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16. Abstract

The research in this report investigates the perceptions of ITS standards for the public transit industry. The public transit industry has a rather colorful past in standardization, and this experience is reviewed with an eye toward lessons that might be applied to transit ITS standards today. Particular examples of standardization include the PCC car from the 1930's, the Transbus program of the 1970's, and the subsequent White Book. To complement this historical review, a survey of transit agencies regarding recent transit standards was conducted. In particular, transit agency experience with the J1708/J1587 standard for on-board electronics, and with the recent Standard Bus Procurement Guidelines, was investigated. Both the historical review and the survey results suggest that there are some primary factors that affect whether transit design standards are successful; i.e., whether they improve technical compatibility and reduce costs. Based on these factors, recommendations for the current transit ITS standards efforts are suggested.

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ECONOMIC EVALUATION OF TRANSIT BUS DESIGN STANDARDS

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ABSTRACT

The research in this report investigates the perceptions of ITS standards for the public transit industry. The public transit industry has a rather colorful past in standardization, and this experience is reviewed with an eye toward lessons that might be applied to transit ITS standards today. Particular examples of standardization include the PCC car from the 1930's, the Transbus program of the 1970's, and the subsequent White Book. To complement this historical review, a survey of transit agencies regarding recent transit standards was conducted. In particular, transit agency experience with the J1708/J1587 standard for on-board electronics, and with the recent Standard Bus Procurement Guidelines, was investigated. Both the historical review and the survey results suggest that there are some primary factors that affect whether transit design standards are successful; i.e., whether they improve technical compatibility and reduce costs. Based on these factors, recommendations for the current transit ITS standards efforts are suggested.

Keywords: *ITS standards, standards evaluation, advanced public transportation systems*

EXECUTIVE SUMMARY

Throughout the history of public transit, formal and *de facto* standards have been proposed for the common design of transit equipment and facilities. Since the development of the National Intelligent Transportation Systems (ITS) Architecture in the mid-1990's, there has been increasing promotion of standards within the ITS community, and also within the transit community more generally. These recent standards have been promoted for a variety of reasons reasons; perhaps most importantly, the standards are intended to reduce capital, operating and maintenance costs and to improve the long-term cost-effectiveness of transit service. At the same time, standards can also have unintended consequences of higher costs and of impediments to technical compatibility and to long-term technology innovation.

With these factors in mind, this study presents some perspectives on the value of transit standards in bus design more generally, and for ITS investments more specifically. The primary intent was to identify the major factors that influence the cost-effectiveness of standards for the transit community. The investigation began with a review of the history of several prominent standardization efforts in the transit industry. In addition, a survey of transit agencies was conducted to investigate the awareness, use, and experience with bus design standards and transit ITS standards.

HISTORICAL REVIEW

Three of the more well-documented cases in the history of public transit in the US include: the Presidents' Conference Committee (PCC) car of the 1930's; the Transbus from the 1970's; and, the so-called "White Book" from the 1970's. To begin, the history of the PCC car suggests three key features of standardization. First, the standards were driven by industry, with a clear need to reduce costs and improve passenger service. Second, the design specifications were targeted to those vehicle features where significant technical improvements were possible, with a reasonably mature technology. Third, the specifications were flexible enough to accommodate local customization to meet local needs.

In contrast, the Transbus experience suggests several issues in the specifications and technical procurement process that were flawed. First, the specifications were based on rigid *design* standards that did not allow manufacturers sufficient flexibility to respond to requirements that emerged as prototype vehicles were developed, tested and demonstrated. Second, the testing of the design was not separate from the public demonstration of the technology, resulting in clear negative impacts on the ultimate acceptance of the technology. Finally, the initial UMTA plan to *mandate* the Transbus standard for federally supported bus purchases ultimately blocked the adoption of the standard. Rather, economic incentives to use the bus design specification may have been much more successful in gaining gradual acceptance and adoption of the standard.

While the White Book was generally an improvement over the Transbus program, similar issues emerge as impediments to the ultimate adoption and use of the design standard. First, the specification was still deemed to be too rigid to allow local flexibility in bus procurement. Also, the federal program allowed only limited input of the manufacturers and the transit operators, thereby limiting the value, and ultimately the acceptance, of the standard. Finally, a federal mandate for design standards, as opposed to more market-oriented incentives, also impeded innovation and prevented adoption.

SURVEY OF RECENT STANDARDS

To explore some of the issues with standards, a survey of current practice was conducted. The purposes of the survey were two-fold: (i) to identify the current use of standards in procurement; and, (ii) to identify perceptions of the potential costs and benefits of these standards for the transit industry. A written survey was mailed to over 300 procurement managers at public transit agencies in the US having "standard" buses. Two sections of the survey asked about the agency's familiarity, and if applicable, the use of the Standard Bus Procurement Guidelines (hereafter, the "SBPG") and the SAE J1708/J1587. A total of 38 agencies responded to the survey, giving a response rate of about 13%. The 13% response rate is somewhat low, and the results presented below may not be truly representative of transit agencies in the US. Nonetheless, the observations from these agencies appear to be similar to the challenges to transit standards that are reported earlier in this paper.

The first main question asked whether the agency was aware of the SAE J1708/1587 and the SBPG standards. Of the 38 transit agencies, 15 agencies (40%) were aware of the SAE J1708/J1587 standard; 32 agencies (84%) were aware of the SBPG, Part 1; and 30 agencies (79%) were aware of the SBPG, Part2. The very low awareness of the SAE standard is surprising, given that the standard has been around since 1992.

A second set of questions asked about the use of the SAE J1708/J1587 standards in procurement. A total of 8 agencies indicated they had used the SAE J1708/J1587 specification, representing 21% of the total respondents and 57% of the agencies that were aware of the standard. Interestingly, in asking what parts of the SAE standard were used in procurement, one-half (4) said they had used the full standard; the other 4 have used only selected parts of the SAE J1708/J1587 standard. Of the agencies that had used the SAE standard, the survey asked them to estimate the cost, or cost savings, they had experienced as a result of using the SAE J1708/J1587. The responses suggest that at least in the short term, the J1708/J1587 standards have resulted in *additional* costs, on the order of $1300 – $2000 per bus, with some vendors even unwilling to bid. Finally, 7 agencies were familiar with, but not using, the SAE J1708/J1587 standards. The two primary reasons for not using the SAE standards were: (i) the given agency's lack of control of the specifications used in procurement, and (ii) the perceived complexity of the SAE standards.

A third set of questions asked about the use of the SBPG in procurement. In total, 19 agencies said they had used the SBPG Part 1 (the procurement guidelines) to purchase buses. This represents 50% of respondents, and 59% of the 32 agencies aware of the SBPG Part 1. This gives an indication of widespread acceptance and use of the SBPG Part 1, in the transit industry. However, only 7 of the 19 agencies had used the full SBPG Part 1; the remaining 12 had used only selected parts from the SBPG Part 1 language. This indicates that there is a need for agencies to pick and choose elements of each standard that fit their local needs.

A final set of questions was intended to probe more recent attitudes at transit agencies about federal mandates regarding bus design standards. The survey asked specifically, "Do you believe it would save your agency money in your motor bus and bus equipment procurements if the Federal Transit Administration required the use of the design standards?" Responses were solicited for the SAE J1708/J1587 standards, the SBPG, and the TCIP family of standards.

Out of the 38 responses, 7 agencies (18%) felt that mandatory SAE standards would save money, 9 agencies (24%) believed that mandatory use of the SBPG would save money, and 7 agencies (18%) believed that mandatory TCIP standards would save money. Of those aware of the standards, 4 agencies out of 15 aware (or 27%) felt that mandatory SAE standards would save money, 8 of 30 (27%) believe that mandatory use of the SBPG would save money, and 3 of 13 (23%) felt that mandatory TCIP standards would save money. In all three cases, only about one-quarter of knowledgeable respondents believed that mandatory standards might save money. Yet, it is not clear from this survey question whether this skepticism is due to the standards themselves, or to the possibility of *mandatory* standards from the FTA.

CONCLUSIONS

The historical evidence on transit design standards, and the more recent experience with these standards, has some common themes. First, in the scoping of standards, there must be a balance between industry-wide standardization while maintaining local flexibility. Second, there is a need for flexibility within the technical features of the standard to accommodate the learning process through development, testing, and demonstration of the design. Third, those standards efforts that appear to have had the greatest success are directed by industry, not by the federal government. Fourth, once the standards process is begun, there is a need to test and to demonstrate the value of the standard. This process should include a process wherein the standard can still be refined as it is tested and demonstrated in the field.

These lessons can help guide the development and implementation of transit ITS standards more specifically, and transit vehicle design standards more generally. Specifically, the following recommendations are made:

- Careful scoping of transit ITS standards, within the TCIP and TSC efforts, is necessary. Standards are appropriate for mature technologies that are widely accepted; rapidly evolving technologies and often-customized features are best left to the discretion of local transit operators.
- The TCIP and TSC efforts should guard their time available in the standards development process for development, testing, and demonstration of the standards in order to facilitate more widespread acceptance and adoption of transit ITS standards.
- Direct federal development or mandates of transit ITS standards are likely to be counter-productive in facilitating the long-term adoption and use of the standard. Rather, wider industry participation, and overall industry awareness of standards, should be the priority. With the seemingly low awareness of these efforts in the broader industry (as suggested by the survey), outreach and educational efforts deserve high priority in the time and funding in the TCIP and TSC efforts.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

DISCLAIMER

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1. INTRODUCTION

Throughout the history of public transit, formal and *de facto* standards have been proposed for the common design of transit equipment and facilities. Traditionally, these standards have played an important role in the development and use of infrastructure and other capital. Historical examples of standards in the mass transit industry include a standard gauge for rails and a large number of bus and light rail vehicle designs. Some of these specifications have met with great success, with a considerably long useful life; others were not widely adopted and were ultimately rejected by the transit industry at large.

Since the development of the National ITS Architecture in the mid-1990's (National ITS Architecture, 1996; PB Farradyne, 1997a and 1997b), there has been increasing promotion of standards within the ITS community, and also within the transit community. These recent standards have been promoted for several reasons. First, it is believed that the standards will serve to improve the technical capabilities of bus transit. Tools like automatic vehicle location, electronic fare payment, real-time passenger information, and related electronics may improve transit operations and long-term service and capital planning. Perhaps most importantly, the standards are intended to reduce capital, operating and maintenance costs and to improve the long-term cost-effectiveness of transit service.

As examples, the recent completion of the Transit Communications Interface Profiles (TCIP) standards (ITE, 1996) and the initiation of the Transit Standards Consortium (TSC, 2000), a joint program of the American Public Transportation Association (APTA) and the Federal Transit Administration (FTA), indicate strong belief in the value of ITS standards in the transit community. Yet, these standards can have significant long-term implications on technology and costs of transit capital and operations.

Part of the justification is based on the belief that standards will result in significant cost savings to the transit industry. This belief in cost savings is based on the notions that: (i) in the medium- to long-term, there will be widespread adoption and use of the standard, and (ii) the use of the standard will be less costly than alternate technical designs over the technology life cycle. With widespread adoption, the argument goes, the resulting cost savings from standards could be quite substantial.

Several recent articles have commented on the integration challenges for ITS applications in transit (Hickman et al., 1998; McGean, 1999; Takyi, 2000). As summarized in Hickman et al. (1998), standards can have both benefits and costs:

- *Interchange-ability and portability*: Components, hardware, software and other services may have "plug and play" capabilities;
- *Inter-operability*: Standard interfaces allow products to operate in conjunction with other vendors' products; and,
- *Data exchange*: Either "standard" data definitions between applications or standard interfaces allow unambiguous translation of data from one application to another.

All of these measures are important to the transit industry. As an example, portability is likely to be a concern for transit agencies where devices are often moved from one vehicle to another. This has led to the development of the Society of Automotive Engineers (SAE) J1708 and J1587 standards for a vehicle-area network. Also, technical communication within transit agencies, and with vehicle fleets, may require the ability to mix-and-match software and hardware from a variety of vendors as well as the ability to share data between applications.

In addition, in the long run, standards may lead to economic benefits such as an expanded choice of products in the marketplace, and greater economies of scale in the production of transit software and hardware. However, some have suggested that since public transit is a relatively small market in ITS, these benefits may not materialize (McGean, 1999).

Open standards may also lead to undesirable impacts in terms of costs, technology compatibility, and long-term technology innovation. In the short term, early adopters of standards may, by the nature of an uncertain market, pay considerable costs (a premium) for standardized products. The initial price of a standard product may be significantly higher than existing proprietary systems. Also, if a market does not materialize, early adopters may face high long-term costs of operating and maintaining these products. If the standard is not universally adopted, early adopters may be "orphaned," with the result being high costs of operating, maintaining, and ultimately replacing a product. Also, given the rapid rate of innovation, the life cycle of a particular product may outlast the standard, if the standard is obsolete before the technology must be upgraded or replaced (Hickman et al., 1998).

This report presents some perspectives on the value of transit standards in bus design more generally, and for ITS more specifically. The following section gives a historical review of the more prominent standardization efforts within the transit industry in the past century. This is done to understand the industry context for standards, which has interesting relevance to transit ITS standardization. To complement this review, a survey was conducted of recent experience with transit standards. The survey itself is described in the third section of the paper, and the results are described in the fourth section. The fifth section offers conclusions based on this review of historical and recent experience, and offers some insight into the likely keys to adoption of transit ITS standards.

2. HISTORICAL REVIEW

The transit industry in the US has flirted with technical standards all during the past century. Some of the more well-documented cases are explored in this section: the PCC car of the 1930's, Transbus from the 1970's, and the so-called "White Book" from the 1970's. The intent in this review is to identify common patterns in how the US transit industry has, historically, responded to standardization efforts. As will be shown, similar issues are emerging for the adoption of transit ITS standards.

2.1 PRESIDENT'S CONFERENCE COMMITTEE (PCC) CAR

In the late 1800's, electric streetcars (or trolley cars) became popular in many large urban areas in North America. The first electric streetcar in the United States was introduced in 1888 in Richmond, Virginia. The concept was used on the elevated rail lines in Chicago beginning in 1895, and the first electric subway line was introduced in Boston in 1897. The electric streetcars provided higher operating speeds than traditional horse-drawn streetcars, had lower operating costs, and provided easier access to land outside of the major urban areas.

During the 1920's, the electric streetcar reached its largest ridership in the US. In 1923, it is estimated that US streetcars carried over 13.6 billion passengers. However, over the course of the 1920's and 1930's, the streetcar share of transit trips fell dramatically, and the motor bus and the trolley bus assumed a greater role in carrying transit passengers. This is evidenced by the data in Table 1 and Figure 1, illustrating the total passenger trips on each transit mode in the US for selected years. From 1900 to 1929 overall transit ridership grew steadily during the early development of electric streetcars, and then due to the economic activity in World War I and the post-war period. During the 1930's, there was a steep decline in ridership due to the Great Depression. World War II brought with it a resurgence of transit ridership, due in large part to fuel rationing and other economic stimuli.

There were several causes of the decline of the streetcar during the 1920's, and these causes were perhaps directly responsible for the development of the PCC car. First, although transit ridership had increased in the early 1900's, after World War I, private transit companies found it difficult to maintain a profit due to the rise of labor and operating costs and regulation of the fares they could charge. Second, by the 1930s, the transit industry had to replace an aging fleet of streetcars, as there was little investment in the 1910's and 1920's in new streetcars, track maintenance and construction. Part of this lack of investment was due to the regulation of electric utilities, which were prohibited from subsidizing electric streetcar operations they owned. Also, with the economic boom of the 1920's, more people invested in private automobiles, and private transit companies began investing in the less expensive motor bus. Nonetheless, the significant capital investment in right-of-way and track was still useful.

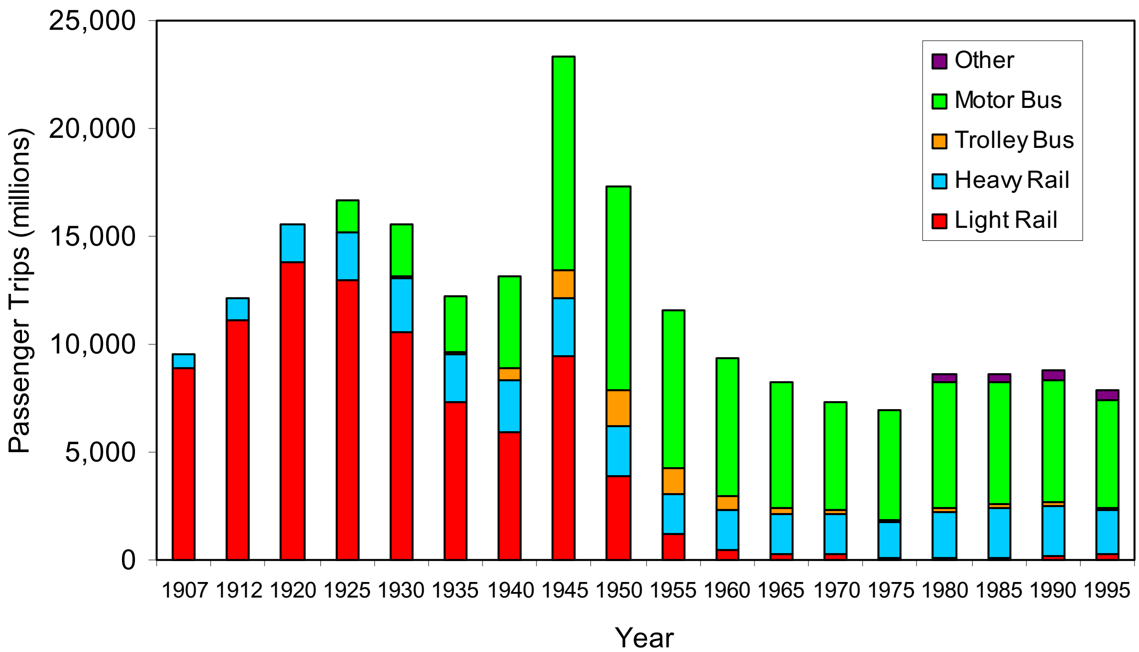
Table 1. Passenger Trips by Mode, millions

Year	Light rail	Heavy rail	Trolley Bus	Bus	Other	Total
1907	8,868	675	0	0	0	9,543
1912	11,109	1,041	0	0	0	12,150
1920	13,770	1,792	0	0	0	15,562
1925	12,924	2,264	0	1,484	0	16,672
1930	10,530	2,559	16	2,481	0	15,586
1935	7,286	2,236	96	2,625	0	12,243
1940	5,951	2,382	542	4,255	0	13,130
1945	9,426	2,698	1,298	9,946	0	23,368
1950	3,904	2,264	1,686	9,447	0	17,301
1955	1,207	1,870	1,223	7,269	0	11,569
1960	463	1,850	657	6,425	0	9,395
1965	276	1,858	305	5,814	0	8,253
1970	235	1,881	182	5,034	0	7,332
1975	124	1,673	78	5,084	0	6,959
1980	133	2,108	142	5,837	347	8,567
1985	132	2,290	142	5,675	397	8,636
1990	175	2,346	126	5,677	475	8,799
1995	251	2,033	119	4,968	498	7,869

Source: American Public Transit Association, *Transit Fact Book*, 1997.

Figure 1. Transit Ridership by Mode

Source: American Public Transit Association, *Transit Fact Book*, 1997.



Sensing pressures on the streetcar industry during the 1920's, there was considerable agreement that the streetcars should have more uniform design features, better operating performance, and lower operating costs (Cudahy, 1999). This sentiment grew into a formal plan of action that was initiated in the fall of 1929 at the annual meeting of the American Electric Railway Association (AERA). From this meeting and subsequent discussion among the railway companies, a separate organization was created, the Electric Railway Presidents' Conference Committee, so named because it included the presidents of 25 electric railway companies in North America. This committee commissioned a staff to look at methods to improve the design and performance of the electric streetcar. The result, unveiled after five years of work in 1934, was the Presidents' Conference Committee streetcar, or the PCC car. The first PCC car went into service in October of 1936 in New York City. Over the course of production from 1934 to 1952, over 5000 PCC cars were constructed and put into service, not only in North America but also in other countries around the world.

Users and operators liked PCC cars because the cars were more comfortable, economical, quieter and faster than previous streetcars (Cudahy, 1999). Many of these features were the result of several new standard design options on the PCC cars, including:

- **A lightweight high-tensile steel car body**. According to Middleton (1967), "utilizing a streamlined car body of welded high-tensile steel, the standard PCC weighed about 33,000 pounds – far less than the previous car of comparable capacity and performance."
- **Floor heating and ventilation units**. These units provided greater circulation of heat throughout the car during colder months.
- **Rubber-cushioned wheels and rubber-insulated trucks**. According to Carlson and Schneider (1981):

  PCC cars would devote more attention to ride comfort than to any other aspect of car design because noise and rough riding were the most common complaints about streetcars in the past, and because this problem could be traced to wheels and truck structure. The new trucks, featuring rubber-cushioned wheels and extensive use of rubber insulation, were remarkably quiet in operation.
- **A dynamic brake system and indirect motor power**. Middleton (1967) states:

  Four 55 horsepower motors provided the PCC car with the highest power-to-weight ratio in street railway history plus exceptional speed and acceleration characteristics… A dynamic braking system, which used the motors for braking action, supplemented by magnetic track brakes and air brakes, provided a comparable improvement in braking performance.

These standard elements in the PCC car design led to better streetcar acceleration and deceleration characteristics, higher operating speeds, greater control of temperature in the passenger area, and lower noise levels (see, among others, Kashin and Welsh, 1986). Many sources document how the PCC car effectively reduced streetcar capital and operating costs and improved customer service. For example, Kashin and Demoro (1986) compiled the information in Table 2, from documented benefits of the PCC cars. Also, according to Middleton (1967), the introduction of the PCC cars was a causal factor as ridership increased as much as 33%. Schedule speeds were increased by as much as 15%, and most lines reported reduced accident rates, power consumption, and labor and maintenance costs.

Table 2: Benefits of the PCC Car (Kashin and Demoro, 1986)

City	Gross Revenues	Schedule Speeds	Other
Brooklyn: Overall	33% increase (Oct.,1936-Sep.,1937)	14% increase	
Brooklyn: MacDonald -Vanderbilt	24% increase (1937) Averaging $3,350 per car per year 11.6% increase (Erie Basin Line) 18% increase (Seventh Avenue)	13.3% increase	
Chicago: Madison St	11.5% increase (Nov 1936-Aug 1937)		10.8% decrease in labor cost
San Diego	18.16% increase on one route 23.5% increase on a second route 6% increase on a third route (Dec 1939)	6% increase	

As a result, the PCC car is often cited as a clear case of the benefits of standardization in transit (McGean, 1999). However, while it is generally believed that standardization was useful, it is important to point out that the standardization of components still left considerable flexibility in the local design. There were 144 patents from PCC car designs; if any one was used in the design, the streetcar was designated a PCC car (Black, 1995). Looking more closely, however, the value of the PCC car appeared to be in both a combination of standard and customized design features. The PCC car did not have a single, comprehensive design specification; rather, the conditions of each city required variations on the original design. As described by Carlson and Schneider (1981):

> *Over the years most operators developed many specialized designs that met what were considered to be "unique local conditions." The 1934 draft specification included five variations of the standard car, somewhat fewer than actually produced between 1935 and 1949. The PCC was so easy to modify that some 2,095 such cars built in North America were double-ended, longer, shorter, wider, or had different center door arrangement than the vehicles defined in the standard 1935, 1945, or 1949 specifications. These cars represented 42 percent of all United States and Canadian production.*

The history of the PCC car suggests three key features of standardization. First, the standards were driven by industry, with a clear need to reduce costs and improve passenger service.

Second, the design specifications were targeted to those vehicle features where significant technical improvements were possible, with a reasonably mature technology. Third, the specifications were flexible enough to accommodate local customization to meet local needs.

2.2 TRANSBUS

In 1971, the Urban Mass Transportation Administration (UMTA, the previous name of the FTA) initiated the Transbus Program. This program was originally intended to provide a new standardized bus design that provided a considerable change from existing bus designs. Specifically, a new bus was intended to provide higher operating speeds, greater passenger comfort and safety, lower maintenance, improved environmental compatibility, better aesthetics, and improved accommodation of the elderly and handicapped (Booz-Allen, 1976, and General Motors, 1975).

According to the General Motors Corporation (1975), the Transbus features included:

- A significantly lower floor versus existing bus designs;
- Independent front suspension for superior ride and handling;
- A special kneeling feature to reduce the front step-to-curb distance;
- Broader tinted side windows to provide better outward visibility;
- Wider doors;
- Brighter illumination of bus steps and curb at bus stop areas;
- Cantilevered seats for a clear floor;
- A U-shaped lounge area in the rear of the coach similar to that used by some airlines;
- Loudspeakers inside and outside to enable the driver to assist passengers with current route and stop information; and,
- Improved air conditioning, heating, and exhaust systems to provide a year-round, fume-free, temperature-controlled internal environment.

Originally, UMTA had planned to procure 300 units of Transbus directly, but abandoned this approach in 1975. At that point, the focus of the federal program shifted to supporting the development of procurement standards for the prototype “Advance Design Bus” (the so-called “White Book,” discussed below). Nonetheless, in 1977, the Transbus program was revived, but was ultimately abandoned when no bus manufacturers chose to bid on the federal Transbus procurement.

There were many reasons why the Transbus program failed, ranging across administrative, political and technical causes (Azad, 1980). Of a more technical nature, it is generally agreed that the technical specifications for the Transbus were too restrictive (Azad, 1980; Cudahy, 1999). To the point, the specifications and technical procurement process were flawed in the following ways (Azad, 1980):

- The specifications were based on rigid *design* standards that did not allow manufacturers sufficient flexibility to respond to requirements that emerged as prototype vehicles were developed, tested and demonstrated.
- The testing of the design was not separate from the public demonstration of the technology, resulting in clear negative impacts on the ultimate acceptance of the technology.
- The initial UMTA plan to *mandate* the Transbus standard for federally supported bus purchases ultimately blocked the adoption of the standard. Rather, economic incentives to use the bus design specification may have been much more successful in gaining gradual acceptance and adoption of the standard.

2.3 THE WHITE BOOK

In 1977, UMTA issued the Baseline Advanced Design Transit Coach Specification, or the White Book, as the only method of procurement for advanced design transit buses under the UMTA capital grants program (Obert, 1985). The original purpose of the White Book was to provide a detailed design specification. With the failure of the design standards from Transbus, however, UMTA chose to publish a performance-oriented specification. This allowed some ability for manufacturers to use innovative technology in the bus design, and allowing procuring agencies some flexibility to respond to local design requirements (Obert, 1985).

The White Book was initially published by UMTA in 1977 as a mandatory standard for procurement of advance design buses (ADBs). Over a short period of time, however, many transit agencies became less and less satisfied with the specification. There were several elements in the performance specification that were still deemed to be too restrictive, particularly regarding passenger capacity, fuel economy, brake and transmission reliability and maintenance, and for a sealed air conditioning system (Obert, 1985). Additional requirements for passenger safety, and for accommodation of access for the elderly and handicapped, were also deemed too restrictive (Azad, 1980; Obert, 1985). UMTA responded to these concerns by gradually phasing out certain requirements in the White Book, and by 1982, no longer required the use of the White Book in ADB procurements. Nonetheless, many agencies continued to use elements of the White Book in procurement, even into the 1990's (APTA, 1997).

While the White Book was generally an improvement over the rigid Transbus program's specification, similar issues emerge as impediments to the ultimate adoption and use of the design standard. First, the specification was still deemed to be too rigid to allow local flexibility in bus procurement. As suggested by Azad (1980), there is a clear balance that is required between a more "ad hoc" process with minimal design direction, and a rigid process that over-specifies the design. Also, the federal program allowed only limited input of the manufacturers and the transit operators, thereby limiting the value, and ultimately the acceptance, of the standard (Azad, 1980). Finally, a federal mandate for design standards, as opposed to more market-oriented incentives, also impeded innovation and prevented adoption (Azad, 1980; Obert, 1985).

3. SURVEY OF RECENT STANDARDS

3.1 INTRODUCTION

To explore some of the issues with vehicle designs, and to probe current bus information system designs, a survey of current practice was completed. This was based on recent standards published by the American Public Transit Association (APTA) and by the Society of Automotive Engineers (SAE). These standards are described briefly below.

In early 1995, a committee of the American Public Transit Association (APTA), consisting of senior representatives of both manufacturers and transit operators, concluded that a comprehensive revision of the White Book would be useful to the industry. The primary emphasis in the revision would be on the procurement language, with less emphasis on the technical bus design specification (Henke, 1995). With funding from the FTA, the Standard Bus Procurement Guidelines, Part 1 (the procurement guidelines) were subsequently published in 1996, and the technical specifications (Part 2) were completed in 1999 (APTA, 1997 and 1999).

In 1986, the Society of Automotive Engineers (SAE) initiated a standardization effort for on-board electronic data exchange for heavy-duty trucks and buses. This was ultimately published as the SAE J1708 standard, specifying the hardware, and the SAE J1587 standard, covering the data sharing requirements. More recently, to overcome speed restrictions on data sharing with J1708/J1587, SAE has been developing a more complex standard named J1939. An excellent summary of these on-board electronics standards is given in TCRP Report 43 (Schiavone, 1999).

According to Schiavone (1999), the J1708 family for on-board electronic integration consists of three levels: drivetrain level, electrical level, and information level. The drivetrain level includes engine, transmission, retarder, anti-lock brakes (ABS), and traction control system. The electrical level includes turn signal switch, running light switch, other on/off switches, signals and running lights, and other electrical devices. The information level includes automatic vehicle location (AVL) systems, destination signs, fare collection, automatic annunciators, security camera(s), automatic passenger counters (APCs), etc. Information level electronics have, for the most part, been designed as proprietary systems until recently. However, for integration of information at this level, the SAE J1708 program was undertaken to create a standardized vehicle-area-network (VAN). According to Schiavone, "all electronically controlled drivetrain components installed in U.S. buses exchange data over one or more SAE-developed networks". As the need for capacity to handle future complex data grows, the SAE J1708/J1587 will be updated to the high-speed J1939 network (Schiavone, 1999).

3.2 SURVEY DESIGN

Ultimately, time will tell whether the Standard Bus Procurement Guidelines and the SAE standards will be widely adopted, or will provide the cost savings that are expected of these standards. However, to gauge the initial response and adoption experience of these bus design standards, a survey was conducted of transit operators around the US. The purposes of this survey were two-fold: (i) to identify the current use of standards in procurement; and, (ii) to identify perceptions of the potential costs and benefits of these standards for the transit industry.

A written survey was mailed to over 300 procurement managers at public transit agencies in the US having buses that are at least 30 feet in length (i.e., "standard" length buses). A copy of the survey instrument itself is given in Appendix A. The first section of the survey asks typical questions about the agency's operations and fleet characteristics. In addition to these typical questions, two additional sections of the survey asked about the agency's familiarity, and if applicable, the use of the Standard Bus Procurement Guidelines (hereafter, the "SBPG") and the SAE J1708/J1587. A final section asked whether the individual completing the survey was familiar with some of the more recent standards development efforts, including the Transit Communications Interface Protocol (TCIP), which later changed the wording to the "Transit Communications for ITS Profiles" (Institute of Transportation Engineers, 1996), the Transit Standards Consortium (2000), and the Advanced Technology Transit Bus program at the Federal Transit Administration (FTA, 1998).

A total of 38 agencies responded to the survey, giving a survey response rate of about 13%. The responding agencies are listed in Appendix B. Among the 38 agencies, bus fleet sizes ranged from 2 to over 1800 buses; the average number of buses across the sample was 222. The agencies also represent a variety of geographic areas around the U.S. The 13% response rate is somewhat low, and the results presented below may not be truly representative of transit agencies in the US. Hence, it is difficult to generalize from the results of our survey. Nonetheless, the observations from these agencies appear to be similar to the challenges to transit standards that are reported earlier in this paper, lending some credibility to the survey results.

3.3 SURVEY RESULTS

The results of our survey are presented in two parts. The first part identifies answers to specific questions in the survey, and the second part describes more general comments that were included in the survey responses.

3.2.1 Results

After the background questions, the first main question on the survey asked whether the agency was aware of the SAE J1708/1587 and the SBPG standards. Of the 38 transit agencies, 15 agencies (40%) were aware of the SAE J1708/J1587 standard; 32 agencies (84%) were aware of the SBPG, Part 1; and 30 agencies (79%) were aware of the SBPG, Part2. The very low awareness of the SAE standard is surprising, given that the standard has been around since 1992. Interestingly, the awareness of the SBPG is about twice as high as that of the SAE standards.

The second question asked about actual ownership of the documents. Interestingly, 6 agencies (40%) of 15 aware possess an electronic or paper copy of SAE J1708/1587. For the SBPG, 27 agencies (84%) of 32 aware possessed the APTA SBPG Part1, and 22 agencies (73%) of 30 aware possess APTA SBPG Part2. This is interesting because, even after accounting for awareness of the standards, actual ownership of the J1708/J1587 standard is lower than the APTA standards.

A second set of questions on the survey asked about the use of the SAE J1708/J1587 standards in procurement. A total of 8 agencies indicated they had used the SAE J1708/J1587 specification, representing 21% of the total respondents and 57% of the agencies that were aware of the standard. Interestingly, in asking what parts of the SAE standard were used in procurement, one-half (4) said they had used the full standard; the other 4 have used only selected parts of the SAE J1708/J1587 standard.

Finally, this leaves 7 agencies that are familiar with, but not using, the SAE J1708/J1587 standards. The two primary reasons for not using the SAE standards were: (i) the given agency's lack of control of the specifications used in procurement, and (ii) the perceived complexity of the SAE standards. From a different perspective, 15 of the 38 respondents indicated that they were not aware of the SAE standards, and hence had not used them. This indicates that a significant barrier to the use of the SAE standards is a lack of awareness.

Of the agencies that had used the SAE standard, the survey asked them to estimate the cost, or cost savings, they had experienced as a result of using the SAE J1708/J1587. This elicited some very interesting insights. One agency estimated that it cost $1400/bus, and another $2000/bus, to include the standard. A third agency said it cost them an unspecified, but small, additional amount per bus to have the J1708 backbone installed on their buses. Curiously, a fourth agency mentioned that they received a $1314/bus credit from the manufacturer for deleting the requirement that the buses include J1708/J1587. Finally, one agency mentioned that they deleted the J1708/J1587 from procurement documents, after some manufacturers said it would cost them too much to provide and, as a result, they would not bid on the procurement. All this suggests that at least in the short term, the J1708/J1587 standards have resulted in *additional* costs.

A third set of questions asked about the use of the SBPG in procurement. In total, 19 agencies said they had used the SBPG Part 1 (the procurement guidelines) to purchase buses. This represents 50% of respondents, and 59% of the 32 agencies aware of the SBPG Part 1. This gives an indication of widespread acceptance and use of the SBPG Part 1, in the transit industry. However, only 7 of the 19 agencies had used the full SBPG Part 1; the remaining 12 had used only selected parts from the SBPG Part 1 language.

This indicates that there is a need for agencies to pick and choose elements of each standard that fit their local needs. Some will use the full standard; others will choose only selected parts; still others will not use any of the specifications. Nonetheless, several agencies commented that the SBPG saved them time in the procurement process, simplified the procurement language, and reduced the overall time-to-contract in the procurement. The primary reason for not using the SBPG was that some agencies did not have these specifications in their hands before their last procurement. A few agencies felt that their local conditions were not accommodated in the SBPG Part 1, and did not use the guidelines at all.

At the time of the survey (Spring 1999), the SBPG Part 2 (the technical specifications) had just been issued, and hence no agencies had used these in procurement.

The fourth set of questions in the survey asked about awareness of more recent transit ITS standards efforts, particularly the Transit Communications Interface Profiles (TCIP) (Institute of Transportation Engineers, 1996) and the Transit Standards Consortium (TSC, 2000). At the time of the survey, the draft TCIP standards were being issued by ITE, and the TSC was just getting under way. Of the 38 respondents, 13 (about 34%) were aware of the TCIP family of standards, and 9 (about 24%) were aware of the TSC. Given the more recent nature of the TCIP and TSC activities, one may expect that the awareness is low. However, the awareness of the ATTB program was high, with 29 out of the 38 agencies (76%) expressing awareness.

A final set of questions was intended to probe more recent attitudes at transit agencies about federal mandates regarding bus design standards. At the time of the survey, there was considerable activity and speculation about federal requirements for conformity to the National ITS Architecture. The survey asked specifically, "Do you believe it would save your agency money in your motor bus and bus equipment procurements if the Federal Transit Administration required the use of the design standards?" Responses were solicited for the SAE J1708/J1587 standards, the SBPG, and the TCIP family of standards.

Out of the 38 responses, 7 agencies (18%) felt that mandatory SAE standards would save money, 9 agencies (24%) believed that mandatory use of the SBPG would save money, and 7 agencies (18%) believed that mandatory TCIP standards would save money. Of course, one might choose to disregard those respondents who were not aware of the standard (i.e., those ignorant of the standard). Consequently, among those aware of the standards, 4 agencies out of 15 aware (or 27%) felt that mandatory SAE standards would save money, 8 of 30 (27%) believe that mandatory use of the SBPG would save money, and 3 of 13 (23%) felt that mandatory TCIP standards would save money.

It is remarkable that, in all three cases, only about one-quarter of knowledgeable respondents believed that mandatory standards might save money. Yet, it is not clear from this survey question whether this skepticism is due to the standards themselves, or to the possibility of *mandatory* standards from the FTA. [Parenthetically, it is now noteworthy that the FTA has resisted requiring standards for transit ITS projects. This is most noticeable in the recent statement on the National ITS Architecture Conformity (Federal Register, 2001).]

It nonetheless seems important to emphasize that there has been little evidence to date of the benefits of standardization. If evidence is forthcoming, a *clear demonstration* of benefits of standardized buses and bus equipment may help to change agencies' attitudes toward these standards.

3.2.2 Respondent Comments

Most of the responding agencies had additional comments about bus design standards. Several of the representative, and positive, comments follow:

> *"If the consortium would work on 3 basic type standard buses, the process would probably save money to all agencies."*
>
> *"Any use of standards will save in procurement and contract administration time, and manufactures should save money, which may be passed along to transit properties."*
>
> *"I am in favor of supporting bus design standards. They should help our industry reduce costs and simplify procurement."*
>
> *"Design standards are good to a point. Each property still has options/needs they prefer for their environment. I feel cost of bus is more associated with small demand vs. standards."*

Several agencies also gave opposing opinions. They said that standards could not meet their specific needs, and that national level standards could not meet needs of the transit industry more generally:

> *"Any financial saving would come from the 'interconnectability' of electrical equipment from various manufacturers. Unfortunately, the quality requirement of the APTA Bus Guidelines is so low that bus customization to meet various operating and service requirement is absolutely necessary."*

"As with any standard, not all extremes are covered. To require adherence without variation penalizes those agencies outside the middle road in equipment needs."

"Having worked for three transit agencies I can see great value in standardization on a system level. Standardization on an industry level is too far reaching."

"It may be difficult to balance specific transit system requirements and national design standards. The cost of vehicles would be lower, but vehicles may not meet local needs."

In both the positive and more critical comments, one may see that there is general interest in standards, and a belief that standards have some value. At the same time, there must be sufficient flexibility with the standards to allow adaptation or supplementary needs at the local level to be included in the procurement specifications.

4. CONCLUSIONS AND RECOMMENDATIONS

The historical evidence on transit design standards, and the more recent experience with these standards, has some common themes. In turn, these lessons can help guide the development and implementation of transit ITS standards more specifically, and transit vehicle design standards more generally.

First, in the scoping of standards, there must be a balance between industry-wide standardization while maintaining local flexibility. The success of the PCC car appears to be in the standardization of selected, mature technologies in the design, while allowing local flexibility in the remaining design features. Conversely, the specification in the White Book seems to have been too constraining without sufficient local flexibility. More recently, the technical specification of the SBPG Part 2 also seems, through the comments shown here, to have stirred debate about whether the specifications are too rigid to accommodate local transit agency needs.

Second, there is a need for flexibility within the technical features of the standard to accommodate the learning process through development, testing, and demonstration of the design. The Transbus experience during the 1970's demonstrated that a more rigid design-based standard was too rigid, both for the manufacturers and the transit operators. More recently, the SAE J1708/J1587 standard has been made obsolete with the higher speed SAE J1939 standard. While no one may have anticipated the growth in the speed of electronics over the last 15 years, one may argue that the J1708/J1587 standard was nonetheless too rigid to accommodate this change in technology.

Third, those standards efforts that appear to have had the greatest success are directed by industry, not by the federal government. The success of the PCC car and the more recent widespread adoption of the SBPG is due in large part to the industry as a whole taking ownership of the problem. For the PCC car, the Electric Railway Presidents' Conference Committee spearheaded the effort; for the SBPG, the effort was directed by both APTA and the bus manufacturers jointly. In contrast, the ultimate failure of Transbus and the White Book are in large part due to a standards development process directed by the federal government, for the purposes of mandatory technical standards. In both cases, the direct federal involvement in development of standards was unsuccessful in achieving the desirable goals of cost savings and technical innovation in bus procurements.

Fourth, once the standards process is begun, there is a need to test and to demonstrate the value of the standard. This process should include a process wherein the standard can still be refined as it is tested and demonstrated in the field. In the case of the PCC car, the cost advantages were clearly demonstrated, and served to promote the use of the PCC car across the US. Moreover, the PCC car specification was revised during the course of its useful life. In contrast, the lack of success of Transbus, or more recently of the SAE J1708/J1587 standard, was due at least in part to a lack of demonstrated cost savings. Rather, both showed *higher* costs of procurement. Also in the case of the SAE J1708/J1587 standard, the technical deficiencies (e.g., slow communications speed) proved to be an obvious weakness of the standard that could not be overcome.

These themes lead to the following recommendations for the ongoing effort to develop transit ITS standards:

- Careful scoping of transit ITS standards, within the TCIP and TSC efforts, is necessary. Standards are appropriate for mature technologies that are widely accepted; rapidly evolving technologies and often-customized features are best left to the discretion of local transit operators.
- The TCIP and TSC efforts should guard their time available in the standards development process for development, testing, and demonstration of the standards in order to facilitate more widespread acceptance and adoption of transit ITS standards.
- Direct federal development or mandates of transit ITS standards are likely to be counter-productive in facilitating the long-term adoption and use of the standard. Rather, wider industry participation, and overall industry awareness of standards, should be the priority. With the seemingly low awareness of these efforts in the broader industry (as suggested by the survey), outreach and educational efforts deserve high priority in the time and funding in the TCIP and TSC efforts.

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APPENDIX A: SURVEY INSTRUMENT

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Bus Design Standards Questionnaire

The Texas Transportation Institute is investigating the potential economic value of transit bus design standards. The objectives of this research project are : (1) to identify the current use of standards in procurement; and, (2) to identify the potential costs and benefits of these standards for the industry. The project is being sponsored by the Southwest University Transportation Center, a federally-supported university research program. We would appreciate if you could complete each of the following sections of this questionnaire. Thank you very much for your participation in our study!

I. Background

1. Contact information (Please feel free to attach a business card instead of the following information)

1a. Agency name : ______________________________

1b. Agency address :______________________________

1c. Name of respondent :______________________________

1d. Phone/Fax number :______________________________

1e. E-mail address :______________________________

2. Would you be willing to participate in a 15-minute telephone interview to answer some additional questions? Yes ❑ No ❑
3. Would you like your responses kept anonymous? Yes ❑ No ❑
4. Would you like to receive a copy of our analysis? Yes ❑ No ❑

The following questions ask about the motor buses in use at your agency. By "motor buses", we mean buses that are at least 30 feet in length, and we include articulated buses. Please use this definition in answering the following questions.

5. How many motor buses are in your agency's fleet? ______________________
6. What is the average age of motor buses in your agency's fleet ? ____________ years
7. How many motor buses did your agency purchase or begin to lease in each of the last 10 years?

1989 :____________	1994 :____________
1990 :____________	1995 :____________
1991 :____________	1996 :____________
1992 :____________	1997 :____________

1993 :___________________ 1998 :___________________

II. Bus Design Standards

The questions in this section ask about your familiarity with recent transit bus design standards.

1. Are you aware of the bus design specifications identified below?

SAE J1708/J1587	Yes ❑	No ❑
APTA Standard Bus Procurement Guidelines, Part 1	Yes ❑	No ❑
APTA Standard Bus Procurement Guidelines, Part 2	Yes ❑	No ❑

2. Does your agency possess an electronic or paper copy of these specifications?

SAE J1708/J1587	Yes ❑	No ❑
APTA Standard Bus Procurement Guidelines, Part 1	Yes ❑	No ❑
APTA Standard Bus Procurement Guidelines, Part 2	Yes ❑	No ❑

3a. Have you used the SAE J1708 and/or J1587 specification in a procurement?

❑ Yes, in total

❑ Yes, in part If so, please identify the standard and associated section numbers :

____

____

❑ No

3b. Please briefly explain why you have or have not used the SAE J1708/J1587 standards.

____

____

____

4a. Have you used the APTA Standard Bus Procurement Guidelines (Part 1)?

❑ Yes, in total

❑ Yes, in part If so, please identify section numbers or headings used :

____

____

❑ No

4b. Please briefly explain why you have or have not used these guidelines.

____

____

____

III. SAE J1708/J1587

In this section, we are interested in learning about your use of the SAE J1708 and J1587 standards.

1. Have you used the SAE J1708/J1587 specification? Yes ❑ No ❑

   (If no, proceed to Section *IV*)

2. In the past 10 years, how many motor buses have been purchased or leased using the SAE J1708/J1587 standard? In each case, give the total cost of the procurement.

Year	**NUMBER OF BUSES PURCHASED WITH SAE J1708/J1587**	Total Cost (Purchase) or Leasing Cost
1989		
1990		
1991		
1992		
1993		
1994		
1995		
1996		
1997		
1998		

3. Do you believe that you experienced a different cost in these bus procurements by using the SAE J1708/J1587 standard, compared with not using the standard? Yes ❑ No ❑

   If possible, estimate the cost savings (or loss) by using the SAE J1708/J1587 standard:

   $______________________________ per bus as a savings/ loss (circle one)

   Please briefly explain your answer:____

   ____

   ____

4. In the past 10 years, did you retro-fit any motor buses to the SAE J1708/J1587 standard?

   Yes ❑ No ❑ If yes, how many buses? ______________________________

5. If you have used the SAE J1708/J1587 standard, what devices have you integrated onto the J1708/J1587 wiring? (Check all that apply)

(a) Fare collection unit (fare box)	Yes ❑	No ❑
(b) Door sensor	Yes ❑	No ❑
(c) Silent alarm	Yes ❑	No ❑
(d) Passenger counter	Yes ❑	No ❑
(e) Voice annunciator	Yes ❑	No ❑
(f) Vehicle control head	Yes ❑	No ❑
(g) Headboard sign	Yes ❑	No ❑
(h) Mobile data terminal	Yes ❑	No ❑
(i) In-vehicle information display	Yes ❑	No ❑
(j) Vehicle location unit	Yes ❑	No ❑
(k) Traffic signal priority transmitter	Yes ❑	No ❑

6a. For the devices you indicated in question 5, do you believe the initial capital costs of these devices were higher or lower because of the SAE J1708/J1587 standard, when compared with non-standard devices?

	Same	Higher	Lower	By how much?($/unit)
(a) Fare collection unit (fare box)	❑	❑	❑	____________________
(b) Door sensor	❑	❑	❑	____________________
(c) Silent alarm	❑	❑	❑	____________________
(d) Passenger counter	❑	❑	❑	____________________
(e) Voice annunciator	❑	❑	❑	____________________
(f) Vehicle control head	❑	❑	❑	____________________
(g) Headboard sign	❑	❑	❑	____________________
(h) Mobile data terminal	❑	❑	❑	____________________
(i) In-vehicle information display	❑	❑	❑	____________________
(j) Vehicle location unit	❑	❑	❑	____________________
(k) Traffic signal priority transmitter	❑	❑	❑	____________________

6b. For the devices you indicated in question 5, do you believe the operating and maintenance costs of these devices is higher or lower because of the SAE J1708/J1587 standard, when compared with non-standard devices?

	Same	Higher	Lower	By how much?($/unit)
(a) Fare collection unit (fare box)	❑	❑	❑	___________________
(b) Door sensor	❑	❑	❑	___________________
(c) Silent alarm	❑	❑	❑	___________________
(d) Passenger counter	❑	❑	❑	___________________
(e) Voice annunciator	❑	❑	❑	___________________
(f) Vehicle control head	❑	❑	❑	___________________
(g) Headboard sign	❑	❑	❑	___________________
(h) Mobile data terminal	❑	❑	❑	___________________
(i) In-vehicle information display	❑	❑	❑	___________________
(j) Vehicle location unit	❑	❑	❑	___________________
(k) Traffic signal priority transmitter	❑	❑	❑	___________________

IV. Advanced vehicle design standards

1. Are you aware of the Advanced Technology Transit Bus? Yes ❑ No ❑

2a. Are you aware of the Transit Communications Interface Profiles(TCIP)? Yes ❑ No ❑

2b. Does your agency possess an electronic or paper copy of TCIP? Yes ❑ No ❑

3. Are you aware of the Transit Standards Consortium? Yes ❑ No ❑

4. Do you believe it would save your agency money in your motor bus and bus equipment procurements if the Federal Transit Administration required the use of the following design standards?

    SAE J1708/J1587 Yes ❑ No ❑

    APTA Standard Bus Procurement Guidelines, Parts 1 and 2 Yes ❑ No ❑

    TCIP Yes ❑ No ❑

5. If you have any additional comments about bus design standards, please feel free to include them here. ____

____

____

Thank you very much for your prompt response!

APPENDIX B: RESPONDING TRANSIT AGENCIES

	Name	Address
1	Birmingham-Jefferson County Transit Authority	3105 8th Avenue North, Birmingham, AL 35203
2	Fresno Area Express	2223 G street, Fresno, CA 93706
3	Monterey-Salinas Transit	One Ryan Ranch Road, Monterey, CA 93940
4	National City Transit	522 West 8th Street, National City, CA 91950
5	Norwalk Transit System	12700 Norwalk Boulevard, Norwalk, CA 90650
6	OMNITRANS	1700 West Fifth Street, San Bernardino, CA 92411
7	Santa Clara Valley Transportation Authority	3331 North First Street, San Jose, CA 95134
8	South Coast Area Transit	301 East Third Street, Oxnard, CA 93030
9	Southern California Regional Rail Authority	700 South Flower Street 26thSuite 2600, Los Angeles, CA 90017
10	Housatonic Area Regional Transit District	107 Newtown Road, Danbury, CT 06810
11	Miami-Dade Transit Agency	3311 NW 31st, Miami, FL 33142
12	Department of Transportation Services, City and County of Honolulu	711 Kapiolani Boulevard, Honolulu, HI 96813
13	Chicago Transit Authority	Merchandise Mart Plaza, PO Box 3555,Chicago, IL 60654
14	Pace Suburban Bus Division of RTA	550 West Algonquin Road, Arlington Heights, IL 60005
15	Topeka Metropolitan Transit Authority	201 North Kansas Avenue, Topeka, KS 66603
16	Owensboro Transit System	PO Box 10003,Owensboro, KY 42302
17	UMass Transit Service	PO Box 31110,Amherst, MA 01002
18	City of Battle Creek	339 West Michigan Avenue, Battle Creek, MI 49017
19	Kalamazoo Public Transportation Division	530 North Rose Street, Kalamazoo, MI 49007
20	Minnesota Valley Transit Authority	100 East Highway 13,Burnsville, MN 55337
21	Southwest Metro Transit Commission	13500 Technology Drive, Eden Prairie, MN 55344
22	City Utilities of Springfield, MO	1505 N. Boonville, Springfield, MO 65803
23	Missoula Urban Transportation District	1221 Shakespeare, Missoula, MT59802
24	Rochester-Genesee Regional Transportation Authority	1372 East Main Street, Rochester, NY 14609
25	Westchester County Department of Transportation	112 East Post Road, White Plains, NY 10601
26	Berks Area Reading Transportation Authority	1700 North 11th Street, Reading, PA 19604
27	County of Lebanon Transit Authority	200 Willow Street, Lebanon, PA 17046
28	Port Authority of Allegheny County	611 W. Warrington Ave., Pittsburgh, PA 15226
29	Westmoreland County Transit Authority	41 Bell Way, Greensburg, PA 15601
30	City of Sioux Falls Transit System	500 E. 6th St., Sioux Falls, SD 57103
31	Temple Transit /City of Temple, Texas	2 North Main Street, Temple, TX 76501
32	Waco Transit System	421 Columbus Avenue, Waco, TX 76701
33	Peninsula Transportation District Commission	3400 Victoria Boulevard, Hampton, VA 23661
34	Potomac and Rappahannock Transportation Commission/OmniRide	14700 Potomac Mills Road, Woodbridge, VA 22192
35	King County Department of Transportation	821 Second Avenue, Seattle, WA 98104
36	Skagit Transit	600 County Shop Lane, Burlington, WA 98233
37	Mid-Ohio Valley Transit Authority	213 1st Street, Parkersburg, WV 26101
38	Fond du Lac Area Transit	160 S. Macy St. Fond du Lac, WI 54936