

Digital command control standards: A non-technical discussion

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The recent blitz of command control articles has left some of us ordinary folks overwhelmed by new concepts and terms such as digital packets, time-division multiplexing, bits, stretched bits, single-chip microcontrollers, and bi-polar digital control signals.

As if that wasn't enough, the NMRA Board of Trustees is now asking us to approve new standards with potentially far-reaching consequences. What to do?

This article will attempt to clarify the issues surrounding the rapidly growing command control movement. The ultimate benefits of an NMRA-approved standard will also be discussed.

Hopefully, the average modeler without a doctorate in Electronic Communications Theory will be able to cast an informed vote on the proposed standards after reading this article.

GENERIC COMMAND CONTROL

By now everyone should know that command control systems enable independent operation of locomotives without traditional insulated blocks and multitudes of toggle switches to control power routing. As a result, we can simply enjoy running trains without worrying about properly throwing a block toggle every

time a locomotive or caboose enters or leaves a section of track. Engine terminal movements, in particular, are greatly facilitated with the use of command control since locomotives can be closely parked without concern as to where the plastic rail joiners are located.

Currently, several commercial systems are available utilizing various technologies such as radio waves, infrared waves, analog signals, digital signals and others. In general, these systems are incompatible with each other. Each technology has its own set of advantages and disadvantages relating to size, cost, sound generation, susceptibility to noise or multiple unit running ability. No single approach has yet emerged as a marketplace frontrunner with obvious unbeatable advantages over other technologies. Command control is presently enjoyed by a small fraction of model railroaders.

BENEFITS OF A STANDARD

Using the broadcast industry as an analogy, "...the electronics industry... recognized that TV would never be inexpensive or popular unless the signals transmitted by all TV stations were standardized."*

In the model railroading world, standardization will probably result in lower costs to the consumer, new and creative

products, greater interchangeability of equipment, more manufacturers, and larger numbers of modelers enjoying command control systems. A wide range of products with various prices, features, current ratings, sizes, etc., will become available from numerous manufacturers once the proposed standards are officially adopted by the NMRA membership.

With standardization, the manufacturing community will have no reason to hold back waiting to see what might eventually emerge as a de facto standard. Nineteen manufacturers have publicly stated their intentions to offer products conforming to the NMRA standards once they are approved.

Progress in the design and availability of new products is expected to be very rapid indeed. A quantum leap, so to speak.

It is believed the retail cost of a low-end locomotive receiver could approximate \$25 given sufficient production volume. With interchangeability a wide variety of locomotives and transmitters could visit club layouts and convention hall modular layouts with confidence of compatible operation.

Those modelers not interested in digital command control, can simply continue to use existing 12 volt DC standards. They would not personally be affected by command control standards one way or the other.

WHY DIGITAL?

Considering the various technologies available to run our miniature empires, why was digital packet communication selected in preference to alternatives? After much research, the NMRA Command Control Working Group felt the chosen approach would meet our needs more easily, with less cost, with smaller size and also allow greater flexibility for future expansion of capabilities as the technology advances.

The basic electronic concepts have already been used in digital systems with literally thousands of installations worldwide. All technology required to implement the proposed standards is free and clear of patents and copyright protection and is available for use worldwide.

Perhaps the single greatest appeal to using microprocessors in locomotives and a digital control signal is the ability to run NMRA-conforming receiver equipped locomotives on a conventional 12 volt DC layout without any modifications whatsoever.

The receiver will sense DC and convert itself to operate accordingly. On a command control layout, the same receiver will sense a digital control signal and automatically convert itself to command control operation. Neat, eh? Not only that, but the reverse is also true — a conventional 12 volt DC motor will operate on a NMRA-approved digital command control layout. Double neat!! This feature will permit gradual transition of an entire fleet of locomotives from DC to command control rather than requiring the full financial plunge at one time.

Other receiver (technically known as a decoder) capabilities include multiple solid state on/off switches in each locomotive to independently control the headlights, marker lights, cab lights, sound, smoke, firebox-flicker lights, and electrically-operated couplers (yes, working couplers have already been demonstrated!).

Obviously, receivers (decoders) with more features will be more expensive, but some folks will want one or two showcase locomotives to be well-equipped.

Other, more mundane, locomotives could be equipped for only speed and direction control. Placing a decoder in a caboose or passenger car enables control of its lights independently of motive power lights. As passengers bunk down

for the night, individual lights in the Pullman cars could be extinguished one at a time. G'nite!

MU lashups and speed matching of different locomotives are also easily accomplished with digital communication techniques. Turnout motors can be digitally controlled via decoders if desired. How about a complex layout that is totally automated under personal computer control? The range of possibilities truly boggles the mind.

For those of us who dislike computers, be assured that owning and learning how to use a personal computer is in no way a requirement for enjoyable command control operation.

It is simply an optional capability for those who do enjoy playing with computer hardware and software.

In fairness to other alternatives, it must be stated that the features described above are theoretically possible with all technologies. However, working models demonstrating these features have thus far only been constructed using the digital packet approach.

SCOPE OF PROPOSED STANDARDS

It is important to recognize exactly what these proposed standards are intended to specify.

Simply stated, the transmission of digital control signals via rails is the only area to which these standards apply.

Transmission of control signals via air using radio or infrared waves are outside the scope of these proposed specifications. Similarly, the use of analog signals via rails are not subject to these standards. To restate: These standards will provide an industry-wide common specification that will apply only when digital control signals are transmitted to the locomotive via rails.

No other technology or medium of transmission is expected to adhere to these standards. As an analogy, neither cellular telephones nor garage door openers are expected to adhere to TV broadcasting standards.

These three applications all use transmitters and receivers, but are totally independent of each other with respect to the control signals sent through the air.

Manufacturers of systems using alternate technologies are free to continue

selling their current systems as designed. Just as the NMRA horn-hook coupler has had little, if any, adverse effect on Kadee, there is no conclusive evidence of long-term future harm to existing command control manufacturers.

In the long run, a free and competitive market will determine success and the company with the best mousetrap usually wins. There may, however, be some temporary discomforts as manufacturers redesign products or decide to continue with non-conforming systems. If the overall expansion of the command control marketplace occurs as expected, there should be sufficient growth so that all manufacturers will benefit in the long run.

It should also be recognized that these standards only specify a communication protocol between transmitter and decoder.

The control signal (waveform shape) is being standardized, but not the equipment used to create, transmit, receive and decode the control signal.

Thus, one manufacturer might use a rotary knob for speed control, another manufacturer may design push buttons for the same function, while yet another firm may require a personal computer keyboard for speed control.

All three command control systems can comply with the NMRA standards since the control signal sent down the rails will be as specified. Any locomotive that accepts control signals from one system will also recognize signals from other systems since the signals will have been standardized.

As an analogy, the NMRA standard of 12 volts DC can be achieved using power packs from numerous different manufacturers. These power packs may look different and act different, but trains will operate properly since 12 volts DC is standardized. The equipment itself is not regulated by these proposed standards, only the control signal is standardized.

Last but not least, it needs to be explained that the proposed digital command control standards may not guarantee a totally satisfactory command control system for all modelers in all instances. Just as there are inexpensive TV sets and expensive TV sets with vastly better reception and sound reproduction, similar differences will undoubtedly hold true for model railroading command control systems.