ISSN 1052-7524

Proceedings of the Transportation Research Forum

Volume 7 1993

35th TRF Annual Forum
New York, New York

October 14-16, 1993

Advanced Train Control Systems: The Right Technology for Railroads In the 21st Century?[1]

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I am Randy Resor. I work for Zeta-Tech Associates, a technical consulting firm in the railroad industry. I have been involved in advanced train control since the fall of 1987. Anyone who has seen the current issue of Railway Age knows that there is something going on about advanced train control since the headline on the cover says, control systems multiplied, but where is advanced train control? Well, where indeed?

Today's panel includes 4 individuals who have been active participants in the development of ATCS, and a fifth who has been an interested although neutral observer of its development. Together, they may shed some light not only on where ATCS is, but also what it is, why it is important, and what it will do for the North American railroad industry.

The first speaker is John Reoch, Assistant Vice President, Operations for Canadian National. John was born in Nachuria, a fact that always interested me. He is a civil engineer and a graduate of the University of Toronto. He began working with CN in 1962. He has been involved in ATCS for nearly 10 years. He attended the first meeting to organize the project, and to discuss the way it would proceed, on September 23, 1983.

The next presenter is Jeff Young, Director, ATCS for Union Pacific. Jeff began his railroad career at Idaho Falls, Idaho, in June 1976. He has worked primarily in the operating and information technology departments at Union Pacific. Throughout his career, he has been involved with implementing technology in the railroad industry. He was assigned to his current position 2 years ago, and has responsibility for implementing the advance train control system, which he will discuss today.

Our next speaker is a person who has been an interested observer of the ATCS development project and an implementor of some advance technology using somewhat different specifications. Joseph Noffsinger is Chief Engineer, Communications and Signals, at Conrail. He got his BS in electrical engineering from Case Western Reserve University. He is Vice Chairman of the AAR Communications and Signal Division, a member of the AAR Signal Liaison Committee, and at Conrail, he is a member of the Operations Planning Team and the Engineering Department Quality Council. He recently completed 2 years with the National Railway Labor Conference negotiating a national wage skill differential agreement with railroad signalmen.

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[1] A grant from the UPS Foundation helped make this session possible.

Our next speaker, Lynn Garrison, is with Burlington Northern, and he was involved in the development and specifications of the ARES project. He is now involved in equipping locomotives with on-board digital communications. Lynn has a BS in electrical engineering, and a masters degree from Columbia. He was with Harmon Electronics for a number of years, and has been with Burlington Northern since 1984, starting as an engineer systems design and manager of the ARES data radio network until 1992. He continues to work on digital applications.

Last, but by no means least, is Chuck Dettman, Vice President, Operations and Maintenance of the AAR. In that position, he has responsibility for providing the industry effort to develop compatible specifications and a plan for implementation. He is a graduate of Georgia Tech and the Harvard Business School, who began work as an industrial engineer for the Missouri Pacific Railroad in 1964. He retired from the Union Pacific last year after 29 years and 17 jobs going from Assistant Train Master to Vice President of Transportation. He has been Vice President of Operations and Maintenance of the AAR since the first of this year, and he has been orchestrating the development of ATCS, and the development of an industry position regarding its implementation.

John Reoch
Assistant Vice President
Operations
CN North America

I think there are 2 main questions. One, looking to the next century, can the railroads not only continue to prosper, but once again become the dominant mode of overland transport? A subset of that question would be, does ATCS have a part to play in making that happen? The second question is, if ATCS is such a hot idea, why isn't everyone doing it? My answer to the first question is a double yes. I believe railroads can not only survive and prosper in the years to come, but railroads have a real chance to become once again the dominant mode of land transport, at least in the freight business. I believe ATCS will play an important part, although we must be clear, only a part, in making that happen.

To the second question, I would answer most railroads on this continent are using ATCS. That may not be fully recognized, and the answer leads to a discussion of a misconception about what ATCS really is.

First, however, let me start with the main issue the railroads must answer, in order to restore their dominant position. The railroad market share in the U.S. has remained constant at about $30 billion, in spite of inflation for a decade, while the market grew by about $60 billion to $189 billion. There is, therefore, an opportunity for railroads measured in billions of dollars. But can they achieve that revival? And, if not, why not? What is missing in what the railroads bring to the market?

First, however, let's look at what railroads do bring to the market – the areas where they already have an unassailable advantage.

First, railroads are safer than their competitors. Railroad fatalities are less than a third those of the trucking industry, and railroad fatalities are continuing to drop. But further, since most rail related fatalities are due to crossing accidents, it is arguable that they should not be attributable to railroads. Second, railroads are much more environmentally friendly than

their competitors. Lower atmospheric emissions illustrate one aspect of that. But rail also has a 3 or 4 to one advantage in terms of energy consumption.

Third, the cost of railroad transportation is much lower than that of its competitors. Admittedly, the truck number is probably a composite of some pretty short haul stuff. But nevertheless, on an overall basis, revenue per ton mile for railroads is much less than for trucks.

Since railroads are safer, more environmentally friendly, and cheaper, why are the truckers handling most of the business? Market analyses leave no doubt that the reasons go to the trucking industry's superior ability to provide fast and reliable service.

The same analyses, plus work that has been done in connection with the ATCS program, show that a very large part of rail service deficiencies can be tied to deficiencies in communications, information management, and operational control. That strongly suggests that solutions lie in the field of command control, communications and information technologies or C^3I, as it has come to be known.

That led a few of us about a year ago to articulate a vision of a technological framework that we believe has the potential to achieve levels of safety, efficiency, customer satisfaction, and profitability not otherwise attainable.

Obviously, this technological framework is not limited to ATCS. There are a lot of initiatives coming forward in the railroad industry encompassing the disciplines of information systems, telecommunications, and command and control technologies. That there is a worldwide revolution in these fields of technology is not news. The news for a railroad audience is that a pattern is emerging. If we stay the course, we will bring about an integrated information, communications, and control technology architecture to support the railroad industry, customer service, product quality, safety, and productivity.

The conviction of a growing number of people is that this technological revolution is a key to reversing years of declining railroad market share in intercity freight transportation, and a key to ushering in a new period of growth based on high quality transportation services.

Several projects of a technological character are underway in the railroad industry. A list of such projects can be organized according to which of 4 fundamental goals each project contributes to: customer service, product quality, safety, or customer service. ATCS, and the applications derived from ATCS, such as reporting work orders and monitoring locomotive operations, span the entire spectrum.

An integration of systems is a key to maximizing benefits. If ever there was a case where the whole could be greater than the sum of the parts, this is it.

The other conclusion I am attempting to illustrate is that ATCS is the backbone of the concept of an integrated set of technological applications.

A question is, however, how does one go about such an integration? It may seem such a daunting task that it would be bound to fail because of sheer unmanageable complexity. Actually, although the technology is complex, the ATCS program, and the architecture of ATCS applications, is such that a program of integrated applications can be quite manageable. At its simplest conceptual level, ATCS is nothing more

than a combination of 3 elements: a mobile or portable computer terminal in the field, a central computerized information or command and control center in the office, and a radio data link connecting the 2. As simple as this configuration may seem, however, there are a lot of different things you can do with it.

The most sophisticated ATCS system could be a fully automated train control system. At a low level of sophistication, ATCS could simply be the use of a portable terminal by track forces to report daily payroll and production data to the central office.

There are many other applications of the ATCS concept. Some are fully developed and in service, while others are at a more conceptual stage. But I really doubt that anyone has thought of all the possibilities of this relatively simple concept which has been brought about by the advent of the microprocessor coupled with mobile data radio technologies.

A perception that ATCS is not going forward on railroad properties may be due to a misunderstanding of what ATCS really is. Perhaps the following definition will help.

ATCS is a family of applications within the context of a common set of technical standards. The comparison might be made with the field of home entertainment electronics. There is a lot of difference, for example, between a VCR and a CD player, but both belong to a compatible set of products that work together on a common technological platform.

While it would be misleading to suggest that there is total flexibility among component ATCS systems, to some extent you can think of them as you would think of the components of a home entertainment system. A railroad can choose the applications that best suits its needs at the present time, leave others out, proceed as quickly or as slowly as it wants in a sequence of its own choosing, and exploit synergies as it adds applications.

This approach to ATCS creates a much more manageable program which avoids the need for a major, long term commitment except to the concept of standardization in order not to foreclose future options.

Still, a railroad is unlikely to want to commit to this direction of technological development unless it feels good about the economic viability of the whole package, regardless of how much that package it intends to use.

A few years ago, CN and BN, acting separately, made fairly comprehensive business cases for ATCS. A wide range of benefits were quantified that added up to $174 million in Canadian dollars per year. Costs spread over several years came to $366 million, plus incremental operating and maintenance costs of $24 million. That gave us a return on investment of 24%.

We also looked at some sensitivities. For example, if we cut the service benefits by half, we would lose 4 points on the rate of return. If we could reduce the cost by 10%, we would add 2 points.

But in fact, this business case is now obsolete. First, the costs are clearly overstated, because they were based on the cost of prototype products.

Second, the case excluded several benefit categories we now know about, although at that time we weren't so sure about.

We have been asked by the AAR Board of Directors to revisit these business

cases on an industry basis, and we expect to estimate a more accurate rate of return. Still, railroads are reluctant to commit to the whole program at once and should not be expected to. That is why the project team is continuing to work out a migration path approach which will contain several options for railroad managements to choose from that allows them to be even more selective in how they wish to commit to this technology while not foreclosing future options.

A simple way to illustrate this approach, which is gaining increasing acceptance, is to compare ATCS to a 2-story house. In this analogy, the first story is built around the mobile data radio network.

This provides the basis for a range of commercial applications of the ATCS concept. For example, on-board work order reporting, code line replacement, and locomotive health monitoring. The list is non-exhaustive.

The ATCS data link is critical because while any single application might be supported by one or another of the available commercial data radio links, it is neither feasible nor cost effective to support them all with general purpose commercial networks.

Further, the ATCS data link is the necessary first floor for the support of the ATCS train control applications in which vitality is a prerequisite, to use signal engineering terminology.

The key additional piece of infrastructure that must be added to the data radio infrastructure in order to create the basis for the ATCS family of train control applications is the central dispatch safety system.

Consideration is being given to developing this critical piece of software on an industry basis, thereby substantially reducing the cost to individual railroads.

Within both stories of the house, the concept is that each application listed, and others that will come along, will be financially self-supporting on a stand-alone basis. That is clearly the case in the first story, which is becoming accepted within the industry. Second story applications will take longer to put into place as we work out a development plan for the central dispatch software.

Where are we now? ATCS has made important progress in the last year or so. The AAR Board of Directors has adopted the ATCS data radio specification as industry standard.

This amounts to a kind of standard gauge decision for command and control systems.

At least 3 of the first story applications are available virtually off-the-shelf: on-board work order, code line replacement, and monitoring locomotive health operations. These are being implemented on several railroads, and others are being developed as railroads are increasingly adopting the first story principle, although such acceptance is not yet universal.

Serious consideration is being given to an industry program to develop the central dispatch software. In Canada, where the tragic accident at Hinton, Alberta, is still a recent memory, both CN and CP will soon implement limited-functioning train control systems.

ATCS is still some way from being adopted in its entirety by the railroad industry. I'm satisfied that good progress is being made and will continue to be made. I have little doubt that as we approach the end of the 20th century,

ATCS will become an increasingly important contributor to the railroad success in the 21st century.

Jeff Young, Director, ATCS
Union Pacific Railroad

ATCS began on our railroad about 1986 or 1987. We began at that time to do a train control pilot on one of our subdivisions in western Nebraska. It is primarily a coal line. We picked that area because we could keep locomotives captive. Since we were moving the control system from the track structure into the locomotive, keeping the locomotives in a captive area is a key component of a pilot test.

We quickly learned, however, that there was a set of complex issues that needed to be addressed. Even though everybody in the industry still refers to this as ATCS, I would prefer to call it advance railroad management systems or something to that effect. Train control is just a piece of this technology.

UP has an on-board computer that communicates data through the radio tower to a communications management computer. That is like a cellular telephone connected to a computer.

That communications management computer tracks the mobile units that it is communicating with. The management computer knows where to deliver messages into our host computer system that we call TCS, or "transportation control system," in St. Louis. So, our equipped locomotives have constant dialogue through our systems while they are operating.

UP locomotives have an AEI reader, the "automated equipment identification." The AEI reader is the wayside track reader that reads the tags on cars as they go by. That information is read, loaded into our TCS system, and downloaded through this communications infrastructure back to the locomotive. These are mostly commercial applications, not train control applications. When we first started this train control application, we underestimated the scope and complexity of the project. We immediately also recognized in the late 80's what was happening to us in terms of loss of market share and the demands that our customers were placing on us. We were market driven to be more reliable.

To be more reliable, we need real-time information, and so do our customers. They want to know in a much more timely manner how we are performing, and it primarily comes down to providing them with inventory management information.

In the 1980's, people believed that information could decrease inventory. That has been a key driving factor behind the dramatic shift in market share in terms of revenue between truck and rail. It also allows shippers to use their resources much more effectively.

We needed to reduce our costs in order to compete more effectively. So, the systems we chose to implement help us reduce our cost. We achieve cost reductions through better asset utilization and higher productivity of our people. These cost reductions are mainly associated with locomotives, equipment, and train crews.

A train control system could help us improve line capacity, by using information to reduce the need for additional infrastructure. We have come to the same conclusion as the highway administration has, and basically it is we can't afford to put in more infrastructure. Laying new track costs a million dollars a mile. We have got to

get more throughput using what we have. The way to do that is through more timely information. Examples include increasing the speed of our trains, and moving from a fixed block control system to a dynamic block control system, in order to increase throughput in certain corridors. With improved technology, we can improve safety through collision warning and avoidance systems.

We began with train control. We saw the complexity of those issues at the time we were centralizing our train control and dispatch operations at Omaha.

Work reporting promised to provide the most immediate application and quickest benefits. Work reporting begins when a crew member comes to work, and gets what we call a work order document. On that document are all the cars that are on a train, and what he is to do with all those cars. The document also includes all the cars that are not on the train that he is scheduled to pick up.

When a crew members arrives at work, he boards his locomotive and logs onto an on-board computer. That log-on message is sent to our host computer in St. Louis. The work order document is then downloaded electronically and stored in his on-board computer.

As he performs this service throughout the day, he inputs information, and that information is uploaded into our TCS system. That information becomes available to our customers, as well as to our train management personnel, who manage the day-to-day allocation of resources, and monitor how well we are conforming to our transportation plan.

Automated equipment identification is a project that is scheduled to come on-line January 1, 1995. I don't think any railroad will put readers in at every customer location. So, we still see work order reporting as a necessary application, because it provides information on the car from pickup at the origin customer's dock to delivery at the destination customer's dock. AEI helps us manage our resources much more effectively by having real time information on where the equipment is located.

CTC or "centralized traffic control" is our most sophisticated control system. With it, we communicate with signals and switches in the field, moving that function from a wayside-pole line, a hard-wire line, to a radio-based system. It provides great benefits in terms of cost, because we eliminate the wayside pole line, which is a high maintenance item.

Locomotive health and diagnostics is a project we will start next year. It is an on-board technology, with sensors on different electrical and mechanical components in the locomotive that we will use to help diagnose a failure.

The greatest benefit is to help prevent a locomotive failure. With sensors on the locomotive and the ability to transmit that information to St. Louis, we expect to know the operating condition of a locomotive prior to its arrival at a terminal. That information will indicate whether the locomotive should go into the shop for fuel line repair, or for any kind of repair. That information will improve the availability of locomotives. Locomotives are a railroad's single biggest asset, and an incremental improvement in availability brings big benefits.

We will monitor the progress of train control through an arrangement with the AAR. Train control is a complex system, especially the required safety

control architecture. The UP is an active participant in train control activity, and the railroad will progress as train control progresses.

Work order reporting is our primary system. We've got 1,300 locomotives with on-board computers. We have installed 250 base station radios. We have trained 5,000 conductors and foremen, and we have contacted 6,000 customers. As we roll this out, we communicate with our customers and sell them on the benefits of service reliability. That is like preaching to the choir. We expect customers to work through our national customer service center, so the request can be entered into our system and be downloaded to our on-board computers.

We at Union Pacific believe quality and technology provide growth to the railroad. We have to improve reliability, transit time, damage-free delivery, and equipment utilization. We will do that through different technologies. ATCS technology can provide work orders, information on locomotive health; AEI and then ISM, can make us appear seamless to our customers.

We are excited about the future of technology. Technology is going to play a vital role in the next few years, in order for us to remain competitive in terms of cost, and to get our reliability up to where we can make in-roads in market share.

Joseph Noffsinger, Chief Engineer
Consolidated Rail Corporation

At Conrail, we have been watching to see what happens with ATCS. We are interested in all the benefits you have heard described by Jeff and John, and certainly there are opportunities in the ATCS scheme to achieve those benefits. But for us, it comes to the bottom line, and the timetable to get there. The answer to these questions depend on the specific ATCS technology that we would adopt. I will speak about the specific technology that is most appropriate for the 21st century.

I won't repeat the description of ATCS systems, but I will speak on a few specific points that we have some concerns about. One of the things evolving is the train control issue, with ATCS being pushed back. Perhaps ATCS should stand for advanced transportation communications systems because ATCS is evolving as a communications backbone for handling railroad business information to customers.

The advantages of ATCS boil down to 2 points: safety, and return on investment. We all want operational safety on the railroad. But, most Conrail core routes have conventional signal systems, unlike some other railroads, and with some very publicized exceptions, we have a very good safety record in train operations.

Railroads are a for-profit business. A threshold for ATCS to be viable would be a return above the cost of capital. That would be an absolute minimum threshold. Early estimates were in the 80% range, and those estimates are being revised. Other modifications to the calculation of returns are being made.

But, all the estimates are based on some assumptions about how customers will respond. A question is whether other alternatives would yield a greater return.

The framework for ATCS is ripe. A digital communications network will be necessary to do business in any transpor-

tation industry. Having an open architecture where you can mix vital train control portions with service information makes sense, because you do not want to have duplicate networks to handle different types of information.

Inter-operability between railroads, and perhaps among other transportation carriers, is important. Having an industry-defined specification, like the ATCS, is essential to having inter-operability.

ATCS has to meet or exceed the level of safety provided by traditional signal systems. There are several areas of concern regarding the hardware of ATCS.

We have a lot of experience with micro-processor-based signal systems. We have a lot of that on Conrail, and everyone is very cautious when we started implementing those systems several years ago. We have that experience under our belt, and so does the supply industry.

In contrast, there is always an opportunity to compromise safety in the logic of ATCS packages. Each supplier has a safety review committee. It takes a long time to have products approved, and to assure there will not be failures.

Procedures are important for installing conventional signal equipment and ATCS signal equipment. Defined test procedures are necessary, in order to prove that the system meets all the required safety functions. Having correct procedures gives us a mechanism to place a system in service.

ATCS shifts the opportunities for human error from field personnel (using conventional systems) to software programmers (developing the ATCS system). Consequently, the possibility of human error does not go away by shifting to ATCS. We must have a method to verify that the system cannot make mistakes and create an unsafe situation. There is not at this time a plan that details how to do that.

Reliability is a concern. As the systems become more complex, the probability of component failures and system down-time goes up. As a system becomes more encompassing, like ATCS, the impact of those failures goes up.

Vitality of the signal system assures that any failure in a train operation system results in a switch to a more restrictive mode, or a safer mode, of operation. Part of ATCS is in the office, part is in software, and part is in the digital communications package.

In contrast, using the current train operation system, vitality is distributed in modules in the field and each module links to its neighbors. ATCS encom-passes some of that concept, but it also places some of the vital logic in a central location. The central logic has to be verifiable.

Another issue is the practicality of absolute control. When we talk about preventing accidents by having enforced train control, that includes enforced train stops. Is it acceptable when an on-board system fails, to bring the whole operation on a rail line to a stop, such as in Amtrak's northeast corridor? In contrast, could that particular train be moved out of the way by any other means? If that train is allowed to move, has the principle of enforcing absolute stop, and absolute safety, been violated?

I have some concern about obsolescence of ATCS hardware. ATCS currently uses 6 channels in the UHF spectrum to provide digital radio communications. The Federal Communications Commis-

sion recently issued a notice for a proposed rule making for reallocating the radio spectrum in the VHF bands. The FCC is proposing changes in the band where the present railroad voice communications are located.

The FCC is proposing that all users of VHF radio go to new technology, and use one-third the present channel space, in some cases one-sixth, to make new channels available for personal communications devices and all sorts of other things.

There is great demand for the limited radio spectrum. What that means to the railroads and others is that between now and the year 2004, we have to replace our radio systems with a new technology that currently is not available. The replacement cost of radio equipment systems for Conrail would be about $100 million.

The technology that will be required supports digital data communications. So, one of the questions that Conrail has is, if we spend $100 million to replace our radio systems in the next 10 years, should we also build an ATCS digital radio system in another band? That would duplicate the cost.

So, we would like to see an operating pilot that can measure the real costs and real benefits of ATCS. The operating pilot should control the parameters, not necessarily on Conrail, but within the industry someplace, or should be a cooperative pilot project. We need to measure exactly what the benefits are before we can make the associated business decisions. We want to compare ATCS to alternatives.

We have heard about AEI. We use work order reporting currently on Conrail for our local train crews. We use a third party communications carrier and a PC-type terminal on the locomotives. That gives us the same benefit as a ATCS work order reporting system at a substantially lower capital investment. Of course, it does not provide a platform for vital train control. So, we are waiting to compare alternatives and make a business decision based on the facts.

Lynn Garrison
Burlington Northern Railroad

I think the analogy of ATCS DEVLINKS to a two-story house is appropriate. I agree with Jeff Young that the system should have a different name.

We started in late 1992 investigating the use of DEVLINK technology, position technology, as the basis of a trail control system. We were involved in ATCS from the start in late 1983, along with the Algoman Central and CN.

ATCS, as a stand-alone train control system, probably would not be economically justifiable to do only train control. I use the term traffic management functions. Jeff used the term commercial business applications to separate the concept of non-vital business applications from critical safety applications.

I think it is becoming obvious from the benefits analysis that we did, and the benefits analysis that CN did, that the benefits largely fall in the area of traffic management, or commercial business applications. What I see happening is that railroads like the UP and CN will adopt the basic technology to perform business applications at first. Train control as a vital system I believe is still some time in the future. BN is participating with the AAR and the REC through the ATCS initiative to continue

development of specifications with the ultimate goal of vital train control in the industry. However, our approach probably will be, as Joe mentioned, to wait until we have a full industry supported working pilot in place for vital train control before we take that last step. In the meantime, many business applications will be made. They are potential. It takes a fairly small subset of the overall equipment that ATCS envisions in order to get to some of those business benefits. In other words, you can equip a locomotive with a basic package that includes a dead link radio, an on-board computer, and in our case, a GPS positioning system. This equipment can be used for non-vital applications. The system can be tied to your central office systems, your IS systems. Then, you can communicate with trains and learn their position. That starts reaping enormous benefits in terms of customer service. That is where the real benefits are.

I estimate that probably 60% of the benefits that we identified for ATCS technologies lie in the ability to provide non-vital command and control functions to support customer needs.

I am optimistic about the railroad industry into the next century. I think that by providing better service to our customers, we will be able to not only maintain the level of business we have now, but to actually start taking some business from truck drivers.

Our customers do not want the absolute best transit time from point A to point B. Our customers demand consistent service. When we pick up a load, they want to know when it is going to be delivered. If we can't deliver it for some circumstance when we say we are going to deliver it, we want to be able to tell them as rapidly as possible that there is going to be a change and we can react and provide a command and control system that will let us do that. That encompasses the business applications, or what I call traffic management, the non-vital functions. On the other hand, regulatory bodies, and the public, demand safety systems, especially after accidents like the recent Amtrak-Conrail collision near Chase, Maryland. These systems are essentially vital train separation systems.

Unfortunately, if you look at the economics alone, those systems probably are not economically justified. Therefore, the industry will have to approach the ATCS family of applications as a common set of technologies that we can use. The system can pay for itself in the traffic management area of non-vital, non-safety-related applications.

I see railroads getting work-order systems, non-vital command and control systems, and ultimately getting the vital safety systems. I do not have a good idea when we will take that last leap.

Quite honestly, I think that leap will not happen based on economics. It probably will happen as a result of a mandate from the public demanding safety, or from regulatory bodies getting involved and actually forcing us to go that last step.

The term ATCS definitely, even in this small panel, means different things to different people. From Joe's background in vital safety systems, ATCS means train control. From my background, that is what it initially meant to me, too, although it is becoming an all-encompassing family of applications. Industry confusion about what ATCS is has prevented, to a large degree, railroad management actually making decisions that could be made now in terms of technology and benefits.

Charles Dettman, Vice President
Operations and Maintenance
Association of American Railroads

The question before this session of the Forum is advanced train control systems: the right technology for the 21st century. The answer, I believe, is an unequivocal maybe. ATCS has the potential to contribute to benefits which the railroads will need to be able to compete in the transportation marketplace in the 21st century. What are those benefits? Reliable, seamless customer service, maximum utilization of assets, quality transportation service at the lowest possible cost.

Railroad economic deregulation in 1980 gave railroads freedom to make tremendous improvements in productivity. This was the major driver for railroads during the decade of the 80's. It has allowed railroads to reduce cost so as to remain competitive.

However, while railroads have maintained their share of traffic, on a ton-mile basis, their revenue market share has decreased. The challenge of the 90's and beyond will be to meet our customers' more demanding service expectations. As the market for goods and services becomes more global in nature, companies are demanding more from the transportation provider to help them gain and keep a competitive edge. Improved service reliability, seamless service, and decreased transit time are not going to be just slogans for discussions in Forums like this one, but demands that railroads must meet in order to remain competitive.

This means not only an improvement in a railroad's ability to provide one-stop shopping and precise information on a shipment, but also the ability to provide reliable, seamless service. The pace of improvement in asset utilization and productivity will likely lessen in the decade of the 90's and beyond, if left to current methods and technologies. As this happens, tools that allow railroads to provide better customer service and address assets and productivity issues as well become more important.

Many of these tools are in what is called information technologies. ATCS is one of those technologies, although ATCS is not merely an information pipeline, but a command, control and communications system as well. ATCS can well be the backbone of a new, complete railroad management system.

Rarely has the technology shown the potential to provide the range of benefits that can evolve from an ATCS system. But, as individual railroad ATCS business cases have shown, half the benefits are soft dollar benefits which come from increased market share or revenue. For this reason, and because ATCS is viewed as an expensive system, the development and implementation of ATCS has been slower than some of its advocates predicted.

There are other issues on the table as well. These include the problem of remaining competitive with truckers, who are taking advantage of this technology to improve their service. They can do this partly through the vast investment our federal government is making in IVHS: Intelligent Vehicle Highway Systems. Other issues include the desire of industry and government to decrease train collisions, and the cost railroads will face to replace their existing control systems. Other communications systems can provide the network for some ATCS applications. Work order reporting can be hosted on digital, cellular, or other data networks already in place, as we have heard. There are older train control technologies that provide some ATCS

benefits, including cab signals or automatic train stop. But, all these alternatives suffer from being one-trick ponies. The extra cost for communication and/or control systems all hosted on different communication networks would be prohibitive if, and it is a bit IF, the industry ever intends to fully develop all of these applications.

The ATCS communication network avoids this pitfall and other pitfalls of these platforms as well. There are no recurring network charges, as with digital cellular networks, or other mobile data radio networks. The network is owned by the railroads. The railroads have exclusive use of 6 900 megahertz radio frequency pairs throughout the U.S. and Canada.

Even if other networks were cost effective, there is no possible way to host the ATCS train control application on a public network where security of messages in the data link is difficult, if not impossible.

So, if we are going to do these things, work order reporting, other commercial applications, including code line and track force work reporting, and ultimately, train control as well, then the answer may very well be ATCS.

The question then becomes how can the railroad industry acquire ATCS? The answer lies partly in what has already been done. Several commercial applications and a train control pilot are in place. Union Pacific is implementing work orders, as Jeff discussed. CSX, Santa Fe, Southern Pacific, and Canadian Pacific are doing code-line replacement using the ATCS data communications network.

The Norfolk Southern has work order and code-line pilot programs in place. Canadian Pacific has turned on a train control pilot from Calgary to Edmonton. Canadian National has a train control pilot in the works in British Columbia. It is apparent that the use of the ATCS digital data communications link to host several different applications is indeed a reality.

Railroads have a good business case for that. The industry is supporting the AAR in maintaining the open, non-proprietary specifications to support these installations. These applications set the table for migration to other applications including track forces, work reporting, locomotive health, and perhaps train control.

The exploitation of the data network is underway. Railroads will use that network to host many applications. This process has led to the term of the 2-story house, as John Reoch discussed earlier today.

I began these remarks with my answer to the topic as an unequivocal maybe. The nation's freight railroad industry is a private enterprise. A private enterprise in our democratic society has responsibilities to shareholders, customers, employees, the public, and the government. I mention government because, in 1992, the railroad industry paid over $1.1 billion of taxes by virtue of being a successful on-going industry. Any discussions that would affect these dependent entities and their respective livelihoods must be made with extreme prudence. That is why the maybe. ATCS has proven itself in pieces, in some production, and in some test beds. The leap from that status to full commitment and production must only be taken with utmost care.

The railroad industry is totally committed to all of the principals of ATCS: safety, productivity, and customer service. However, massive

expenditure of capital is not necessarily the answer. Witness the FAA effort to computerize the air traffic control system. It began 6 to 8 years ago at an estimated cost of $2.0 billion, and has now cost $10 billion and it is not in production. The railroad industry, their shareholders, customers, employees, the public, and, yes, the government, cannot afford that kind of program.

Instead, the AAR Board, comprised of the CEO's of all large North American railroads, convened a group of senior railroad officers to develop a full-blown business case for ATCS. This panel will consider cost-benefit, cash flows, and migration pairs, so that we may move ahead with promising technology with our eyes wide open.

Only after a thorough understanding of all the ramifications will a truly meaningful answer be forthcoming as to whether ATCS is the right technology for railroads in the 21st century. Stay tuned.

Question - How do you prove to doubters that improving reliability through the use of ATCS gives you hard benefits in terms of real dollars?

Dettman - That is probably one of the tougher issues of ATCS. We have in the industry a system called interline service management. The idea is to tie all railroads together centrally. Called a second generation train, or train II, where a customer will deal with one railroad that will follow service all the way through to destination.

It would be one-stop shopping for railroad customers that does not exist today. As an example, we have a generic EDI package where a customer can call any railroad. You have to call Norfolk Southern, Canadian National, or whatever. That is in the works.

We are developing interline standards for service which are agreed to across the route, to look at one-stop shopping. Now, the benefit that would come from a plateau of reliable, seamless service is more intuitive and less costly.

A commitment has been made to spend tens of millions of dollars to get there. Whether a customer will pay for the cost of ATCS is another thing. We have conducted studies of business alternatives available to our customers if we increase reliability. The indications seem to be that the value will be there. We do not have evidence that would convince shipper CEO's to spend $2.0 billion. First, the system itself won't give reliability. ATCS of itself is just a tool which management uses. Is the management commitment going to be there? Second, what reliability will IVHS give truckers in the meantime?

So, many pieces will fit, but there is no overall grand strategy because we can't see that far into the future. We are spending a lot of money to become more reliable and shipper responsive. But, how ATCS fits into the overall plan has not been determined.

Question - I have a question regarding safety aspects. The National Transportation Safety Board (NTSB) has wanted positive train separation for a while. If the DOT and Federal Railroad Administration (FRA) are reconstituted, we could face a mandate for positive train separation. I would be curious as to your view of that, and if we are going to face a mandate, are we likely to address that mandate through ATCS. Or, alternatively, are we likely to look for positive train separation by other means?

Dettman - We are all aware that the NTSB wants positive train separation. I would characterize that as a catalyst

for industry action. We want to achieve the safety objectives. We are all in sync with that. The question is just how much and when.

There has been an abortive attempt at FRA to evaluate ATCS. They don't understand what the system is. They are enlisting help through other parts of the government.

The rail industry is taking deliberate steps to develop the infrastructure to get there. We are in business to satisfy stake holders, all of them. Building a business foundation is a matter of building a communications foundation. We are interested in applications that return benefits greater than costs.

Train control is a huge financial investment, because of the vitality issue, and because the systems have not demonstrated in actual applications. I think the Clinton Administration has shown openness. They have shown that they will be more amenable to cooperating on achieving safety, rather than mandating achievement. They recognize that the way we are going forward now is leading to safety achievement.

The question, I think rightly, will be timing. There will be a greater push on bringing the timing forward as opposed to what the industry would want to do, and the industry is going to want to do it because of technological soundness as well as cash flow.

Comment - From any railroader's point of view, the question is not do we want to build a positive train control system. I think the question is, how can we make it affordable.

I think that is the approach we are advocating in ATCS. ATCS utilizes the communications infrastructure, and the traffic management or commercial applications, as a funding mechanism to continue to put some of that infrastructure in place. The result is in the direction of ultimately making positive train control affordable.

Alternatively, one-trick pony systems will accomplish some, but not all, of the positive train control benefits associated with ATCS. Further, one-trick pony systems provide none of the commercial benefits. So, the one-trick pony systems create an unaffordable program. We are trying, through the multiple capabilities of ATCS, to create an affordable program that will pay for itself, and ultimately lead to positive train control opportunities.

Comment - High speed rail is a figment of a lot of people's imagination and it has a significant funding requirement. Inherently, in our estimation, high speed rail on conventional railroad operations will mandate an ATCS-type system. The reason is because there is no way that conventional signalling systems can handle 135 mile-an-hour passenger trains interspersed with 40-, 60- and 70-mile an hour freight trains. The current signal system can't handle that mix of trains, and still maintain any sort of viability for the freight operator whose rail line is used for the high speed rail system. So, speed rail adds an impetus for government to be involved in acquisition of ATCS-type equipment.

Comment - I don't necessarily see all the safety benefits for ATCS coming when we turn on an ATCS vital train control system. There may be some intermediate steps in the migration path that would enhance safety, albeit perhaps in a "non-vital fashion."

As positioning systems become available, and we start testing it, ATCS may be possible, given the fact that we have

CTC and other on-board, single-trick-pony systems in use already, to use the ATCS positioning system to overlay in concert with the current train control system. It might provide a proximity warning of another train, or a motor vehicle at a grade crossing, in a non-vital sense to start with. Maybe something as simple as protecting the end limits of an authority on stopping the train short of a red signal is not going with a full blown control system. So yes, we are interested in improving safety as much as we can. It is a matter of affordability. I believe there will be some interim steps available to enhance safety well before we to get to full "vital" period of ATCS.

Question - How much time do we have?

Answer - Good question. Perhaps the best thing that can happen in terms of applying ACTS as a vital train control system would be a mandate. It would certainly force us to do something. If we were mandated to install a train separation system within 2 years, I don't know if we would have a lot of options available to us. We probably would have to install conventional cab signaling systems.

Comment - That is one of the things that appears to be under consideration.

Comment - An ATCS system which has been around for decades could be installed, but it might not be a desirable outcome.

Comment - My impression is that ATCS-type technology is already being used in Europe and Japan. If that is true, are we reinventing the wheel?

(inaudible)

Answer - There is no technology in Europe or Japan that will do what we are talking about doing. There are superior levels of existing technology, the train stop and things like that, in both transit and high speed applications in the (inaudible) and TGV. But, there is nothing that goes to a predictive, warning, moving block, major vital communications system that we are speaking about in ATCS.

Comment - In Europe there is now a program called ETCS, European Train Control System. ETCS is patterned after the North American ATCS program, and the Europeans seem to be coming to similar conclusions. But I don't think they are far down the road on developing something better than ATCS.

Question - You were talking about high speed rail. In Europe they have high speed passenger trains. They must have something to prevent accidents with freight trains.

Comment - They run freight trains as fast as the passenger trains, or they schedule them at times when passenger trains aren't there, or they run 20-30 car freight trains for a short distance intermixed with passenger trains. Our rail operations system in the United States is totally different and is based on a totally different economic and technical environment.

Comment - It is not just a matter of how long the trains are. In Europe there is a huge infrastructure in track. The United States is mainly a single-line railroad. European railroads double, triple and 4-track systems.

Comment - In general terms, although comparisons are difficult, American railroads are 10 to 100 times more productive per dollar of assets employed in transportation. That is the answer. A 6-track railroad can run high speed

trains and slow speed trains on different tracks.

Martin - Has any development work been done to link information from sales and marketing with car orders to assure that the right cars actually make connections in terminals when there are high priority shipments coupled with equipment constraints? Has anything been done to speed the information flow to help terminal reliability?

Answer - Some thought has been given to that topic, but no development work.

Comment - That is like phase 5, and we've got to get to reliability first to protect our existing traffic base before we start bringing in the margin traffic and priorities and things like that. Terminals are a significant issue that is being addressed, but a third of the failure in reliability is between the customer's dock and the yards. Another third is the failure of trains to get over the road and protect the schedule. Two-thirds of the failures of reliability result from the failure of yards. And part of that failure is the inbound train is late. Those are 2 big things that are being addressed.

Question - Inaudible.

Answer - We have not estimated the cost-benefit for a train control system on Union Pacific. On the initial phase, our work order reporting, we have an ROI that is in excess of 35%. It was about 42%. Our investment on that was about $55 million capital and about $30 million operating expense. From that, we had a 42% ROI. We have not estimated the full benefits for positive train, as BN and CN have done.

Comment - Is there an industry consensus on the comparison of safety on dark territory versus existing ATCS technologies? In other words, a comparison was given of ATCS safety as unproven as compared with conventional signal technologies. But, how would that comparison rate if you compared it with global block manual dark territory operations.

Answer - Let me try and answer your question this way. Our existing safety record, based on the technologies employed in the United States today, is equal to any other in the world.

ATCS, as currently designed, would give 2 orders of magnitude safer operation than existing operations, according to Draper Labs in Cambridge.

Comment - And that includes single territory as well?

Answer - Yes it does.

Comment - That is specifically related to human factors.

Comment - If ATCS works as designed, it would reduce accidents caused by human factors by 2 orders of magnitude, compared to the existing ATS train systems.

Question - Is there any BN operating experience, range tests, or any other operating experience, to suggest what relevant safety is achievable?

Answer - Our operating test was not full ATCS, down to the last nickel, but we did automate some of the train control functions. Our experience is that the technology is working and it is possible to get to those levels of safety.

Comment - One of the things we have to deal with here is the unfortunate Hinton, Canada, and Chase, Maryland, incidents. They are such a small data point.

Thirty-five employees were killed in the railroad industry last year. Eight of those accidents could have been prevented by ATCS. Because the magnitude of operations is so large, compared to the number of accidents, it could take years to accumulate enough data to show any savings from ATCS. That is one of the problems. How safe is safe? How many did you avoid? You have to have a massive amount of data and a large system to be able to statistically quantify the benefits and cost.