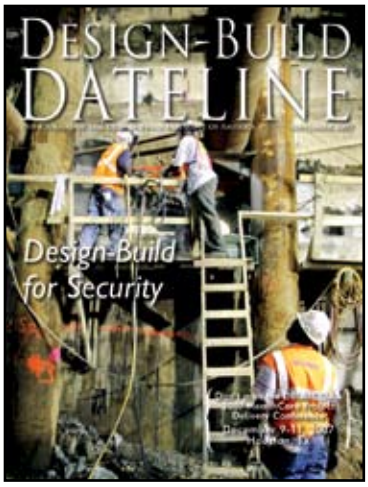


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# *Design-Build Approach Delivers Enhanced Security for Atlanta's Mass Transit System, Decreased Risk for Metropolitan Atlanta Rapid Transit Authority*

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The Metropolitan Atlanta Rapid Transit Authority (MARTA) is leveraging the design-build approach to acquire advanced technology, achieve rich functionality, and reduce cost, schedule, and performance risks for the upgrade and expansion of its CCTV surveillance system. MARTA and its contractor have taken advantage of the flexibility of design-build to incorporate technologies that were not available or cost prohibitive at the time of proposal submission, but were on the market for a reasonable cost when the contractor developed the system design. The rigorous testing program incorporated into the project lifecycle by MARTA further reduces risk by requiring the contractor to demonstrate design and system proof of concept, interoperability, and compliance with performance specifications.

## MARTA System Background

MARTA provides subway, bus, and paratransit services for one of the fastest growing metropolitan areas in the United States. Operating within the city of Atlanta and the counties of DeKalb and Fulton, MARTA transports an average of 450,000 passengers daily and more than 141 million passengers annually. Greater Atlanta, within which MARTA's service area is contained, recently reached a population of more than five million, making it the nation's ninth largest metropolitan area.

MARTA's rail system is comprised of two main rail lines, the East-West Line and North-South Line, as well as the North Line extension and Proctor Creek Line, both of which are branch lines. The main and branch lines consist of 48 miles of track connecting 38 rail stations and carrying 338 heavy rail cars. In addition to rail service, MARTA operates daily more than 500 buses and 125 paratransit lift vans that serve more than 1,500 route miles on approximately 150 routes.

MARTA was formed in 1965 and began operation in 1971, purchasing the previous mass transit system, Atlanta Transit Company, which operated bus service only. Construction of the first rail line began in 1975, with rail service beginning in June of 1979. Construction on the two main rail lines was completed in 1992 and the two branch lines were built in the 1990s.

## Project Overview and Objectives

MARTA has used CCTV surveillance within its rail stations since the 1979 inception of rail service. Rail stations, cash counting areas, Ride Stores, bus garages, rail yards, and other MARTA facilities are under video surveillance. Buses, rail cars, and paratransit vehicles are not part of the existing CCTV system and no plans exist for wholesale installation of CCTV surveillance on these vehicles, although the upgrade contract incorporates installation on rolling stock as an option.

The original CCTV system had been expanded as new rail stations were added and had undergone several upgrades to take advantage of technological advances. Notable improvements include the addition of time-lapse video capabilities in 1995, the replacement of the trunk cable and amplifier transmission system on the North Line with single mode fiber in the late 1990s, and the 2003 replacement of all existing cameras with solid-state color cameras. While these upgrades enhanced system functionality, limitations remained. Among these were no ability for real-time video monitoring by system operators, limited or no functional interfaces with other systems or first responder centers, and the lack of system-wide digital video recording. Additionally, and primarily due to its age, the system could no longer be expanded and was becoming difficult to maintain.

## Design-Build Procurement

To address these limitations, increase camera coverage, replace all of the trunk cable and amplifier transmission infrastructure with single mode fiber, and provide wireless video feed capabilities for the Authority's Mobile Command Vehicle (MCV), MARTA determined that a system-wide upgrade was required. MARTA provided Advance Notices to Offerors to 53 firms, then issued a Request for Proposals (RFP) in August 2004. The RFP sought a design-build contractor and incorporated a preliminary system design as a response requirement. MARTA employed three phases of response submissions, with down selection in each phase. Nine of the 53 firms submitted initial technical and cost proposals, which were evaluated for the adequacy of the design, the offeror's qualifications, and the cost of the proposed system. The Authority found the proposals from eight of the nine offerors to be in the competitive range, and invited these offerors to submit revised technical and cost proposals in response to a revised RFP. In September 2005, offerors delivered their revised proposals and MARTA again evaluated them for adequacy of design, offeror qualifications, and cost. Two of the eight offerors were invited to submit Best And Final Offers (BAFOs), and, based on evaluation of the BAFOs, M.C. Dean, Inc., of Dulles, VA, was identified as the offeror whose response represented the best value for the Authority. MARTA awarded M.C. Dean, Inc., a $6.8 million base contract with a maximum value (based on the exercising of 15 options) of $30.8 million and a 780-day schedule for project completion. Notice to Proceed was issued in January 2006.

## Design Highlights

M.C. Dean, Inc.'s design features video encoded to digital format at each camera, then transported over multimode fiber to a new network switching fabric and, finally, to operator workstations and storage media. One challenge associated with the development of this design was the need for a miniature encoder capable of operating outdoors, a requirement affecting all of the new and existing cameras to be replaced or upgraded. At the time of proposal submission, such encoders were not widely available. The products available in the marketplace offered the desired ruggedness and weather resistance, but presented cost risks. Among the options considered and rejected were MPEG2 and JPEG format encoders, which use relatively large amounts of data to achieve the level of video performance MARTA requires. The transmission of large amounts of data would occupy more of the system bandwidth, causing potential delays in the viewing of live video or recovery of stored video across the network. Additionally, the size of the resulting files would require much larger amounts of storage to retain all video for 30 days and provide the 20 percent excess storage capacity the Authority requires.

At the time of RFP submission, the fastest affordable network equipment available operated at a maximum speed of one gigabit per second. The installation and integration of more than 1,000 cameras into a common, autonomous network created a significant design challenge. Specifications of the contract required that multiple operator workstations have the capability of viewing up to 16 independent live camera views, all while the system continued to record both locally and remotely. The existing single-mode fiber backbone provided to the contractor is arranged in a snowflake configuration. Each station is assigned to one of six zone centers and its fiber is routed from the station to its associated zone. The six zone centers are then connected back to the MARTA Police Communications Center (PCC) via single-mode fiber. Two of the zone centers have more than 200 station camera streams connected to their uplinks to the MARTA PCC. The contractor was provided only two single-mode fibers from each zone center to the MARTA PCC for the purpose of the uplink limiting the uplink from each zone center to one connection.

The design-build approach, however, allowed the contractor and MARTA to take advantage of the technological advancements that occurred between the initial proposal submission and the commencement of the project's design phase. During this time, a cost effective MPEG4 video encoder became available and offered acceptable image quality, low power draw requirements, and scalability in terms of the amount of data transmitted. The scalability allows for video to be captured and transmitted as relatively small data streams, resulting in images of a higher quality that are transmitted more quickly. While high quality video still involves the transmission of large amounts of data, the scalability allows users to determine when the importance of image quality is secondary to speed and conservation of bandwidth.

Around the time of the contract award, faster network switching fabric became available. New network switches were able to transmit data at a rate of ten gigabits per second (10Gb). All six zone centers were then able to be configured with a 10Gb uplink to the MARTA PCC using the two single-mode fibers provided. This significant increase in speed allowed for higher encoder bandwidth (increasing video quality) and the inclusion of a second stream of video from the encoder for the dedicated purpose of recording. Additionally, the faster network throughput allows for a much higher expansion capability for future camera additions.

Additional design highlights mitigate quality/performance risk in wireless video transmission and quality/performance and schedule risks camera installation and maintenance. One of the key features of the upgrade is the incorporation of wireless connectivity for the Authority's MCV. This connectivity allows the MCV to pull up to any one of the 38 rail station and access live and recorded video to monitor emergency conditions and other activities. This allows off-site, mobile monitoring of any station within the system, expediting response time to incidents. Wireless connectivity is provided by 38 tri-mode outdoor mesh access points and 38 directional antennas. The access points operate in the 4.9GHz frequency range, currently reserved and licensed for use only in the emergency sector. Operating within this reserved frequency range is a value-add that reduces the likelihood that there will be signal interference from unauthorized users.

New fixed and PTZ camera assemblies support, fabricated by the manufacturer at the contractor's request support, rapid and consistent installation and ease of maintenance by enclosing support components within a single module. For 500+ new fixed cameras, this module encloses a power supply, MPEG4 video encoder, and Ethernet fiber transceiver. The module is constructed to meet the architectural lines of the new fixed cameras and is installed between the camera and the pendant or wall mount. Support components for the over 200 PTZ cameras are contained in a similar enclosure. Both enclosures also protect the components from outdoor conditions. Because these enclosures are constructed and assembled by the camera manufacturer and shipped to the job site as single units, installation time is decreased by 75 percent. Installation of single units also eliminates many of the opportunities for inconsistencies and errors when the cameras are installed. After MARTA takes ownership of the system, these enclosures will continue to provide quality, schedule, and cost benefits related to ease of system maintenance. MARTA personnel will be able to remove the assembly as a unit for maintenance, repairs, or replacement.

## Component and System Testing

MARTA mitigated the risks associated with the design build process by requiring extensive, rigorous testing throughout the project lifecycle. This testing requires the contractor to demonstrate that, among other things, all equipment conforms to physical specifications, is operable at the component, subsystem, and system levels, and delivers the required functionality. The intent is to not only verify, as the system is being developed, that it works as it is supposed to, but also to identify any problems related to system performance and functionality as early in the project as possible. Early identification minimizes the schedule impact associated with remedying the problem.

For this reason, testing began when the system existed on paper only. In September 2006 the Authority and its engineering consultant, Regional Transit Partners (RTP), completed a design verification review, which is a proof of concept process that ensures that the design developed can be built to support the desired functionality.

Following the design verification review, the contractor performed factory testing, witnessed by MARTA and RTP personnel. During the week-long factory testing activity, MARTA and RTP personnel observed the head end system components assembled, connected, and operating in the contractor's system integration and testing laboratory. The contractor demonstrated, on a device-by-device basis, that each component worked properly and functioned correctly as part of the resulting system.

The contractor is also performing camera factory inspection and testing on each of the new cameras. Factory inspection ensures that the correct equipment is received undamaged. At that point of inspection, the serial number is recorded into a configuration data list. Through this list, the entire lifecycle of every component in the system is tracked until removed from service. Following factory inspection, factory testing occurs where each camera is tested to verify that the fixed and PTZ cameras meet the specifications of the contract. This exhaustive testing of every planned piece of equipment ensures that no failures are installed into a station, reducing the potential for rework, disruption of the public, or loss of MARTA revenue.

As equipment is installed, the contractor subjects it to a component-specific performance verification test (PVT). The PVT verifies that the equipment is properly installed and performs all required functions. This testing is a subsystem test performed on a station by station basis. At the completion of the installation, the system, inclusive of all stations and other peripheral locations, will be tested once again, as a whole. The intent of the final performance testing is to ensure that no anomalies are created when all stations within the system are commissioned with all components operational. This last test provides for the final verification that the specification has been satisfied.

## Project Status

Key milestones completed include the testing cited above and installation of the system head end. Camera installation is currently under way, with the first rail station with cameras commissioned in April 2007. To date, 14 of the 38 stations have been commissioned and are being operated by trained MARTA control center operators. The project is on schedule for completion of the remaining 24 rail stations and project closeout by February 2008. The completed system will have more than 1,000 cameras and support ongoing expansion with additional capacity built into the conduit, fiber optic cabling, and RAID storage arrays.

**INFO:** M.C. Dean, Inc. (www.mcdean.com)