reliable and that creates a lot of problems. A lot of liability issues crop up as a result of that lack of reliability or perceived lack of reliability. And I think that point can be argued.

The devices that are in place today are probably not as flexible as the traffic safety professionals would like. Flexible in terms of issues like constant warning time. There's an industry standard of not less than 20 seconds. When you get into areas with a lot of variability associated with train speed, you've got a problem in translating those variable train approach speeds into a constant warning time. The devices used to do that are fairly expensive and probably not as accurate as we would like.

Reduced implementation and maintenance costs. Bob mentioned the number 80,000 to 100,000. I hear it kicked around as 150,000 to 200,000. So, I don't know which number is right, both are high, both limit the range of implementation for active devices at grade crossings. With

a communication based approach, we believe that we can dramatically reduce the cost by getting away from track circuits as the activation mode and spread the range of coverage dramatically.

Here's some of the devices that we're testing in the Pacific Northwest; a crossing mounted horn, a crossing illumination system, standards lights and gates, will all be activated by an intelligent intersection controller receiving real time train position information. The other two that we anticipate looking at here are getting real time train position data to a traffic management center, urban traffic management center. We're going to do that in this test using a cellular modem. That's a choice that gives us a lot of flexibility in the experimental realm. A lot of different approaches could be used here. Then we're going to work with a dynamic display that is going to be a combination of a two- or three-position light and changeable or variable message sign and will deliver contingent messages in a test situation to motorists.

This is the Pacific Northwest 1010 high speed rail corridor, from Eugene up to Vancouver, British Columbia. This overlaps Union Pacific and Burlington Northern Santa Fe tracks, where they're carrying out their tests. The track to the west of Olympia is a branch line called the Aberdeen line. That is likely where we'll perform some of our field tests. It's a low density line. We'll be able to control a number of different parameters on there, like stopping a train and asking him to back up and things like that, which we probably wouldn't get away with on UP's main line. We'd get away with it once, maybe.

Now, I'll call your attention to a slight variation. This is the way this system is designed. If you look at the cover of your brochure for this, I thought this was a very very nicely done cover. One exception is the communication to the vehicle. I'm sorry, the intelligent controller at the crossing really is not much different than a communication to a train. It's an address within the PTS communications network and it will emanate from the same location, which will be a PTS base station. So, we marked out one line, I think the red line, it looks like it's coming from the central dispatching station, and moved it over to what we interpreted as the PTS controller. That is, in essence, a very good diagram of what we're doing in the Pacific Northwest.

The intelligent intersection controller is a programmable logic controller that receives inputs and has the capability of a number of different kinds of outputs; serial, parallel, you name it, it can do it. So we've got a lot of flexibility at the grade crossing and can operate lights and

gates and horns and illumination systems and send packets of information to a traffic management center. That provides them with meaningful information.

The data requirements are really very modest in this respect. We're asking from the PTS system for the estimated time of arrival at an intersection and the estimated time of departure. Those are numbers that are easily calculated based on the algorithms and the equations embedded within the PTS system. This suggests, and a point I want to make right here, it suggests that the work we're doing needs to become, will become an integral part of the controlling software for the PTS system. Because, the highway-rail intersection is now becoming a feature in the railroad landscape that needs to be addressed by sending this kind of information in a prescribed, pre-prescribed manner with a determined frequency of transmission.

Our tests in the Pacific Northwest, both laboratory and field tests, are going to look at some very fundamental things. Accuracy of activation, does it work. We hope we get past the first bullet here. Accuracy of de-activation. We want to be able to set this controller at 25 seconds and time the activation to the lights and gates, and 25 seconds later we want to see a train at that intersection. We will measure the variability around our target time through multiple iterations on this test run. Accuracy of de-activation is just the opposite. When the train leaves the intersection we want to make sure that those gates are up within an adjustable, pre-determined time; five seconds, ten seconds, whatever the industry standard might be. We'll measure the variability associated with that. We're anticipating there's going to be more variability there because trains stretch and shrink depending on the terrain, depending on the characteristics of the movement at hand. We'll watch that very closely.

Reliability of the system. I mentioned reliability is an issue with the track circuits. We want to make sure that we are looking at 100% reliability and we'll measure that. If it's not 100% we'll troubleshoot it and then try to determine what, in terms of our best guess, what the level of reliability we can achieve is. Then compare the two systems.

In terms of some of our operational tests and we'll look at a dynamic display and we'll look at the ability to send contingent messages. Messages that have meaning beyond just stop and go. Potentially a message that will indicate, after the gates are down, that the crossing will be blocked for another two-and-a-half minutes, and have that message potentially change. With

the traffic management center we're looking at sequential activation of crossings in a corridor. We want to monitor that and I've got a little more on that here in a second. Then with a crossing mounted horn we want to measure the accuracy of activation, as well as being able to vary the pattern that is emitted, the auditory pattern that's emitted.

I harken back here, just briefly, to the public safety, public agency involvement issue and how traffic management centers are in a position to take a bigger role, a more active role, in the safety associated with this intersection, with this unique intersection. If we can provide them real time train position information then they can begin dealing a little more effectively with urban mobility and safety issues. They can choreograph traffic with changeable message signs. They can reduce exposure by shunting traffic away from a soon-to-be occupied highway-rail intersection. And having that anticipatory information and being able to react in advance of the arrival of the train is something that's new, something that's brought to us through the use of communication and ITS-ATCS technologies. We're excited about it, it looks very promising for getting more out of the limited resources that we've got on our urban freeways.

This is kind of a stylized diagram that shows what we want to put in a TMC. This is supposed to be a computer terminal. Showing the corridor, showing some intersecting roadways. I hope you can see in the back that there's a red, yellow, green display at the intersection. That indicates, obviously, the crossing is occupied, it's soon to be occupied, or it's clear. If you are routing an emergency vehicle from a traffic management center, this information is going to help.

We'll also annotate this diagram with some numerical information, ETAs, ETDs, and so on and so forth. So they'll have, you know, if it's going to take the fire truck ten minutes to get to the intersection and the ETD is in two minutes, that's a decision that could be made then with some degree of reliability.

Rural highway-rail intersections. Again, I'm repeating other people but I think what the PTS system and the approach the railroads are beginning to look at for train control and digital data radio and some of the other tools that we can bring to bear to the intersection problem, it allows us to greatly expand the range. To install active devices without relying directly on expensive and difficult-to-maintain, expensive-to-maintain, track circuitry. And we can begin working on a low cost alternative to passive systems. An automated cross bar comes to mind and

is often talked about in this regard, that could have characteristics of an active device, be operated through an intelligent intersection controller, receive the appropriate data, and do a better job of warning motorists.

Finally, these things have been talked about too, traffic signal interconnect. There's a world of possibilities there. This controller, this intersection controller, is going to be underworked in our application, I think. It's going to have certainly enough capability to deal with an adjacent intersection and maybe deal with the Fox River Grove kind of incidents a little better. Vehicle proximity alerting systems; we're beginning to work with a company out of Chicago called Federal Signal that employs an emergency radio data system. This is a standard radio that is commercially available, and may be standard equipment on new cars, that provides an in-vehicle warning to motorists with a short range transmission from the intersection. We'll dovetail our application with Federal Signal's and add that other user service, thirty capability.

Then down the line the potential for intrusion detection at the highway-rail intersection, within the venue of high speed rail.

PRESENTATION

of

STEVE CRANE

FHWA Office of Motor Carrier Safety Technology

ITS AND ITS EFFECT ON THE EFFICIENCY OF COMMERCIAL VEHICLE OPERATORS

National ITS/CVO Program Framework

Program Areas

Safety Assurance	Credentials Administration	Electronic Screening	Carrier Operations
• Access to driver, vehicle, and carrier safety information • Automated inspections and reviews • Onboard monitoring	• Electronic credentialing • Electronic one-stop shopping • Interagency data exchange • Interstate data exchange	• Automated weight and credentials screening (fixed site) • International electronic border clearance	• Fleet and vehicle management • Traveler information systems • Hazardous materials incident response

CVISN (Technical Infrastructure)

Mainstreaming (Organizational Infrastructure)

Expected Changes Due to Safety Information Exchange

- Increased Compliance with Safety Regs
- Real-Time OOS Verification
- Fewer Delays at Roadside
- Better Decisions on Who to Inspect
- Crash Reduction
- Access to Information from Other States

Battelle
Pulling Technology To Work

Expected Changes Due to Electronic Credentialing

- Faster Turn-Around Time
- Fewer Errors
- Information Shared Among Agencies
- Reduced Costs to Carriers
- Improved Accuracy and Data Completeness
- Increased Costs for Network and IS Support
- Time Savings

Baltelle
Putting Technology To Work

Expected Changes Due to Electronic Screening

- Easier to Target High Risk Carriers
- Industry Savings (Compliant Carriers)
- More Effective Use of Inspection Resources
- Increased Safety Compliance
- Improved Throughput at Scales
- Improved Traffic Flow

Baltelle
Putting Technology To Work

PRESENTATION

of

MIKE ONDER

FHWA ITS Joint Program Office

ITS AND INTERMODAL FREIGHT TRANSPORTATION

PRESENTATION

THOMAS J. KELLER Esq.

Verner, Liipfert, Bernhard, McPherson and Hand

RAILROAD RADIO SPECTRUM ISSUES

OUTLINE OF PRESENTATION

BY .

THOMAS J. KELLER

"RAILROAD RADIO SPECTRUM ISSUES"

JOINT FRA - ITS AMERICA

TECHNICAL SYMPOSIUM

INTELLIGENT TRANSPORTATION

SYSTEMS AND THEIR

IMPLICATIONS FOR RAILROADS

June 5, 1997

RAILROAD RADIO SPECTRUM ISSUES

1. Present use of mobile radio in railroad industry
   a. Approximately 1.4 MHz of spectrum
   b. Many and varied uses

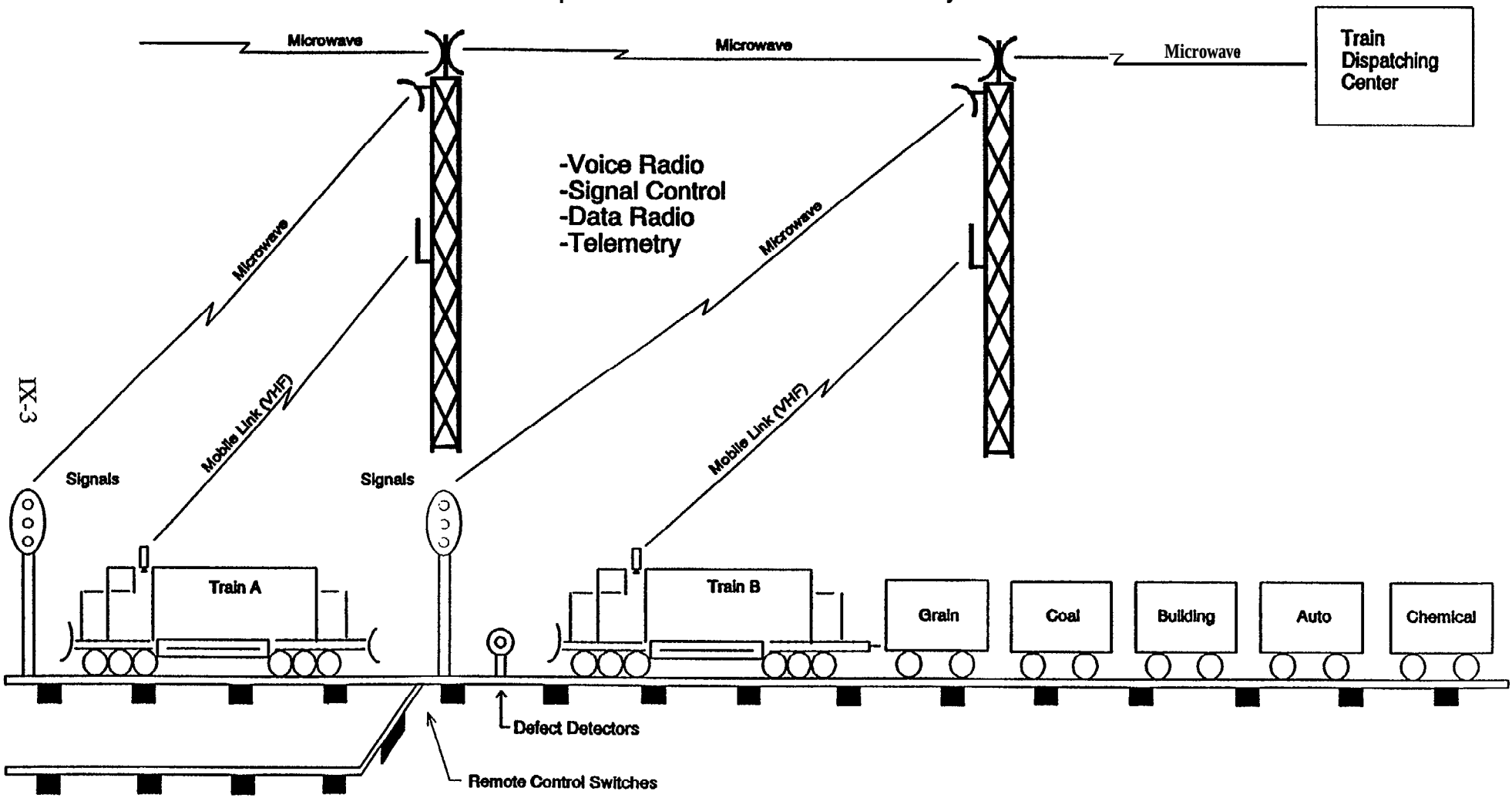
2. Recent regulatory issues
   a. FCC "Refarming" proceeding
      - channel splitting
      - sharing with non-railroad users
   b. Sharing with mobile satellite operators
   c. Maritime users

3. Future uses of radio by railroads
   a. PTC, PTS, ATCS
   b. Incorporation of GPS for position determination
   c. Mobile links to ITS infrastructure

4. Future access to additional spectrum
   a. TV channels 60-69 (10 x 6 MHz)
   b. Other frequency bands
   c. Spectrum auctions, spectrum lease fees

Railroad Radio Systems

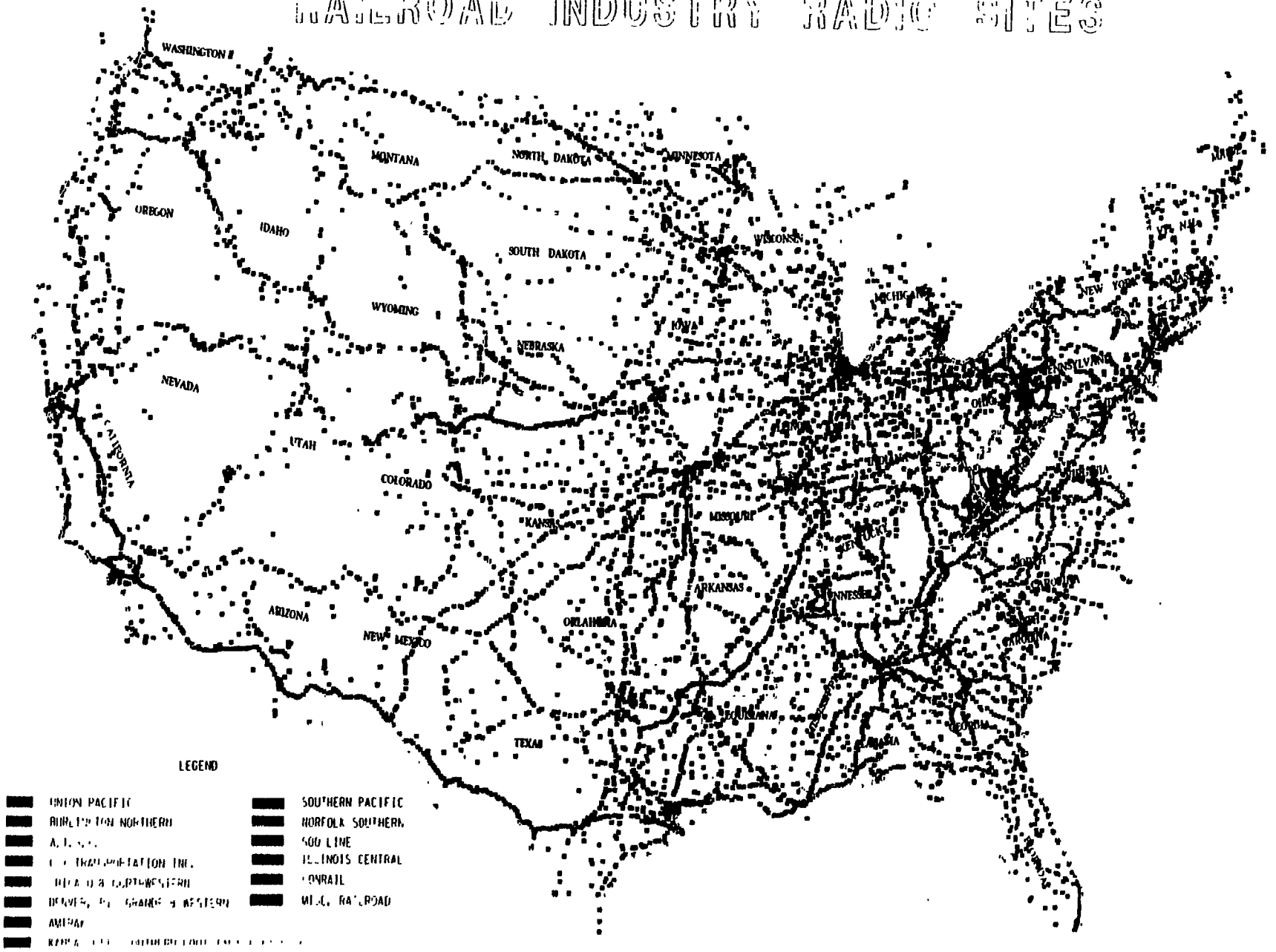
-are essential for safe, reliable, efficient rail transportation to interconnect train control systems.



Public safety is dependent on safe transportation.

Railroad freight transportation is critical to U.S. economy.

RAILROAD INDUSTRY RADIO SITES



Thomas J. Keller
Member of the Firm

Tom Keller . specializes in telecommunications and intellectual property law. His experience has covered a broad range of activities both in private practice and government service,

Mr. KeIler began his legal career in 1971 when he entered private practice and began representing clients in the fields of broadcasting, cable television and domestic communications satellites. In 1973, he was invited to join the legal staff of the Office .of Telecommunications Policy, Executive Office of the President, and served as General Counsel there from 1975 to 1976. At OTP, Mr. Keller assisted in formulating U.S. government policy. on copyright legislation, cable television regulation, . original frequency allocations for cellular telephones and SMR services, 'communications. privacy and. security, and international communications matters,

Since joining the Verner Liipfert law firm in 1976, he has represented clients engaged in diverse aspects of the media and telecommunications industries. These include numerous on-the-air radio .and TV broadcast stations in regulatory, contractual-.. and other Iegal. matters,. including copyright libel and program rights issues. Other clients include companies engaged in the manufacture and sale of two-way radios, electronics equipment and personal computers; companies that provide domestic as well as international satellite communications services; cellular telephone entities; SMR systems; and; large users. of communications technology such as railroads, electric utilities and large manufacturers.

Having served as Senior Advisor to the U.S. Delegation at the 1993 World. Radio communication Conference (WRC) in Geneva, and a member of the U.S. Delegation at. WRC-95,. Mr. Keller is presently serving as a member of the U.S. Industry Advisory Committee for the next World Radiocommunication Conference to be held in Geneva in November, 1997.

Mr. Keller received his law degree. from the- American University in Washington, D.C. in 1971. He has served as Adjunct Professor of Law at the Georgetown University Law School.

PRESENTATION

of

PAUL PISANO

FHWA Office of Safety and Traffic Operations

Research and Development

INTEGRATED WEATHER INFORMATION FOR SURFACE TRANSPORTATION

Weather Information for Surface Transportation:
Defming Needs and Planning Actions

FHWA Team Activity Summary
June 1, 1997

Background and Contacts

A ***Weather Team*** has been convened as part of the activities of the Intelligent Transportation System (ITS) Joint Program Office (JPO) of the U.S. Department of Transportation (USDOT). The Weather Team is under the Office of Safety and Traffic Operations Research and Development of the Federal Highway Administration (FHWA). The Team is defining federal activities to address needs and opportunities for supply and use of weather information across all surface transportation modes. Operators and users of surface transportation, suppliers of weather information, federal and local public agencies, and the private sector will be sought for guidance. The Weather Team will:

1. Integrate a multi-organizational approach for development and use of weather information systems within surface transportation.

2. Facilitate a complete definition of the weather information system that meets needs of all travelers and transportation providers.

3. Provide a focal point for technical information on surface transportation weather systems.

The Weather Team will produce in 1997:

- A White Paper to define system needs and to begin formulation of strategic and program plans for federal activities to meet those needs.

- A Problem Statement and solicitation for a system development project.

For further information, contact:

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Team Support:
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gnelson@mitretek.org

Weather Information System Perspective

A surface transportation weather information system will be part of the Intelligent Transportation System (ITS). The ITS is being coordinated by a National ITS Architecture and its derived standards activities. At present, the National ITS Architecture is complete at a high level, but needs detailing at a lower level for weather information. The standards effort most related to weather information is for Environmental Sensor Systems (ESS) under the National Transportation Communications for ITS Protocol (NTCIP).

An ITS-embedded weather information system includes, but goes beyond, the existing Road Weather Information System (RWIS). The RWIS originally was for highway maintenance decisions, and particularly for plowing of snow and treatment for surface freezing. The RWIS includes sensor systems operated by highway departments. RWIS users ***consult*** other sources of weather information, including products of the National Weather Service (NWS), and of commercial weather services. RWIS observational data can feed back into assimilated databases for use in NWS and private forecasting.

The Weather Team will expand the modal scope of RWIS to include all surface modes, with the opportunity for intermodal links to water and air terminals. The kinds of decisions that need weather information will be broadened beyond plowing and salting. Information needs will be considered for highway traffic management as well as maintenance, for the private or commercial traveler, for those who depend on transportation for deliveries, for the operators of freight or passenger transportation on road or rails, and for those who must use transportation in emergency response.

The scales of weather information to be considered are general and extend those of RWIS. The middle, "meso", scale of kilometer resolutions and lookaheads on the order of hours is central. But larger scales serve advanced trip or operations planning, and even climatic scales can be important to transportation planning. Smaller scales, based on direct or extrapolated observational data, serve warning and immediate-response decisions. Routing decisions for long trips are challenging because they require a range of scales fused into a uniform and route-specific presentation.

A preliminary finding is that there is already a wealth of weather information The focal issues are in fusing appropriate information, packaging it for transportation decision makers, and insuring that the people with weather knowledge and information affect the deployment of assets and control of transportation systems. Team analysis will focus on transportation decision makers and how they need and use weather information Their needs will define the "upstream" system components, including weather observations, assimilation of observations into a database, numerical forecasting, observation and forecast dissemination, data fusion, and finally the interface with the human. The human interface must be fully adapted to the task and environment, whether long-range planning, fleet dispatching from a central office, highway and track control, or operator decisions in a vehicle.

A System Vision

The vision is that various and decentralized surface transportation decision makers will share ***open*** systems for obtaining weather information. The sharing will occur at several scales. Nationally, some publicly established infrastructure will exist to spread common costs over many users, and similarly at state, regional ***or*** agency scales. This will reduce the costs to each user and enhance the exchange of information.

The open systems will support a variety of decision-specific, decentralized, ***applications*** at many levels. Openness is a principle of the National ITS Architecture and its standards activities. Openness means coordination of decisions through system interoperability. Openness means that any procurement will be competitive and that the latest technologies will keep being inserted. Openness means that there will not be a single, massive, system procurement at any level, but that 'the system" will evolve through its many, locally adaptive, constituents.

The vision is that each decision ***maker*** will have ***sufficient*** information. Weather information will be tailored to particular decisions. The information will be presented in a way that is comprehensible to specific users, so that favorable outcomes will occur in the transportation system. With proper applications of technology and an open system using a common infrastructure, cost will not be a major barrier to acquiring sufficient information. However, investments for various decisions will be commensurate with total public benefits from incremental improvements in weather information and the dependent decisions.

The institutional vision is as important as the technology vision. The vision is that surface transportation organizations have staff with appropriate levels of weather expertise and access to weather information. Institutional chains of command, internal communication and external coordination promote getting relevant information to the right people. Distance and other organizational barriers will have minimal effect on coordinating decisions.

A public-private allocation of roles is an important issue. The vision is that public and private activity will continue in both the decision making and the supply of weather information. The transportation system will continue as a public infrastructure with private operators, and weather information will be supplied to both sectors. Weather information will start with observations from many sources, but will continue to be centrally assimilated for NWS forecasting and other uses. The private sector will add value by application-tailored processing of observations and predictions.

How the increasing abundance of weather information is used is crucial. The vision is to educate decision makers in how to deal with the inherent uncertainties of weather information. Rather than seeking the unattainable "perfect forecast", the appropriate

scale of weather information will be used, and various sources of information will be mixed to produce the best decisions. Local, near-term decisions will use some simple observations and will invest in some additional sensors. Local observations will be usable by shared and assimilated databases to improve data and forecasts for all.

Existing and Non-Federal Efforts

The Weather Team builds on many existing efforts, but intends to feed, coordinate and expand them.

System requirements that need a national focus will be handed-off to the National ITS Architecture effort. There will not be a federally specified or acquired ITS, nor will there be a federally specified or acquired surface transportation weather information system. The architecture serves to identify issues of coordination at national and international scale. Systems will be acquired by the users, in the public or private sectors, and will be supplied through private industry. By obeying standardized protocols, the market for systems will be competitive and interoperable.

The need to specify weather information requirements more broadly and in more detail within the ITS has been recognized. The meteorological community through the American Meteorological Society (AMS) has joined with ITS America to form a Weather Information Applications Task Force (WIATF). The WIATF will be sponsoring papers to be cross-published in the meteorological and ITS communities to increase awareness of issues.

Federal activities in weather are in the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce. The Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) exists to create cross-coordination between NOAA, USDOT and other federal agencies. The NWS is undertaking its modernization program that will increase the capability of its field offices to analyze weather information and disseminate it to the public. Behind this is the development of better observational systems and numerical forecasts, especially at the meso-scale. The Weather Team will develop surface transportation activities with NOAA via the OFCM.

There will continue to be strong private sector development of weather technologies and services. While the NWS can provide a public base of information, specialized products must be privately provided.

Many state, and interstate, DOT activities are relevant. A compendium of these is being compiled. Research and development efforts will continue, and the Weather Team intends to focus federal sponsorship on the most outstanding needs. The federal role is to disseminate information on the best practices and on available technologies.

Team Objectives

Weather Team objectives are to:

- Define weather information as a context for making a wide variety of weather-related, surface-transportation decisions by those who use, operate, plan and build any mode of surface transportation.
- Review the processes that exist for making weather-related decisions, along with the kinds and quality of weather information that is used.
- Define the improvements needed in weather-related decision making to enhance surface transportation system performance.
- Review existing research and practices that can contribute to an improved system.
- Initiate a program of federal coordination to achieve the desired system including hand-off of system architecture and standards issues to the National ITS Architecture and standards teams, and insertion of program elements into various USDOT activities.
- Disseminate results to many national and local, public and private, interests for review and to promote participation in subsequent programs.

The Team seeks input on needs and opportunities to include in the White Paper on weather information for surface transportation, to be produced in FY 97. The White Paper will be the basis for planning future projects and coordinating activities.

PRESENTATION
of
RICHARD SHAMBERGER

FRA Office of Research and Development

PLANS FOR NATIONWIDE DGPS COVERAGE

Nationwide DGPS Coverage

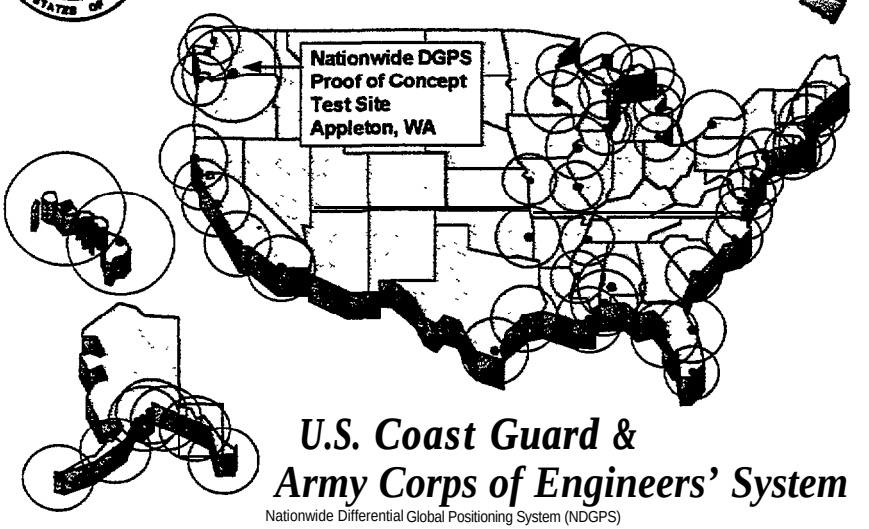
Richard Shamberger

Presented to the
. Joint FRA-ITS America Symposium

June 5, 1997

Nationwide Differential Global Positioning System (NDGPS)

Current DGPS Coverage



U.S. Coast Guard &
Army Corps of Engineers' System

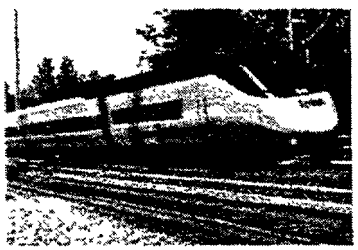
Nationwide Differential Global Positioning System (NDGPS)

Nationwide DGPS
System Characteristics

+ Redundant Coverage Nationwide
+ Availability greater than 99.9%
+ Provides 1 to 5 meter position accuracy
+ Time to Alarm 8 seconds
+ Continuous integrity monitoring by USCG
+ Nonproprietary International Standard
  - RTCM SC-104 and ITU-R M.823 compliant
  - 22 countries are currently testing or operating
  - 12 more countries plan to install systems this year

DGPS Requirements
Positive Train Control

- DGPS use in the Positive Train Control will
  - Prevent accidents, saving over $35 million per year
  - Reduce fuel consumption by better pacing traius
  - Increase rail line capacity through closer train spacing, reducing the need for additional capital investment in plant aud equipment



Nationwide Differential Global Positioning System (NDGPS)

DGPS Requirements
Intelligent Transportation System

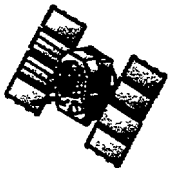
+ DGPS is currently being used in
  - Fleet Management Systems
  - Geographic Information Systems
    - Combination of electronic maps, databases and accurate DGPS location of all trains and buses
  - Automatic Vehicle Location (AVL) systems
    - Used to dispatch aud monitor truck fleets, police cars, ambulances, buses aud trains
  - Wayside Information Systems
    - Real-time graphic displays of a transit system in the train and bus stations

Nationawide Differential Global Positioning System (NDGPS)

DGPS Reauirements
Intelligent Transportation System

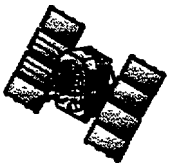
+ Precise DGPS will become part of the integrated vehicle safety system
  - An integrated vehicle safety system consisting of DGPS, map matching & communication links will:
    - Automatically notify emergency personnel when au air bag is deployed, allowing for faster response to the exact location, thus saving some of the 41,000 people who die on U.S. roads each year
    - Automatically reroute traffic around an accident, preventing multi-car pile-ups and improving traffic flow
    - Plot cost effective trips, thus saving both time and fuel

DGPS Requirements
Other Agencies



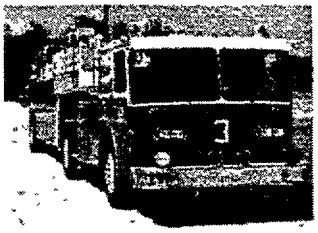
- 17 Federal Agencies have Public Safety missions
- EPA - Locate 1.4 million toxic waste sites
- DO1 (National Park Service) -
  - Search and Rescue, fire fighting and oil spills
- DOE - Continuously monitor shipments of radioactive materials
- DOJ - Locate FBI & DEA personnel in danger & traek vehicle location
- DOA - precision farming - application of pesticides and fertilizers and harvest yield monitoring
- Bureau of Land Management - mapping natural resources and tracking fire fighting equipment

DGPS Requirements
State & Local Governments



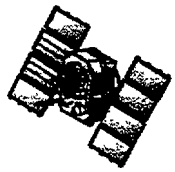
+ Many State and Local Governments

- Have contacted DOT asking that the DGPS System be expanded to cover the country
  - Mapping transportation infrastructure
  - Police, fire & ambulance 911 emergency response
  - Monitoring police officers' safety
  - Location of fire hydrants in snow
  - Monitoring contaminated well water
  - Monitoring endangered species



Implementation

The GWEN Opportunity



+ Background

- Air Farce plans to decommission the Ground Wave Emergency Network (GWEN) in 1999
- DOT plans to convert some GWENs into DGPS sites
- This is the largest Defense to Civil conversion in history

+ Nationwide Coverage

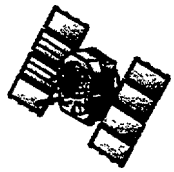
- 22 GWEN Sites
- 16 moved GWEN Sites
- 4-6 Sites will be used in Alaska

Implementation

+ Proof-of-Concept at Appleton, WA Site

- Proof-of-Concept for both
  - GWEN to DGPS Conversion
  - Positive Train Control
- Status
  - GWEN Equipment was Removed l/97
  - Engineering Site Survey was Completed l/97
  - MOA (FRA, CG, AF) was signed 3/97
  - DGPS installation was Completed 4/97
  - Testing will be Completed 12/97

Costs



Options	Capital cost	Annual Operating cost	Annual Maintenance cost
1. GWEN + Relocated GWEN	$ 10.7M	$ 1.9M	$ 1.2M
2. GWEN + New Sites	$ 11.1M	$ 1.9M	$ 1.2M
3. All New Sites	$ 16.1M	$ 1.9M	$ 1.2M

Nationwide Differential Global Positioning System (NDGPS)

Benefits

Organization	One Time Savings
FTA	$3.6M
USAF	$ 5.5M

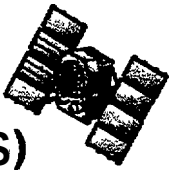
Organization	Annual Savings
Railroad	$35.0M
EPA	$1.7M
Forest Service	$1.3M
Agriculture	$8,700.0M
States	$47.3M

Nationwide Differential Global Positioning System (NDGPS)

Life cycle Cost / Benefits
OMB Circular A-94

+ Net Present Value
  - OMB Circular A-94
+ Based on 15 Year Life Cycle
+ Preliminary Estimate
  - Multi-Billion Dollar Benefits
  - Significant Saving of Lives
  - Total Life Cycle Costs $42.75 million

Nationwide Differential Global Positioning System (NDGPS)



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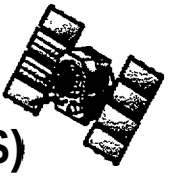
Nationwide . Differential Global Positioning System (NDGPS)



Len Allen

Transportation Policy

Department of Transportation

If you have DGPS requirements please send the information to:

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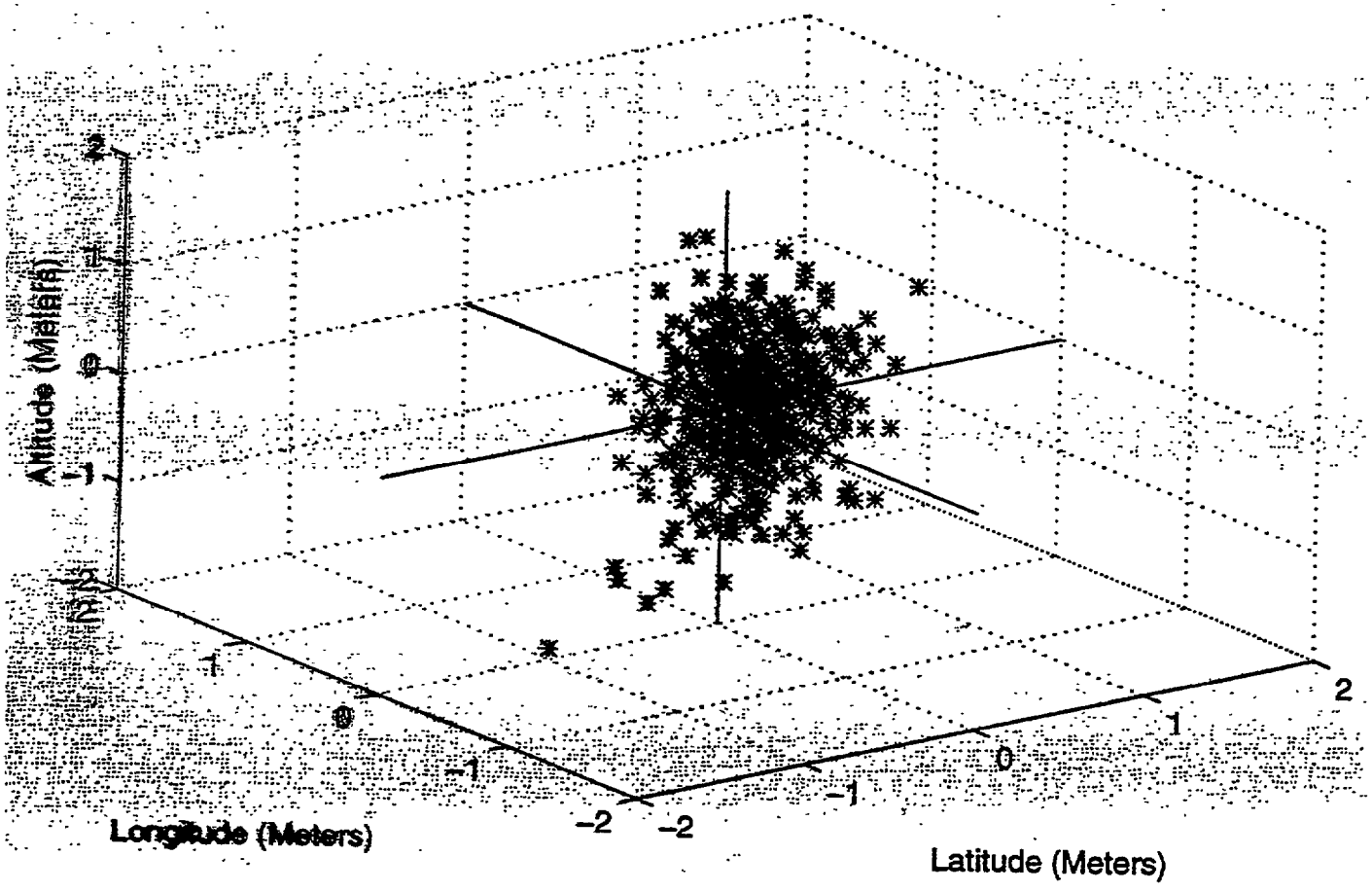
Fax: (202) 366-3393
E-mail: Len.Allen@ost.dot.gov

Department of Transportation
400 7th St S.W. Rm 10309
Washington, DC 20590-0001

Appleton, Side A
3D Radial Position Error (latitude x longitude x Altitude)



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TRANSCRIPT
of
THOMAS HUMPHREY

Consultant to U.S. DOT

PROFESSIONAL CAPACITY DEVELOPMENT FOR ITS

PROFESSIONAL CAPACITY DEVELOPMENT FOR ITS

STEVE DITMEYER: Here to speak with us is Tom Humphrey, recently retired from MIT, now a consultant to the Department of Transportation, who is running the Professional Capacity Development program.

THOMAS HUMPHREY Throughout its history, the U.S. Department of Transportation (DOT) has recognized the need to elevate the knowledge, skills, and abilities of surface transportation professionals to advance new technologies and programs. In the 1950s, the Interstate Highway System required transportation agencies to acquire and develop new road-building and civil engineering skills. In the same decade, the Federal Aviation Administration retrained its staff to master new electronics and advanced information systems that improved air traffic safety and efficiency.

Today, DOT is again rising to the challenge to build professional capacity. DOT is devising innovative training, education, and outreach programs to advance the deployment of intelligent transportation systems (ITS) infrastructure across the nation.

The introduction of ITS systems and technologies will expand the "business" focus of many public-sector surface transportation agencies from the building and expansion of physical infrastructure to include more extensive operation and management of existing infrastructure. This expansion of focus will fundamentally change the functions and routines of transportation professionals whose daily job is to support the flow of passengers and cargo across the nation.

In particular, ITS deployment will require skills that go beyond the borders of the traditional civil engineering knowledge of many of today's surface transportation professionals. ITS deployment rests upon a foundation of multidisciplinary knowledge, skills, and abilities. It requires expertise in information, communications, electronics, and automated technologies and systems integration. ITS deployment will also require unprecedented cooperation among public-sector agencies and between the public and private sectors, necessitating new skills in partnering, contracting, and negotiations.

Goals of the Professional Capacity Building Program

In March 1996, DOT and the Intelligent Transportation Society of America (ITS America) launched a five-year Professional Capacity Building (PCB) Program to support the national goal to deploy ITS infrastructure in the 75 largest metropolitan areas by 2005. The PCB Program has four primary objectives:

- Ensure that sufficient numbers of trained public transit, highway agency, and motor vehicle regulatory professionals are available to build, operate, and maintain an integrated, interoperable, and intermodal ITS infrastructure, particularly multimodal transportation management and traveler information services.
- Cultivate the next generation of transportation professionals to staff ongoing and future ITS deployments and operations, particularly by instilling interdisciplinary knowledge and skills.
- Increase the awareness of ITS benefits and deployment options among public-sector decision-makers and industry, particularly regarding interjurisdictional cooperation, public-private partnerships, and funding.
- Raise public awareness about ITS benefits and services to create informed transportation users.

DOT and ITS America guide the PCB Program in cooperation with a steering committee of prominent transportation professionals from government agencies, academic institutions, and the private sector; the commissioner of the Georgia DOT, Wayne Shakelford, serves as the chair.

The Need for ITS Professional Capacity

Since 1992, a series of studies, reports, conferences, and workshops have identified the need to develop a new “breed” of transportation professional to deploy ITS. This early research revealed four fundamental facts.

First, ITS deployment will require skills unfamiliar to today’s cadre of transportation professionals. According to a survey conducted by the Institute of Traffic Engineers (ITE), 44 percent of the respondents working within local agencies judged their ability to operate and

maintain advanced traffic management systems as fair or poor, and 35 percent of those same respondents stated that the lack of qualified technical and maintenance personnel was a severe or major problem. For state agencies, 50 percent of the respondents rated their ability to operate advanced systems as fair or poor, and 66 percent rated their ability to maintain such systems as fair or poor. Of these respondents, 71 percent felt that improved training would increase their ability to maintain such systems.

Second, trained ITS professionals do not currently exist in sufficient numbers to effectively support widespread ITS infrastructure deployment. ITS deployment will require more transportation professionals now and in the future. For example, according to ITE, 550 new entrants to the professional ranks of public-sector traffic operations are needed annually to meet current requirements. An additional 300 to 500 annual entrants are also necessary to met emerging needs such as ITS. The current curricula at many universities and colleges may be unable to provide these entrants with the requisite knowledge and skills. Notably, one report found that the "[Civil Engineering] baccalaureate candidate has been exposed to an average of 4.6 credit hours in all transportation subjects. His/her exposure to traffic operations principles and applications can be, literally, zero!"

Third, we need a deeper and more technical understanding of the requisite knowledge, skills, and abilities needed for ITS deployment. ITS deployment encompasses a broad range of activities, including promoting general awareness of ITS infrastructure and its benefits; mainstreaming ITS projects within the transportation planning process; developing regional frameworks that are rooted in the national ITS architecture; and installing, operating, and maintaining ITS infrastructure. We need a comprehensive and systematic method for understand what unique knowledge, skills, and abilities are required for each stage of ITS deployment and by which particular agencies. We must then develop appropriate education, training, and outreach programs to build professional capacity.

Fourth, we must determine and understand the best methods to deliver ITS training, education, and outreach programs. There are already existing ITS courses, which have been developed by federal agencies and associated training institutes such as the National Highway Institute and the National Transit Institute, state agencies, universities and colleges, and professional

organizations. The PCB Program is determining how these courses could more keenly serve ITS deployment needs. In addition, course development and delivery of both new and existing courses must surmount practical obstacles to learning. An ITE report, for example, identified five critical reasons why transportation staff do not receive adequate training: heavy workload; unavailable funding, long duration of courses, inconvenient place of training, and inconvenient scheduling of courses. Thus, new delivery media such as distance learning, interactive CD-ROM, and other innovative technology-based programs must be pursued.

"Tracking" Professional Capacity

The PCB Program proposes to address professional capacity building needs within a framework that places targeted audiences into three tracks that focus the development and delivery of ITS training, education, and outreach programs.

As shown in the accompanying table, Track 1 targets existing transportation professionals and trained professionals from other fields including academic faculty and consultants working with public agencies — whose expertise supports ITS. Track 2 advances the development of future transportation professionals and leaders, including students at universities, colleges, and technical and vocation schools. Track 3 builds the awareness of elected and appointed officials who have influence over transportation policies, especially concerning funding, land use, environmental protection, and quality of life. This track also raises the awareness of the traveling public, which benefits from ITS deployment. In little more than a year, the program has made considerable progress in each track.

In Track 1, which addresses the current training needs within the federal ranks, as of the end of May 1997, DOT:

- Presented a one-day ITS Awareness Seminar in 11 DOT regional and in 21 Federal Highway Administration (FHWA) divisional locations. Approximately 800 individuals participated in these seminars. The number of participants will reach 1,500 by the end of fiscal year 1997.
- Prepared and piloted a four-day course titled "Integrating Intelligent Transportation Systems" in Washington, DC., in June 1987. This course will be presented to about 400 state, regional, and local professionals by the end of the fiscal year.

PCB PROJECTS FOR TARGETED AUDIENCES

	Track 1 Current Professionals	Track 2 Future Leaders	Track 3 Deployment Decision-Makers
Program	Training and/or retraining of existing professionals	Facilitating the education of future transportation professionals	Public outreach
Objective	Continuing education and expansion of the trained pool of ITS practitioners	Facilitate the development of next generation of ITS leaders	Informed decision making for transportation and ITS
Substance	Seminars, workshops, short courses	Courses, programs, curricula	Public information
Audience	Federal, state, regional, local	Undergraduates, graduates, faculty	Public decision-makers, elected and appointed officials, pre-college students
Media	Classroom, distance learning, CD-ROM, non-traditional forms, WWW	Various new media, traditional classrooms	WWW, PBS/television, literature, video
Delivery Organizations	DOT headquarters, National Highway Institute, National Transit Institute, Local Technical Assistance Program, DOT regions, divisions, technical/vocational schools, universities, private sector, professional associations	Universities, colleges, community colleges, technical schools	Professional associations, public technology companies, ITS America

- Developed a series of nine one-day technical guidance seminars and workshops targeting federal, state and local ITS professionals. In cooperation with universities and professional associations, the PCB Program will deliver 20 seminars to approximately 500 individuals in 1997. Two workshops on telecommunications have already been presented and are now available to interested states and localities.

In Track 2, which promotes the development of future transportation professionals, we:

- Coordinated with the National Transit Institute (NTI) to develop ITS technology training for the transit industry.
- Launched programs with universities to assess educational needs and design model courses and curricula.

In Track 3, which aims to increase the awareness of public decision-makers, we:

- Developed and delivered Executive Scanning Tours and Reviews, which allowed high-level public-sector officials, legislators, and industry senior executives to view ITS deployments first-hand.
- Developed an Intelligent Transportation Infrastructure "Toolbox" for FHWA and Federal Transit Administration field offices.

Going Forward

Building the professional capacity needed to support deployment of ITS infrastructure is and will continue to be a priority for DOT. Going forward, the PCB Program will be needs-driven — continuously assessing training, education, and outreach needs. It will develop and offer training and educational programs to meet current and future demands. And it will infuse ITS into the mainstream thinking of government, industry, and academia. Also in the future, the PCB Program will expand to address the professional capacity needed to support rural ITS infrastructure and commercial vehicle information systems and networks (CVISN).

As it has done in the past, DOT will ensure that transportation professionals, decision-makers, and travelers can support and effectively use the technologies and systems — in this case, the new ITS infrastructure — that will advance the safety, efficiency, and quality of the nation's surface transportation systems.

The above article was ***written by Mr. Thomas A. Humphrey and reprinted with permission from PUBLIC ROADS, September-October 1997.***

PRESENTATION
of
ROBERT GALLAMORE

Union Pacific Railroad

THE FUTURE DIRECTION OF POSITIVE TRAZN CONTROL

The Future Direction of Positive Train Control

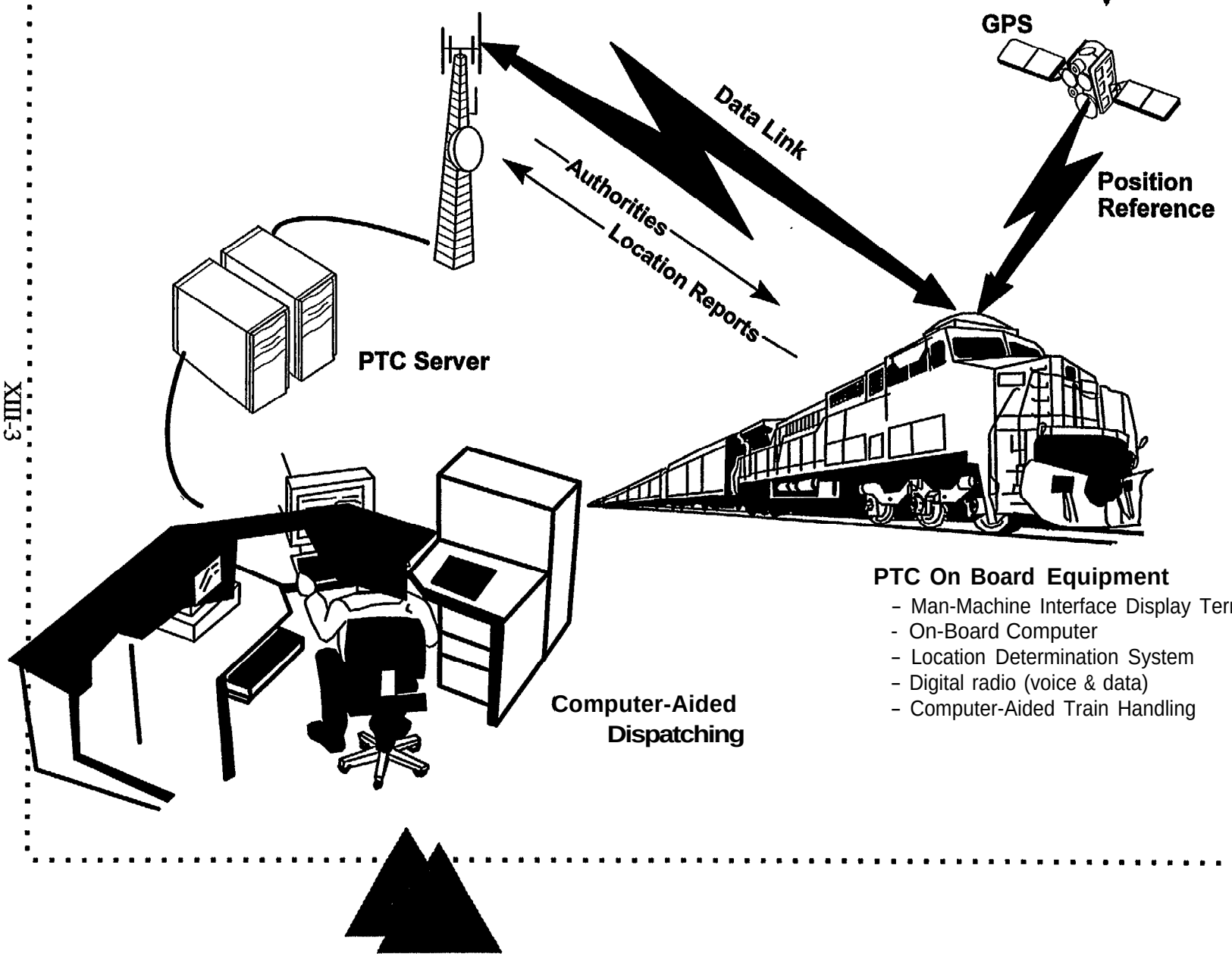
Washington, DC

June 5, 1997

Positive Train Separation

- Non-Vital, Safety Overlay System
- Prevents Virtually all Human Caused Collisions and Accidents
  - Between Trains
  - Between Trains and Maintenance Crews
  - Due to Overspeed Conditions
- Enforces Train Movement Authorities and Speed Limits
- Pilot Region is in Pacific Northwest

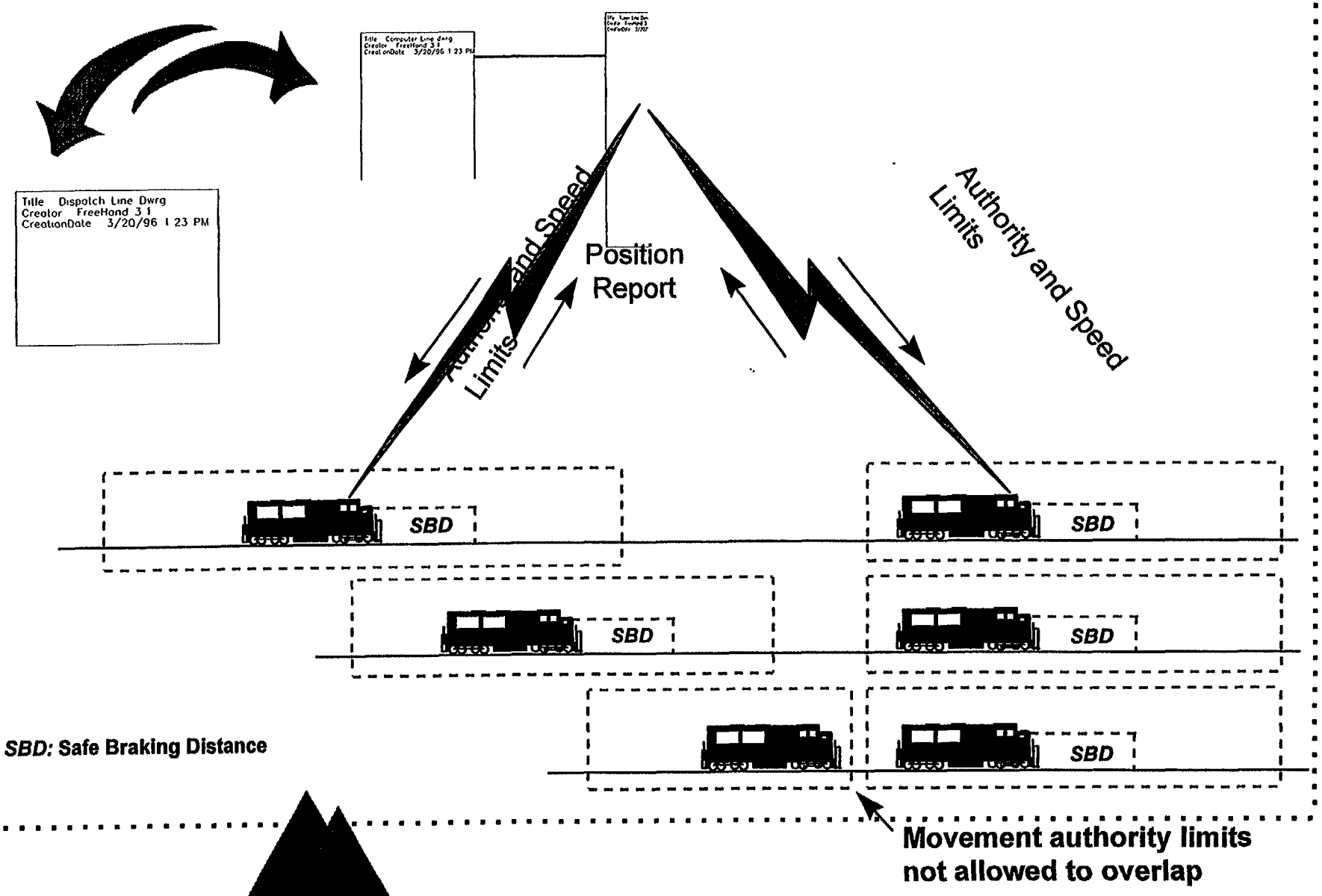
Positive Train Control



PTC On Board Equipment

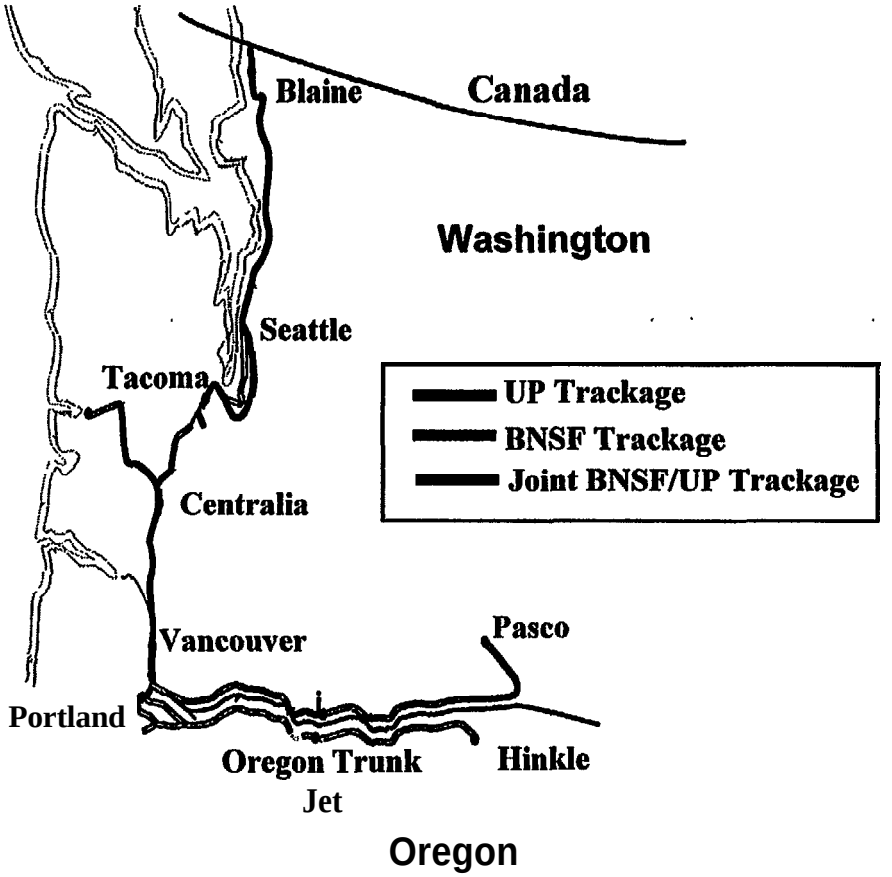
- Man-Machine Interface Display Terminal
- On-Board Computer
- Location Determination System
- Digital radio (voice & data)
- Computer-Aided Train Handling

Basic PTC Operation



SBD: Safe Braking Distance

UP/BNSF PTS Territory



- Total of 845 Miles
  - **BNSF = 570, UP = 275**
  - **665 Miles of CTC Territory**
  - **65 Miles TWC/ABS**
  - **53 Miles of TWC**
  - **62 Miles of ABS Double Track**
- 193 Miles of Joint Track Operation

PTS Releases

- Release 1 Deliverables (Completed November, 1996)
  - Install and Test all Locomotive and Dispatch Office Hardware
  - Send Track Warrants to Equipped Locomotives
  - Track Locomotives using Track Transponders
  - Perform Predictive Enforcement Stop of Track Warrant
- Release 2 Deliverables (May, 1997)
  - Install and Test Location Determination System Hardware
  - Multiple Locomotive Consist

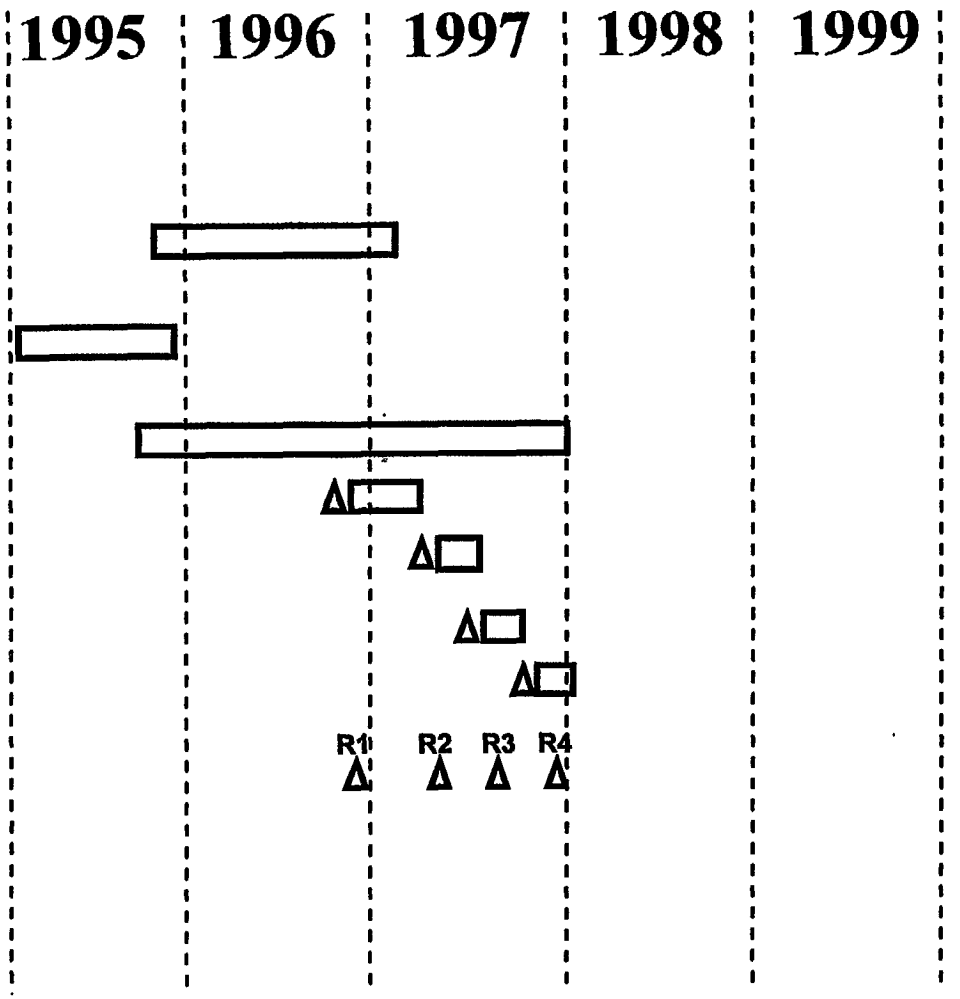
PTS Releases

- Release 3 Deliverables (August, 1997)
  - Full LDS Deployment
  - All Movement Authority Types Delivered to Trains
  - Manage Dynamic Train Consist
  - Manage Track Bulletins
- Release 4 Deliverables (December, 1997)
  - UP PTS Server to BNSF PTS Server Interface
  - Full PTS Interoperability Between UP & BNSF
  - PTS Server Redundancy

PTS Implementation

Activity

- Capacity Modeling (WSDOT)
- PTS Planning & Definition
- PTS Pilot Development
  - Release 1 install & test
  - Release 2 install & test
  - Release 3 install & test
  - Release 4 install & test
- PTS Pilot Demonstrations



Where is UP Going?

+ Complete PTS Pilot Project to Enable Design of Precision Train Control (PTC)

+ Developing New Computer Aided Dispatch System with CBTC Capabilities

+ Developing Cost/Benefits Analysis for Business Decision on PTC Implementation

Communications Based Train Control Systems

	Location Determination System	Block Flexibility	Braking Algorithm	Wayside-Train Communications	Architecture
UP-BNSF: *PTS/PTC*	GPS/DGPS/ Inertial Multi-Sensor Kalman filter	Dynamic Moving Block	Consist/Track Database - Adaptive (Learning)	900 MHz & *160* MHz	Open
Harmon-Amtrak: *ITCS*	GPS/DPGS	Fixed - Wayside Dependent	Discrete Tables (Fixed)	900 MHz	Proprietary
Illinois-CANAC-Arinc: *ATCS*	Transponder	Dynamic Moving Block	Consist/Track Database (Fixed)	900 MHz	Open
NS-CSX-Conrail:	— Under Study-				

Strategic, Technology and Regulatory Issues

+ Positioning Accuracy
+ Railroad Interoperability
+ Communications
+ Rail Integrity
+ Software Verification and Validation
+ FRA Safety Regulations
+ Liability
+ CBTC Benefits
+ ITS and CBTC Synergies

Positioning System Accuracy

- Availability of GPS (Accuracy ~ 100 Meters)
- PTS/PTC will use DGPS (Accuracy ~ 5 Meters)
- Must have Assurance of Government Support for Nationwide DGPS Coverage
  - What Specifications? (Frequency, Range, Security)
  - What Timetable?

Railroad Interoperability

+ Interoperability is the Capability to Move From One Railroad to Another at Track Speed

+ Rail Industry has Minimum Set of Functions that Must be Interoperable

+ Pilot Testing is Sorting Out Some of the Issues, but Difficult to Reach Industry Consensus

Communications

Now that FCC has made a decision on refarming....

- What is the VHF Network going to Look Like?
- What new RF Equipment Offerings will Affect CBTC and Voice Networks?
- Management of Communications
  - Shared Networks in Metropolitan Areas
  - Multi-Band Radios (e.g., VHF and UHF)

Rail Integrity

- Alternative Technologies:
  - For Broken Rail Detection
  - Rail Flaw/Misalignment Detection
- Also, New Inspection Strategies?
- Have to Keep D.C. Track Circuits Until Alternative Technology Solution
- Valuable Area for FRA and World Cooperative R&D $$

Software Verification and Validation

+ Verification of Source Code
  - Must be Both Quantitative and Qualitative
  - What Rail Industry Standard?

+ Software Validation
  - What will be Acceptable to FRA?
  - What is the Process to be Used?
  - How to Demonstrate??

FRA Safety Regulations

- Historical Approach: Command and Control
  - Waivers for CBTC = Cumbersome Process
  - What CFR Changes will be Required?

- Alternative: Risk Based Performance Standards Recommended
  - What Standards Should be Set?
  - Research and Benchmarking Needed (Including International)

CBTC Business Benefits: Is It A Public Policy Issue?

- NTSB and FRA want to attach Business Benefits to Safety Case for CBTC
- Volpe Center Study Underway with Some RR Data
- Cost and Benefit Streams Different for Each RR
  - Different Operating and Investment Strategies
  - Different Geography and Infrastructure Affect Migration
- RR Companies' and Regulators' Viewpoints very Different on Benefits Case for PTS/PTC

Liability

+ Tort Liability System has Huge Costs to Railroads

+ Do. Liability Laws. Retard New Technology Deployment? Three Areas will be Key:
  - Moving Block
  - CBTC Activation of Grade Xing Protection
  - Intelligent Transportation Systems (ITS)

ITS and CBTC Synergies

+ Natural Alliance of ITS and CBTC **Technologies**
+ Make Case for Surface Transportation **Mapping &** Positioning Systems/Protocols
+ Interoperable Equipment I.D. (Trailers and Containers) Has Not Happened - - Should It?
+ What is Next in Intermodal Surface Transportation Policy?

APPENDIX

PARTICIPANT LIST

INTELLIGENT TRANSPORTATION SYSTEMS AND THEIR IMPLICATIONS FORRAILROADS

Participant List: Intelligent Transportation Systems and Their Implications for Railroads

11-Jun-97

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1			Nishie	Yuji	Hitachi Software Engineering Americ	7226 Vistas Lane	McLean	VA	22101	703-748-0984
1	1		Nixon	Allan	Rail Systems Technology	PO Box 2248	Binghamton	NY	13902	607-770-4075

Registered	ITSA	Speaker	Last Name	First Name	Organization	Address	City	ST	Zip	Telephone
1	1	1	Onder	Michael	US DOT; ITS Joint Program Office	400 7th Street, SW, Room 3422, HVH-1	Washington	DC	20590	202-366-2639
1			Ott	George	Ashtech, Inc.	12030 Sunrise Valley Drive, Suite 300	Reston	VA	20191	703-476-2242
1			Panda	Durga	Image Sensing Systems, Inc.	1600 University Ave. W., Suite 500	St. Paul	MN	55104-3825	612-603-7700
1			Parker	Daniel	Integrated Systems Control, Inc.	350 Centre Pointe Drive	Virginia Beach	VA	23462-4415	757-473-9726
1	1		Parsons	Bob						
1	1	1	Pisano	Paul	US DOT, FHWA	6300 Georgetown Pike, HSR-30	McLean	VA	22101-2296	703-285-2498
1			Polivka	Alan	GE Harris	PO Box 8900	Melbourne	FL	32902-8900	407-242-5343
1			Proper	Allen	Mitretek Systems	600 Maryland Avenue SW	Washington	DC	20024	202-488-5705
1	1		Raisanen	Donald	MN DOT, District 3	1991 Industrial Park Road	Baxter	MN	56401	218-828-2463
1			Ralph	Robert	Norfolk Southern Corp.	34 Scruggs Street	Chattanooga	TN	37403	423-697-1076
1			Reddy	Ram	Apex Technology Inc.	1735 Jefferson Davis Hwy, Suite 907	Arlington	VA	22202	703-412-8966
1			Resor	Randolph	VP, Costing & Economic Analysis	PO Box 8407	Cherry Hill	NJ	08002-0407	609-779-7795
1	1		Reynold	James	PB Farradyne Inc.	5775 Blue Lagoon Drive, Suite 360	Miami	FL	33126	305-261-4785
1	1		Reynolds	Keith	Litton-PRC	1500 PRC Drive	McLean	VA	22039	703-556-2247
1			Rodman	Richard	KPMG Peat Marwick	2001 "M" Street, NW	Washington	DC	20036	202-467-3528
1		1	Roop	Steve	Texas Transportation Institute	Texas A&M University	College Station	TX	77843	409-845-5817
1			Roth	Stephanie	Railway Progress Institute	700 N. Fairfax Street, Suite 601	Akexandria	VA	22314	703-836-2332
1			Ryan	Timothy	TransCore	Suite 313, 8600 LaSalle Road	Baltimore	MD	21286	410-825-5414
1			Sandler	Jerry	Motorola, Inc	7230 Parkway Drive	Hanover	MD	21076	410-712-6405

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1			Scheid	Frank	Honeywell	7900 Westpark Drive, Suite A-530	McLean	VA	22102	703-734-7858
1			Schnacke	Dick	Amtech Systems Corporation	17304 Preston Road - E100	Dallas	TX	75252	972-733-6623
1	1		Schulz	Lance	NDSU	IACC Bldg, PO Box 5074, RM 430	Fargo	ND	58105	
1	1		Scrase	Richard	ITS International	Vigilant House, 120 Wilton Rd	London		SWIV ITZ	44-171-976-5870
1		1	Shamberger	Dick	US DOT, FRA, R&D	400 7th Street, SW	Washington	DC	20590	
1			Sherlock	Michael	AMTRAK	30th & Market Streets - 8th Floor	Philadelphia	PA	19104	215-349-3388
1		1	Simmons	Lee	ITS Joint Program Office	400 7th Street, SW, Suite 3422	Washington	DC	20590	202-366-8048
1	1		Smadi	Aymen						
1			Smith	Brian	Assn of American Railroads	PO Box 11130	Pueblo	CO	81001	719-584-0558
1			Sonefeld	Otto	AASHTO	444 N. Capitol Street NW	Washington	DC	20001	202-624-5813
1			Spofford	Paul	National Geodetic Society, NOAA	2724 Hillside Court	Ijamsville	MD	21754	301-713-3205
1	1		Starsman	Ray	ITS America	400 Virginia Avenue SW, Suite 800	Washington	DC	20024	202-484-2897
1			Strathmeyer	Audrey	ARINC, Inc.	2551 Riva Road	Annapolis	MD	21403	410-266-4754
1			Stroud	Bill	AMTRAK	Box 41 30th Street Station	Philadelphia	PA	19104	215-349-1986
1			Thelen	Gerhard	Conrail	2001 Market Street - C 12-A, PO Box 41412	Philadelphia	PA	19101-1412	215-209-4236
1	1		Thirumalai	K.	TRB, National Research Council	2101 Constitution Ave., NW	Washington	DC	20418	202-334-3568
1			Thornton	Thomas	Honeywell, Inc.	2600 Ridgeway Parkway	Minneapolis	MN	55413	612-951-6504
1			Tobin	Frank	Post, Buckley, Schuh, & Jernigan, Inc.	1211 Governor's Square Blvd., Suite 400	Tallahassee	FL	32301	904-877-7275
1			Turner	Allen	GeoFocus, Inc.	1155 NW 13th Street	Gainesville	FL	32601	352-336-8444

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1	1		Vercruyssen	Max	University of Hawai'i School of Medic	347 N. Kuakini Street, HPM 9	Honolulu	HI	96817	808-523-8461
1	1		Volz	Matthew	Kansas DOT	915 SW Harrison	Topeka	KS	66612-1568	913-296-6356
1			Webb	Jack	Texas Transportation Institute	CE/TTF Tower	College Station	TX	77843	409-862-7918
1			West	John	Caltrans	PO Box 942873, MS 83	Sacramento	CA	94273-0001	916-654-8877
1			Wilson	Frank	Rockwell Railroad Electronics	400 Collins Road NE	Cedar Rapids	IA	52498	319-295-4552
1			Woll	Thomas	FRA, Office of Safety	400 7th Street, SW	Washington	DC	20590	202-632-3314
1			Woods	Robert	Rockwell Railroad Electronics	400 Collins Road NE	Cedar Rapids	IA	52498	319-295-5910
1			Yacopino	Frank	Motorola	1309 E. Algonquin Road	Schaumbury	IL	60196	847-538-6001
1	1		Yomogita	Hiroshi	The Nippon Signal Co., Ltd.	13-8, Kamikazaki 1-Chrome	Urawa-Shi, Saita		338	048-859-2290
1	1		Zhang	Wei-Bin	PATH, UC Berkeley	1301 S. 66th St, Bldg 652	Richmond	CA	94804	
141	49	15								