A Field Survey of Site Visits to Passenger Intermodal Transfer Facilities in California

Chris Mitchell
Mark A. Miller

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A Field Survey Investigation of Site Visits to Passenger Intermodal Transfer Facilities in California

Chris Mitchell
Mark A. Miller

July 14, 2000
ABSTRACT

In 1991, with the passage of the Intermodal Surface Transportation Efficiency Act and passage of the Transportation Equity Act for the 21st Century in 1998, the role of an intermodal transportation system has become increasingly important. Regional metropolitan planning organizations have been given the authority for the first time to shift federal funds between categories, including funding transit projects with federal highway dollars. This new regional authority strives to pave the way for a more regional and intermodal transportation system.

This project aims to recommend strategies for the improvement of passenger intermodal operations and services by both evaluating the current state of passenger intermodalism in California and to identify ways that intelligent transportation systems can be deployed to enhance the services currently in place from both the user and institutional perspectives. A three-tiered approach has been developed to conduct this evaluation. First, site visits to intermodal sites in urban areas of California were conducted and are the focus of this report. Second, an institutional survey has been developed and will be used to assess the institutional perspective of transit properties from a sample of the visited intermodal sites. Finally, a user survey has been developed and will be administered at one site within the set of sites for which the institutional interviews will be conducted. This three-tiered approach should help provide a nearly complete and clear picture of the current passenger intermodal system and all its major players in California.

A total of thirteen site visits were conducted at passenger intermodal transfer facilities in the San Francisco Bay Area, metropolitan San Diego, and the Sacramento Area. Each site visit considered four stages of the intermodal transfer experience: approach to the facility, the ticketing process, the transfer within the facility and departure from the facility. Comparisons and contrasts are made across regions and modes leading to the formation of generalized hypotheses regarding intermodalism that will be tested later in the project.

Key Words: intermodalism, passenger intermodal operations and services, intelligent transportation systems, California site visits
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INTRODUCTION

This report constitutes the interim deliverable for the second year of PATH Project MOU 375 — “Assessing Opportunities for Intelligent Transportation Systems in California’s Passenger Intermodal Operations and Services”. The project is investigating passenger intermodal transfer facilities in urban areas of California to assess their operations and services and recommend opportunities for the use of intelligent transportation systems technologies in such settings.

BACKGROUND

In 1991, with the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA), and with the passage of the Transportation Equity Act for the 21st Century (TEA-21) in 1998, the role of an intermodal transportation system has become increasingly important. ISTEA, for example, gives regional metropolitan planning organizations (MPOs) the authority for the first time to shift federal funds between categories, including funding transit projects with federal highway dollars. This new regional authority strives to pave the way for a more regional and intermodal transportation system.

With what seems to be the framework for developing an extensive intermodal system in place, this project aims to recommend strategies for the improvement of passenger intermodal operations and services. To that end, we aim both to evaluate the current state of passenger intermodalism in California and to identify ways that Intelligent Transportation Systems (ITS) can be deployed to enhance the services currently in place.

METHODOLOGY

In assessing both the current state of passenger intermodalism and opportunities for ITS in its further development, we identified two major components to the current intermodal system. First, the institutional component consists of public transit properties, regional MPOs, and other government regulating agencies. By working together, these institutions can lay the groundwork for a seamless intermodal system by cooperating to enhance the overall experience of a passenger. This may include, but certainly is not limited to, coordinated schedules, coordinated information dissemination activities, and coordinated fare structures.

The second player in the intermodal system is the user. It is the way in which the user interacts with the system and policies put in place by the institutions that determines the success of the system. The most effective way of coordinating an intermodal system, of course, is dependent on the needs of the user. By knowing the users’ needs, a priority can be placed on improving those areas that are of most importance to the user.
Given the apparent two-sided nature of passenger intermodalism, this project attempts to analyze both the current status and the opportunities for ITS to become a major player in improving the system from both the user and institutional points of view. In doing this, we have developed a three-tiered approach to conduct our evaluation. First, we have conducted several site visits to intermodal sites throughout urban areas of California. Second, using the information garnered from our site visits, we have developed an institutional survey that we will use to interview all transit properties for a sample of the intermodal sites we have visited. Finally, we have developed a user survey that will be administered at one site within the set of sites at which we will conduct the institutional interviews. We believe that this three-tiered approach will present us with a much more complete and clear picture of the current passenger intermodal system and all of its players in California.

The focus of this report is on the first phase of our research, the site visits, in which we felt that it would be somewhat helpful to take on the role of a transit user. Thus, we conducted most of our site visits by actually riding one mode of transit to the subject facility when possible, and transferring to another mode to leave the facility, noting as much as we could about the facility as we passed through it. In other words, our site visits were conducted by actually using the facilities in question.

The goal of this phase was certainly not to establish any final conclusions or recommendations, but rather, to form hypotheses about the nature of passenger intermodalism and the use of intelligent transportation systems, that could later be tested through our institutional and user surveys. Further, we hoped that this purely anecdotal data, collected by the project team and based only on observations, could provide us with some guidance in actually developing both the user and institutional surveys that we will be later conducting.

With that goal in mind, we do, then, believe that there is value in these site visits, and therefore, attempted to be as methodical as possible in conducting them. In order to assure that all of our site visits were conducted in much the same way, and that all of the information that we sought was collected for each site visit we made, we developed a template containing all of the criteria we hoped to evaluate for each site. On this template there is space to record gathered information regarding fare structures, schedules, physical qualities of the terminal, and any use of technology at the site (see Appendix A for completed site visit templates). A summary of each site visit follows in the next section.

The next phase of this project is to choose a sample of the intermodal sites we have visited. With this sample of approximately four sites, we plan to interview all of the transit properties with service to these sites. For example, if three transit providers serve a particular intermodal facility of interest, we will interview at least one representative from each of the three transit service providers and examine the results of the three interviews to gain a sense of the institutional setting in which the facility operates. We believe that this will give us a sense of one half, the institutional portion, of the two-sided intermodal setting discussed earlier.
The institutional survey will probe several different areas. First, we aim to find out the ways in which each agency stores and maintains their own data. We feel that this could be a valuable indicator as to the level of technology employed by the transit property, and could also indicate the property’s willingness to explore opportunities for ITS in improving its overall performance. The second area we wish to examine is inter-agency data sharing arrangements and attitudes. This will enable us to assess the level of cooperation between transit providers and the extent to which they cooperate, or would be willing to cooperate, to optimize the entire intermodal system. Finally, we hope to question the transit properties about their own attitudes and institutional policies toward particular intermodal facilities, the relationships they have with other providers at the facilities, and also how they perceive regional intermodalism in general.

The third phase in our three-tiered methodology is to conduct a user survey. We have identified one site, the El Cerrito Del Norte BART Station in El Cerrito, to probe user attitudes toward intermodalism and identify characteristics in their daily trip patterns which may influence the ways in which intelligent transportation systems may be employed most effectively.

Finally, comparing the user needs and desires with the results of our institutional surveys will allow us to:

- Evaluate our hypotheses formed as a result of the site visits we conducted in the first phase of our research
- Recommend ITS strategies that meet both user demands and still fall within the range of feasibility from an agency point of view

With these recommendations and findings, we believe that a successful strategy can be developed for improving passenger intermodalism within the current institutional framework that will utilize advanced transportation technologies to improve user satisfaction with the public transportation systems in California. The documentation of the second and third phases of the project will be included in the project’s final report.

SUMMARIES OF SITE VISITS

In this section, we provide the reader with a basic overview and summary of each site visited. A filled-out template for each site in which we took on the role of a transit user is included in Appendix A. Those sites that were simply visited, but not used from the point of view of a passenger are included in this section, but not in Appendix A. The information we have gathered by visiting a number of sites from different regions in the state, and which are quite modally diverse, will allow us to make some generalizations and hypotheses that we will test with our survey instruments.
In developing the template by which many of our site visits were conducted, we identified four stages of an intermodal transfer. First, the approach to the facility and the quality of service to reach the terminal sets the stage for a passenger’s intermodal experience. Second, a transferring passenger must go through some sort of ticketing process. The third step is the actual transfer itself, including locating the new vehicle, the waiting time, and physical qualities of the terminal. The final step in an intermodal trip is the departure from the terminal, by which, much like the approach category, a user’s experience is greatly affected. These summaries, then, attempt to take the reader through these four steps for those sites visited via transit.

**San Francisco Bay Area**

*Transbay Transit Terminal (San Francisco)*

The Transbay Transit Terminal (TTT) has served a number of functions over its existence, including transbay rail service. Now, however, it serves primarily as a bus terminal, with one rail line, the San Francisco Municipal Railway (Muni) F Market Trolley Line. The main user of the terminal is Alameda-Contra Costa Transit (AC Transit), which uses the facility as the terminus of its transbay bus service. Also at the station, are Muni (buses and F Market Trolley Line), San Mateo County Transit (SamTrans), and Golden Gate Transit (all located on the streets surrounding the TTT). Also, private bus companies, including Greyhound, share the space inside the terminal with AC Transit.

There do not appear to be any forms of advanced traveler information services available at the terminal. Each transit provider has a glass display case in which system maps and printed timetables are posted. In addition, there is a large terminal map that shows a user where each bus stop is located to aid the user in his or her intermodal/inter-system transfer. Further, there are small television screens that display the scheduled departure times for the next two buses on each line for Muni and AC Transit. However, these displays are static, and do not update the times with any dynamic, real-time information. In addition, the bus stops at the arrival platform on the upper level used primarily by AC Transit contain printed schedules for each route.

On the trip we made during this site visit, transferring between AC Transit and Muni bus #12 proved to be rather difficult. The vast number of Muni bus stops at various locations around the terminal, rather than one central bus loading location serving the TTT, caused somewhat of a challenge in locating the particular side of the terminal that the #12 bus served. A further challenge was that there were no coordinated fare discounts between AC Transit and Muni. Passengers who use the bus to commute across the bay, do not receive a fare discount for transferring to Muni, while those who use Bay Area Rapid Transit (BART) for their transbay commute, receive what amounts to a half-price discount on all Muni fares, even though the fares are similar on BART and AC Transit for transbay service.
El Cerrito Del Norte BART Station (El Cerrito)

The El Cerrito Del Norte BART Station is a rather significant intermodal site in the San Francisco Bay Area. In addition to a large park and ride facility mainly for use by BART patrons, the station is served by a number of bus services, including AC Transit, Golden Gate Transit, Vallejo Transit, and West Contra Costa County Transit (WestCAT). With this in mind, we have decided to include it, in addition to our site visit, both as a site for a user survey and an institutional interview.

In making the site visit, we rode BART to the station, where we transferred to AC Transit Bus #72, bound for Contra Costa Community College. We arrived at the Berkeley BART Station at 10:12 A.M., and began waiting for a Richmond-bound train. At 10:20 A.M., exactly at its scheduled arrival time, the BART train arrived, bound for the El Cerrito Del Norte station. The trip took approximately ten minutes before arrival at the Del Norte station. An AC Transit transfer discount was available from a dispensing machine in the paid area of the BART Terminal, as we made our way to the bus stops.

The bus facilities at the station are quite near to the exit area from the BART terminal. There are two lanes of bus bays, which are both within 50 feet of the BART terminal exits. Another attractive feature of this particular transfer facility is that there are transfer discounts available for BART patrons for those who transfer to bus. Finally, similar to the TTT, there are static television screens near the bus waiting areas that display the arrival times of the next two buses for each line that serves the station. These are static and simply reflect the published schedule times, and are not capable of alerting passengers to any incidents or other stochastic deviations from the published schedule. At the BART platforms, however, in addition to the posted schedule, there are changeable message signs that display updated information, including dynamic expected train arrival time information.

Amtrak Depot (Emeryville)

The Emeryville Amtrak Depot is served by a number of Amtrak routes, including the Capitol Corridor, the San Joaquin, the Coast Starlight, and others. While Amtrak provides the only passenger rail services that use the station, AC Transit, Emery-go-Round, and Amtrak Thruway buses also serve the station. The bus area is on the opposite side of the terminal building as the rail waiting platforms.

Inside the terminal, there are several passenger information and ticketing services. The station supplies automatic ticketing machines in addition to Amtrak ticketing agents. Also, presumably because of the large number of trains and routes serving the station, there are television monitors throughout the terminal that display updated and dynamic arrival times for upcoming trains. This display appears very similar and operates very similarly to the analogous arrival information screens in an airport. In addition to the in-terminal displays, the arrival platform has a changeable message sign that continuously
displays the updated arrival times of each train, and also says whether or not the updated
arrival time is different from the scheduled time, i.e., the display announces how far
behind schedule a given train is running.

*Embarcadero BART/Muni Station (San Francisco)*

The Embarcadero BART/Muni Station at the foot of Market Street in San Francisco
serves both Muni Metro (Light Rail Transit (LRT)) and buses, in addition to BART.
Further, it is directly across the street from the Embarcadero Ferry Terminal. Unlike most
of the other stations we visited, the Embarcadero BART/Muni station separates its modes
vertically rather than laterally. Because two of the modes act as subways as they travel
down Market Street, they are located below ground, rather than on the street with the
buses. BART platforms are on the bottom level, Muni Metro trains are on the next level,
the ticketing and passenger terminal area are on the level directly below street level, and
the Muni buses are at street level. Passengers transferring either from Muni Metro to
BART or BART to Muni Metro are required to go up to the ticketing/terminal area before
going back down to their next mode.

Although they do require passengers to pay a separate fare when transferring between the
two modes, Muni and BART have a fare discount arrangement for transferring
passengers. Customers in the BART paid area may purchase round trip Muni tickets (for
use on either buses or Muni Metro) for the price of a normal one-way ticket. The
discounted transfer ticket machines, however, are not easily located and often appear to
be out of order. The terminal area has ticket machines for BART users. The BART ticket
machines generally accept cash only, and only give change in coins. However, there are a
limited number of BART ticket machines that do accept credit and debit cards in the
terminal. Muni Metro riders do not need to purchase a ticket at a machine, but rather must
put $1 in coins into a turnstile to enter the Muni paid area, where they receive a paper
proof of payment ticket.

The Muni Metro and BART waiting levels and platforms each have electronic
changeable message signs, which announce both train arrivals and provide dynamic train
arrival information. However, the signs for each service only announce arrival times for
that service at which the sign is operating. In other words, the signs on the Muni level
only offer arrival information about Muni trains, while BART signs only provide BART
arrival information.

*4th & King Streets Caltrain Station (San Francisco)*

The Caltrain Station at 4th and King Streets in San Francisco serves as the terminus for
the Caltrain commuter rail line. At this facility, passengers can transfer to Muni buses,
which offer service at the station’s curbside, or to Muni Metro (LRT) trains, whose tracks
and platforms are adjacent to the Caltrain station, and offer service to downtown San
Francisco.
At the time of the site visit, there did not appear to be much technology at the station, although the passenger amenities seemed quite complete. To purchase a ticket, passengers waited in line to buy their ticket from a Caltrain employee. Further, to find which platform their train would be leaving from, passengers merely had to look at a wooden sign above the door to their platform. There did not appear to be any electronic information media available that displayed either static or dynamic information. Thus, it seems that there may be a number of opportunities to develop ITS applications at the station.

Further, there did not appear to be any transfer discounts on fares for passengers transferring to or from Muni. Caltrain patrons who purchase monthly passes may use their passes on SamTrans, Dunbarton Express, and Santa Clara Valley Transit Authority (VTA) buses, however, and special passes may be purchased for a slightly higher price which will provide riders with passes to ride Muni also.

Since the site visit was made, Caltrain has added some automated ticket machines at some of its facilities. This will reduce the need for employee staffing at many stations, and allow passengers to purchase tickets at hours when the station is not staffed. These ticket machines are now employed at the 4th and King Street Station in San Francisco, although the ticket booth remains staffed. A $1 surcharge is placed on all tickets purchased from Caltrain employees whenever ticket machines are available.

**Diridon Caltrain Station (San Jose)**

This site visit involved riding Caltrain from San Francisco to the Diridon Station in San Jose, and transferring to a VTA bus. The entire trip went according to published schedules, and the VTA bus #64, with service to Downtown San Jose, arrived approximately two minutes after our Caltrain arrived in San Jose.

The bus headway during this time of day is 15 minutes. Although with this headway at this time of day, it is unlikely that our timely transfer was the result of schedule coordination, it still suggests that we may want to probe this deeper during our institutional interviews.

Similarly to many commuter rail stations that we visited, the San Jose Diridon station is served by a variety of public transportation service providers. In addition to Caltrain commuter rail, the Diridon Station is served by VTA buses, Amtrak trains and Amtrak Thruway buses, the Altamont Commuter Express (ACE) commuter rail, Highway 17 Express commuter bus, and BART Connection buses, which serve the Fremont BART station. Although the station is served by a number of different transit properties, we can see that it really only serves two modes: heavy rail and bus.

Although we did not encounter any problems making the transfer connection, there does not appear to be much new technology deployed at the Diridon Station. The fare payment systems for all modes serving the station are in-vehicle or in-station via an agent in the terminal. There is no automatic fare payment. Further all of the signage and maps at the
facility are static, with the exception of changeable message signs over the rail tracks. These signs had just been installed at the time of the site visit and were not yet operational. Thus, it is unknown whether or not they provide dynamic incident information, or just announce train arrivals.

**Metropolitan San Diego**

*San Ysidro/Tijuana Trolley Station (San Ysidro)*

Although the only truly public transportation provider at the San Ysidro/Tijuana Trolley Station is the San Diego Trolley itself, the station does, in fact, exhibit a large amount of passenger intermodalism. Directly adjacent to the trolley platforms, on the street (approximately 50 feet from the trolley platform) is an area where various jitneys, taxis, and shuttle buses stop to transport tourists across the Mexican border (about 1/8th of a mile from the trolley station) to Tijuana.

Given the rather informal nature of this terminal, it comes as little surprise that there is not a high degree of technology or ITS employed there. The trolley station contains automatic ticket machines and changeable message signs above the platforms that announce train arrivals, but do not display any real-time information. However, this level of ITS is focused strictly on the trolley service, and does not contribute to easing passenger transfers between the trolley and the informal jitneys and taxicabs waiting outside. Certainly there are no fare discount arrangements and there appears to be very little coordination among the modes.

*Santa Fe Depot (San Diego)*

To make this site visit, we boarded the San Diego Trolley at the San Ysidro Station (U.S./Mexico International Border) at approximately 2:45 P.M. The trolley traveled north until reaching the San Diego Santa Fe Depot at 3:30 P.M. The trolley stopped about ten feet from the adjacent track where the Coaster commuter rail train was waiting for its departure at 3:40 P.M.

Between the trolley and Coaster tracks were automatic ticketing machines for both the trolley and the Coaster. The Coaster ticket machine functioned properly and allowed for transfer discounts from the trolley. The user first selects his or her ticket type (one-way, senior discount, round-trip, transfer discount, etc.), then his or her destination, then payment type (credit card, cash (machine gives change), or ATM). The machine then prints the ticket and receipt. The user then simply must “validate” his or her ticket in a validation machine next to all of the ticket machines. The function of this validation process allows many tickets to be purchased at once. Then the user may simply insert one ticket in the validation machine each time he or she makes a trip. The validation machine simply prints the date and time of validation, which must be printed on the ticket for the ticket to be used. This validated ticket is only good for just enough time for the ride to be completed, assuring that the ticket may not be used for multiple trips. Further, any discounted transfer fare tickets (users receive a $1.50 discount for riding the Coaster after
transferring from the trolley) purchased must be accompanied by a ticket from the other mode (e.g., a valid trolley ticket).

The Santa Fe Depot terminal building contains the Amtrak ticketing area and a large waiting area for passengers. Further, there was an information booth inside the waiting room, which was staffed by an employee of the San Diego Transit District who was able to aid passengers who wished to navigate the San Diego transit system. Because the information agent at the booth had information about all the different transit services offered not only at the Santa Fe Depot, but throughout the local transit system, new passengers or tourists may get around the area (often by transferring) without a car, and familiar passengers may find alternate, more convenient routes to reach their destination.

*Oceanside Transit Center (Oceanside)*

The Oceanside Transit Center in Oceanside, about 50 miles north of San Diego’s Central Business District, is the terminus both for the San Diego County Coaster commuter rail to the south, and for the Los Angeles County Metrolink commuter rail from the north. The two trains’ routes meet at this facility, which is also served by Amtrak, a number of North County Transit District buses, and a park and ride lot.

This facility employs a relatively high degree of technology both for passenger information and for ticketing. Similar to the other Coaster stations, the Coaster ticketing machines are completely automated, supplying users with a variety of ticket types including senior discounts, student discounts, and transfer discounts for passengers who have a valid bus transfer ticket. The Metrolink trains also employ the same type of automatic ticketing machines located next to the Coaster ticket machines. These ticket machines are located outside of the train platform area so any passengers transferring between the Coaster and Metrolink must exit the platform area via an underground walkway to purchase a ticket for the train they are transferring to. The rail waiting area also employs some dynamic information through a changeable message sign. At the time we visited the site, the signs were displaying information about an incident on the Coaster, informing passengers that the trains would be arriving late. While this information was rather qualitative in nature, it not only eases passenger anxiety, but it also serves as a guide for passengers to perhaps choose alternate modes to reach their destination.

*Old Town Transit Center (San Diego)*

This trip began in Oceanside at the Oceanside Transit Center. We boarded the Coast Express Rail (Coaster) commuter train at the Oceanside Transit Center at approximately 4:50 P.M. and the train departed the station at 4:55 P.M., its scheduled departure time. The train continued southbound, continuing on-schedule.

At 5:52 P.M., exactly on schedule, the train arrived at the Old Town Transit Center, and we waited at the adjacent track platform for the San Diego Trolley Blue line. The trolley
came approximately three minutes later, and continued to the Fashion Valley Transit Center, where we arrived approximately six minutes later.

The Old Town Transit Center in San Diego is truly intermodal in nature. In addition to the commuter rail (Coaster) and LRT (San Diego Trolley), the station is served by a number of bus lines from the San Diego Transit system and a park and ride lot. The rail lines for both trolley directions and the Coaster (three tracks) are all parallel, and are only separated by waiting platforms between them. This made for very easy rail-to-rail transfers. The buses, however, were located on both sides of the rail platforms. A passenger making a rail-to-bus connection who knows which bus line he or she is transferring to can simply follow the sign to the correct side of the terminal. However, a passenger who does not know which bus to take may go to the incorrect side via an underground walkway which goes under the tracks. This passenger would then have to turn around and walk underneath the entire terminal again to get to the other side.

The automated ticket machines for both the Coaster and the trolley were located on the platforms, in between the two modes, so that transferring passengers crossing a platform to connect to a rail mode do not have to go out of their way to purchase tickets. Further, these ticket machines are able to print several different types of tickets, including discounted tickets for passengers transferring between modes. In addition, the Coaster platform was served by a changeable message sign that displayed real-time, dynamic incident information, alerting waiting passengers of any unexpected delays that may occur. The trolley platforms also contained changeable message signs, but did not appear to be able to display any dynamic information. Rather, the trolley’s message signs displayed the line and destination of any approaching vehicles to help ensure that passengers board the proper train.

Another feature of this station was a portable information kiosk/booth in which an employee of the San Diego Transit District could sit, presumably to aid passengers in navigating the San Diego area on transit. However, we could not obtain the actual information available at this kiosk during our site visit at approximately 6 P.M. on a weeknight, because the kiosk was not staffed, providing no information.

**Fashion Valley Transit Center (San Diego)**

This site visit trip began at the Old Town Transit Center in San Diego at 5:54 P.M. We boarded the northbound San Diego Trolley Blue Line to the Fashion Valley Transit Center stop. The trolley arrived at the Fashion Valley platform, leading to a pedestrian bridge and down a flight of stairs to a bus platform below. This platform had a number of bus bays, each containing approximately two bus stops.

From here, we boarded the San Diego Transit Bus #16. The bus fare on this line was $1.75, but as long as a passenger had a trolley ticket worth at least that much, he or she could simply transfer to the bus for free. If a passenger was transferring from the trolley, but did not have a ticket worth the bus fare (trolley tickets operate on a graduated fare structure based on distance traveled and may be as low as $1) he or she could simply
upgrade their trolley ticket by the necessary amount to reach $1.75 in the trolley ticket machines.

As with all other trolley stops we visited, the trolley platform had overhead changeable message signs, which only announced vehicle arrivals and did not have any dynamic vehicle arrival information. Also, the trolley ticket machines were located both upstairs at the trolley waiting platform and also downstairs at the bus platform to aid passengers transferring to a bus in upgrading their trolley tickets to the posted bus fare value of $1.75, as necessary. This station also had a portable information kiosk just like that found at the Old Town Transit Center. However, as was the case at the Old Town Transit Center, the information kiosk was not open.

**Sacramento Area**

*Amtrak Depot (Sacramento)*

Although the Sacramento Rapid Transit District (RT) operates a large number of buses and a light rail line, there is only one bus line that serves the Sacramento Amtrak station. In addition, no other rail services other than Amtrak trains and Amtrak Thruway buses (serving the north coast, the Tahoe region, and the the northern central valley) operate at the facility.

In visiting this site, which does exhibit intermodalism between the RT bus, Amtrak Thruway buses, and Amtrak trains, we felt that the level of intermodalism and the technology used to aid this intermodalism should be evaluated. However, an examination of the site indicates only a small amount of technology in use. There are no changeable message signs in the terminal or at the rail platforms, and no user information services seem to be available except for the Amtrak ticket agents in the terminal. The main form of automation at the terminal is an automatic ticketing machine, at which Amtrak patrons may purchase one-way or round trip tickets using credit or debit cards for any station served by the Capitol Corridor route (rail service between San Jose and Sacramento).

In transferring between Amtrak rail and Amtrak Thruway buses, a passenger need not worry about timing his or her connection, because the buses are there exclusively for passengers transferring from the train. Therefore, even if the train is late, the buses still wait for the train’s arrival before departing. Passengers transferring to the RT bus (DASH Line #30) at the station simply wait at the inner side of the rail platform, which also serves as a bus curb. There are no discounts on the bus fare for passengers with Amtrak tickets.

*Arden/Del Paso RT Station (Sacramento)*

The Arden/Del Paso RT Station serves both the RT’s light rail line and ten RT bus lines, in addition to a park and ride lot. The buses are located on the curbside of the LRT waiting platform (approximately 20 feet from the tracks). Also in this waiting area are
system maps and timetables for each of the buses that serve the station. There were no changeable message signs for announcements at this station.

The ticket machines where passengers can purchase RT tickets for use either on the light rail line or the buses are also located at the station platform. The fare for the bus and for riding the light rail line is the same ($1.50). Further, tickets are good for 90 minutes from the time of purchase, allowing passengers to transfer between bus lines or between bus and rail without paying additional fares for their entire trip. Passengers may also purchase all-day passes for a fee of $3.50 for unlimited rides on all bus lines and the light rail line operated by RT.

**ANALYSIS**

After collecting the site visit data, there are some comparisons and contrasts that can be made both across regions and across modes. From these similarities and differences, we can form some generalized hypotheses regarding intermodalism, and subsequently test these hypotheses. To do so, using the findings we develop in this section, we aim to develop the next steps of our research, including formulating our user and institutional surveys.

The first cross-site comparison that we can make compares rail modes with bus modes. From the above site visit summaries, we believe that it is significant that the rail facilities visited tended to exhibit a higher degree of technology for user information and ticketing than bus modes. For example, many of the heavy rail stations we visited (e.g., the Santa Fe Depot in San Diego, the North County Transit Facility in Oceanside, the Diridon Station in San Jose, and the Emeryville Amtrak Depot) utilized not only changeable message signs, but in many cases, used them to provide dynamic, real-time updated information. As we move to a slightly lower level in rail transit, we see that many of the light rail stations used changeable message signs, but that Muni Metro was the only light rail transit service provider that appeared to provide real-time, dynamic information. Taking our analysis one step further, looking at buses, we see no changeable message signs at bus facilities. The monitors at the El Cerrito Del Norte BART Station and at the Transbay Terminal in San Francisco displayed static bus schedule information, but did not make any announcements or provide any new information beyond that which was already posted.

Another aspect that we can examine is ticketing. Every rail mode that we visited had some form of automated advanced payment machine, with the exception of Caltrain’s San Francisco station (Caltrain has since placed automatic ticketing machines in the 4th and King Streets Station). For most of the sites and systems that we examined, although bus users may use their rail tickets to transfer to bus, the ticketing machines are oriented to rail users.

Therefore, one generalization that we hypothesize is that rail modes tend to be more technologically advanced. The evidence that we have seen from our site visits indicates
that the ticketing procedures and the traveler information (including in-terminal monitors and changeable message signs) are at a more technologically advanced level than those used for buses.

The next evaluation that we make is whether the presence of technology differs by area. From our site visits, it appears that the level of technology used in the San Diego area is higher than that used either in the San Francisco Bay Area, or Sacramento. Sacramento appears to employ the least amount of advanced technologies and the San Diego area seems to have the highest use. The extent of Sacramento’s advanced technologies seems to lie with the changeable message signs discussed earlier, and the automatic fare payment machines, both associated with the light rail system. San Diego, on the other hand, employs both of the above technologies on a wide scale for both the trolley and Coaster, but also provides Coaster passengers with real-time information on its changeable message signs. Further, San Diego’s automatic fare payment machines are quite a bit more advanced than Sacramento’s in that they make change, they will accept dollar bills and credit cards, and they display electronic instructions to ticket purchasers. The Bay Area seems to lie somewhere in between Sacramento and San Diego in technology use, providing some real-time information to train platforms, but not using advanced fare payment systems on as wide a scale as San Diego.

Just as the use of advanced technologies seems to have a fairly clear hierarchy by region, the level of fare coordination seems to have an analogous hierarchy. Fare coordination (transfer discounts, single-fare tickets for multiple modes, etc.) seems to be higher in both Sacramento and San Diego than in the Bay Area. Sacramento, which does not employ a high level of technology at any of the sites we visited, appears to have quite simple and convenient fare coordination. Passengers simply have to pay one fare, giving them free transfers for 90 minutes on all of the modes and lines that RT operates. Of course, the presence of only two modes (bus and LRT) certainly makes this easier to achieve. However, in San Diego, which has a much more complex and diverse network than Sacramento, a similar ease of fare coordination still prevails. Trolley tickets are valid for riding San Diego Transit buses, and also allow users to purchase discounted tickets on the San Diego Coaster. In the San Francisco Bay Area, however, perhaps because of the complexity of the transit system, fare structures seem to be more autonomous, often forcing passengers to pay separate fares for each mode. There are exceptions in the case of Muni, where passengers who ride either the bus or the light rail may transfer without paying additional fare to the other Muni mode, and for BART, which offers transfer discounts for transfers between BART and bus. However, it still appears that San Diego and Sacramento have achieved a higher level of coordination than the Bay Area. The reasons for such geographical differences will be pursued with the agency surveys in the institutional component of the project.

NEXT STEPS

The information gathered in the site visits has been intended to give us a better sense of the current state of intermodalism in urban areas of California. In gaining a better sense
of the systems in place, we hope to be able to better identify areas for improvements. Certainly however, the data we have obtained from our site visits is rather anecdotal in nature and is not meant for drawing any firm conclusions. To make our final analysis, then, we will be conducting interviews with the transit agencies serving a selection of our sites, and conducting a user survey at one site. We believe that the site visits have given us a better idea of the information that we should concentrate on in conducting these subsequent evaluations. With these interviews and survey, we hope to confirm or reject both our initial hypotheses about technology and coordination across regions and across modes. Further, we hope that these surveys will help us identify additional ways in which intelligent transportation systems technologies can be used to further promote passenger intermodalism in California.
Transbay Transit Terminal (San Francisco)

Date: December 28, 1999

Arrival Mode: AC Transit Bus #LC

Departure Mode: Muni Bus #12

Ticketing:
- Are discounted transfer fares available (either in-vehicle or in the terminal)?
  No.
- Does a user need to pay a separate fare for the “transfer-to” mode?
  Yes.
- Does a user need to purchase a new ticket before boarding?
  No.
  - If so:
    - Was the ticket machine “well signed?”
    - Did the machine function properly?
    - If user needs needed correct change, was there a change machine nearby?
    - Were the fare structures clear?
  - If not:
    - Was the fare structure clear for a new user before boarding?
      Yes. Signs at bus platform stated the Muni Bus Fare.
    - How are fares collected (e.g. on-board, in the terminal)?
      On-Board.
- Was the fare a flat fare?
  Yes.
- Do users need correct change?
  Yes.
- What type of ticket is used?
  No ticket given, unless passenger requests a paper transfer.
- Was there a queue of passengers at the turnstile or the ticket-purchasing machine?
  No queue.
Transfer/Mobility in Transfer Terminal:
- Does more than one line serve this terminal (e.g. multiple bus lines at a stop, multiple trains at a BART station, etc.)?
  Yes.
  - If so, was it clear where to board our particular vehicle?
    Not very clear. There were a number of Muni stops around the terminal.
    - Was it clear which vehicle to board? (if multiple lines stop at the same platform)
      Yes.
- Was there a system route map in the terminal?
  Yes.
  - If so, did it show integrated information about other transit providers?
    No. Each provider had its own system map.
- Was there a station agent present?
  Only for AC Transit.
  - If so, do they have information on all systems, or just one?
    Mainly AC Transit.
- Was the waiting area covered? Indoors?
  AC Transit area is Indoors, Muni is outdoors with covered waiting areas.
- How long did we wait for our vehicle?
  22 Minutes.
- What is the scheduled headway for this vehicle/line during this time of day?
  20 Minutes.
- Was there a schedule posted in the terminal?
  Yes.
  - If so, was it accurate?
    Bus was 5 minutes late.
    - Was there any real-time information provided?
      No.
- What security features, if any, are present in the terminal?
  CCTV, Station agents.
- Does the terminal facility seem safe?
  Yes, during the day there are many people around.
- Does the terminal appear well maintained?
  Terminal seems slightly outdated, not kept up.
- Is the “transfer-to” mode inside the same terminal as the “transfer-from” mode?
  No, AC Transit is upstairs and indoors, Muni is across the street, downstairs.

Departure from the Transfer Station:
- What was the total fare for the entire trip?
  $3.25 ($2.25 for AC Transit Transbay, $1.00 for Muni)
- What was the total travel time and how is that time spent: (e.g. how much was in-vehicle, how much was waiting)?
  58 minutes, 35 minutes in vehicle, 23 minutes out of vehicle (at TTT).
Date: April 14, 2000

Arrival Mode: BART Richmond-bound Train

Departure Mode: AC Transit #72

Ticketing:
- Are discounted transfer fares available (either in-vehicle or in the terminal)?
  Yes, issued in terminal.
- Does a user need to pay a separate fare for the “transfer-to” mode?
  Yes.
- Does a user need to buy a new ticket before boarding?
  No.
  - If so:
    - Was the ticket machine “well signed?”
    - Did the machine function properly?
    - If user needed correct change, was there a change machine nearby?
    - Were the fare structures clear?
  - If not:
    - Was the fare structure clear for a new user before boarding?
      No.
    - How are fares collected (e.g. on-board, in the terminal)?
      On-board.
- Was the fare a flat fare?
  Yes.
- Do users need correct change?
  Yes.
- What type of ticket is used?
  No Ticket. Only paper “transfers” if requested.
- Was there a queue of passengers at the turnstile or the ticket-purchasing machine?
  Yes.
Transfer/Mobility in Transfer Terminal:
- Does more than one line serve this terminal (e.g. multiple bus lines at a stop, multiple trains at a BART station, etc.)?
  
  Yes, multiple bus lines serve terminal.
  - If so, was it clear where to board our particular vehicle?
  Yes. Each bus has a separate stop, but they were clearly signed.
  - Was it clear which vehicle to board? (if multiple lines stop at the same platform)
  Each bus had its own stop.
- Was there a system route map in the terminal?
  Yes.
  - If so, did it show integrated information about other transit providers?
  Yes.
- Was there a station agent present?
  Yes.
  - If so, do they have information on all systems, or just one?
  BART station agent, but had some information on other services.
- Was the waiting area covered? Indoors?
  Covered.
- How long did we wait for our vehicle?
  0 minutes. Vehicle was waiting when we arrived at stop.
- What is the scheduled headway for this vehicle/line during this time of day?
  30 minutes
- Was there a schedule posted in the terminal?
  Yes.
  - If so, was it accurate?
  No, bus was 20 minutes late.
  - Was there any real-time information provided?
  Not for buses.
- What security features, if any, are present in the terminal?
  Station agent, CCTV.
- Does the terminal facility seem safe?
  Yes.
- Does the terminal appear well maintained?
  Yes. It was undergoing construction at the time of the site visit.
- Is the “transfer-to” mode inside the same terminal as the “transfer-from” mode?
  No. Buses are located at terminal’s curb, but within terminal’s property.

Departure from the Transfer Station:
- What was the total fare for the entire trip?
  $2.25 ($1.10 for BART, $1.15 for AC Transit with BART transfer)
- What was the total travel time and how is that time spent: (e.g. how much was in-vehicle, how much was waiting)?
  35 minutes, 26 minutes in vehicle, 0 minutes out of vehicle
Diridon Caltrain Station (San Jose)

Date: January 3, 2000

Arrival Mode: Caltrain #68 Express Southbound Train

Departure Mode: VTA Bus #64

Ticketing:
- Are discounted transfer fares available (either in-vehicle or in the terminal)?
  Only for Caltrain monthly pass holders transferring to VTA buses.
- Does a user need to pay a separate fare for the “transfer-to” mode?
  Yes.
- Does user need to buy a new ticket before boarding?
  No.
  - If so:
    - Was the ticket machine “well signed?”
    - Did the machine function properly?
    - If user needs needed correct change, was there a change machine nearby?
    - Were the fare structures clear?
  - If not:
    - Was the fare structure clear for a new user before boarding?
      No.
    - How are fares collected (e.g. on-board, in the terminal)?
      On-board.
- Was the fare a flat fare?
  Yes.
- Do users need correct change?
  Yes.
- What type of ticket is used?
  No ticket, only paper “transfers” if requested.
- Was there a queue of passengers at the turnstile or the ticket-purchasing machine?
  No
Transfer/Mobility in Transfer Terminal:
- Does more than one line serve this terminal (e.g. multiple bus lines at a stop, multiple trains at a BART station, etc.)?
  Yes, multiple bus lines.
  - If so, was it clear where to board our particular vehicle?
    Not immediately. Bus platform was dark, making it hard to find proper stop
    - Was it clear which vehicle to board? (if multiple lines stop at the same platform)
      Yes.
- Was there a system route map in the terminal?
  Yes.
  - If so, did it show integrated information about other transit providers?
    Yes.
- Was there a station agent present?
  Yes.
  - If so, do they have information on all systems, or just one?
    Yes, for all trains.
- Was the waiting area covered? Indoors?
  Bus and train platforms covered, outdoors, but there was an indoor terminal.
- How long did we wait for our vehicle?
  0 minutes; bus arrived just as we arrived at stop.
- What is the scheduled headway for this vehicle/line during this time of day?
  15 minutes
- Was there a schedule posted in the terminal?
  Yes.
  - If so, was it accurate?
    Yes.
  - Was there any real-time information provided?
    No.
- What security features, if any, are present in the terminal?
  Agents, CCTV.
- Does the terminal facility seem safe?
  Yes, except bus areas, which are not well lit.
- Does the terminal appear well maintained?
  Yes.
- Is the “transfer-to” mode inside the same terminal as the “transfer-from” mode?
  No. Buses are located outside terminal.

Departure from the Transfer Station:
- What was the total fare for the entire trip?
  $6.50 ($5.25 for Caltrain, $1.25 for VTA Bus)
- What was the total travel time and how is that time spent: (e.g. how much was in-vehicle, how much was waiting)?
  90 minutes, 85 minutes in vehicle, 5 minutes out of vehicle.
Santa Fe Depot (San Diego)

Date: April 19, 2000

Arrival Mode: San Diego Trolley Blue Line

Departure Mode: San Diego Coaster Northbound Train

Ticketing:
- Are discounted transfer fares available (either in-vehicle or in the terminal)?
  Yes, $1.50 discount on Coaster with valid trolley ticket.
- Does a user need to pay a separate fare for the "transfer-to" mode?
  Yes.
- Does user need to buy a new ticket before boarding?
  Yes.
  - If so:
    - Was the ticket machine “well signed?”
      Yes.
    - Did the machine function properly?
      Yes.
    - If user needs needed correct change, was there a change machine nearby?
      Ticket machine gave change.
    - Were the fare structures clear?
      Yes.
  - If not:
    - Was the fare structure clear for a new user before boarding?
    - How are fares collected (e.g. on-board, in the terminal)?

- Was the fare a flat fare?
  No.
- Do users need correct change?
  No.
- What type of ticket is used?
  Paper ticket.
- Was there a queue of passengers at the turnstile or the ticket-purchasing machine?
  No
Transfer/Mobility in Transfer Terminal:
- Does more than one line serve this terminal (e.g. multiple bus lines at a stop, multiple trains at a BART station, etc.)?
  No, only one Coaster line and one trolley line (multiple Amtrak lines/routes, though).
  - If so, was it clear where to board our particular vehicle?
    Yes.
  - Was it clear which vehicle to board? (if multiple lines stop at the same platform)
    Yes.
- Was there a system route map in the terminal?
  Yes.
  - If so, did it show integrated information about other transit providers?
    Yes.
- Was there a station agent present?
  Yes, in the terminal.
  - If so, do they have information on all systems, or just one?
    Yes, information on all local transit services.
- Was the waiting area covered? Indoors?
  Covered platforms, indoor waiting area.
- How long did we wait for our vehicle?
  10 minutes
- What is the scheduled headway for this vehicle/line during this time of day?
  30 minutes during P.M. peak.
- Was there a schedule posted in the terminal?
  Yes.
  - If so, was it accurate?
    Yes
  - Was there any real-time information provided?
    Yes, for Coaster.
- What security features, if any, are present in the terminal?
  CCTV, Security officers, station agents.
- Does the terminal facility seem safe?
  Yes.
- Does the terminal appear well maintained?
  Yes.
- Is the “transfer-to” mode inside the same terminal as the “transfer-from” mode?
  Yes, trolley tracks are adjacent to Coaster tracks.

Departure from the Transfer Station:
- What was the total fare for the entire trip?
  $7.25 ($5.00 for trolley all-day pass, $2.25 for Coaster ride with trolley transfer)
- What was the total travel time and how is that time spent? (e.g. how much was in-vehicle, how much was waiting)?
  120 minutes, 105 minutes in vehicle, 15 minutes out of vehicle.
Old Town Transit Center (San Diego)

Date: April 19, 2000

Arrival Mode: San Diego Coaster Southbound Train

Departure Mode: San Diego Trolley Blue Line

Ticketing:
- Are discounted transfer fares available (either in-vehicle or in the terminal)?
  
  Available for transfer from trolley to Coaster.
  
- Does a user need to pay a separate fare for the “transfer-to” mode?
  Yes.

- Does user need to buy a new ticket before boarding?
  Yes.

  - If so:
    
    - Was the ticket machine “well signed?”
      Yes.
    
    - Did the machine function properly?
      Yes.
    
    - If user needs needed correct change, was there a change machine nearby?
      Ticket machine gave change.
    
    - Were the fare structures clear?
      Yes.

  - If not:
    
    - Was the fare structure clear for a new user before boarding?

    - How are fares collected (e.g. on-board, in the terminal)?

  - Was the fare a flat fare?
    No.

  - Do users need correct change?
    No.

  - What type of ticket is used?
    Paper ticket.

- Was there a queue of passengers at the turnstile or the ticket-purchasing machine?
  No.
Transfer/Mobility in Transfer Terminal:
- Does more than one line serve this terminal (e.g. multiple bus lines at a stop, multiple trains at a BART station, etc.)?
  Yes. Only one Coaster and only one trolley line, but multiple bus lines.
  - If so, was it clear where to board our particular vehicle?
    Yes, for rail. Buses are on both side of terminal, so user must know which bus beforehand.
    - Was it clear which vehicle to board? (if multiple lines stop at the same platform)
      Yes, each vehicle (bus and rail) seemed to have its own stop.
  - Was there a system route map in the terminal?
    Yes.
    - If so, did it show integrated information about other transit providers?
      Yes.
  - Was there a station agent present?
    No, info booth was empty.
    - If so, do they have information on all systems, or just one?
      N/A
  - Was the waiting area covered? Indoors?
    Covered.
  - How long did we wait for our vehicle?
    3 minutes
  - What is the scheduled headway for this vehicle/line during this time of day?
    15 minutes
  - Was there a schedule posted in the terminal?
    Yes.
    - If so, was it accurate?
      Yes
    - Was there any real-time information provided?
      Yes, for Coaster.
  - What security features, if any, are present in the terminal?
    CCTV, Security officer.
  - Does the terminal facility seem safe?
    Yes.
  - Does the terminal appear well maintained?
    Yes.
  - Is the “transfer-to” mode inside the same terminal as the “transfer-from” mode?
    No. Buses are located at terminal’s curbs on both sides.

Departure from the Transfer Station:
- What was the total fare for the entire trip?
  $7.25 ($5.00 for trolley all-day pass, $2.25 for Coaster ride with trolley transfer)
- What was the total travel time and how is that time spent: (e.g. how much was in-vehicle, how much was waiting)?
  70 minutes, 67 minutes in vehicle, 3 minutes out of vehicle.
Fashion Valley Transit Center (San Diego)

Date: April 19, 2000

Arrival Mode: San Diego Trolley Blue Line

Departure Mode: San Diego Transit Bus # 16

Ticketing:
- Are discounted transfer fares available (either in-vehicle or in the terminal)?
  Yes. **Valid trolley tickets may be applied to bus fare as well.**
- Does a user need to pay a separate fare for the “transfer-to” mode?
  No, if trolley ticket is worth $1.75 or more.
- Does user need to buy a new ticket before boarding?
  No.
- If so:
  - Was the ticket machine “well signed?”
  - Did the machine function properly?
  - If user needs needed correct change, was there a change machine nearby?
  - Were the fare structures clear?
- If not:
  - Was the fare structure clear for a new user before boarding?
    Yes.
  - How are fares collected (e.g. on-board, in the terminal)?
    On-board.
- Was the fare a flat fare?
  Yes.
- Do users need correct change?
  Yes.
- What type of ticket is used?
  **Passengers transferring from trolley may use trolley ticket.**
- Was there a queue of passengers at the turnstile or the ticket purchasing machine?
  No.
Transfer/Mobility in Transfer Terminal:
- Does more than one line serve this terminal (e.g. multiple bus lines at a stop, multiple trains at a BART station, etc.)?
  Yes. One trolley line, but multiple bus lines.
  - If so, was it clear where to board our particular vehicle?
    Yes.
  - Was it clear which vehicle to board? (if multiple lines stop at the same platform)
    Yes, each posted bus stop was only for two bus lines.
- Was there a system route map in the terminal?
  Yes.
  - If so, did it show integrated information about other transit providers?
    Yes.
- Was there a station agent present?
  No, info booth was empty.
  - If so, do they have information on all systems, or just one?
    N/A
- Was the waiting area covered? Indoors?
  Covered.
- How long did we wait for our vehicle?
  25 minutes
- What is the scheduled headway for this vehicle/line during this time of day?
  30 minutes
- Was there a schedule posted in the terminal?
  Yes.
  - If so, was it accurate?
    Yes.
  - Was there any real-time information provided?
    No.
- What security features, if any, are present in the terminal?
  CCTV.
- Does the terminal facility seem safe?
  Yes.
- Does the terminal appear well maintained?
  Yes.
- Is the “transfer-to” mode inside the same terminal as the “transfer-from” mode?
  No. Buses are located downstairs at terminal’s curb.

Departure from the Transfer Station:
- What was the total fare for the entire trip?
  $5.00 ($5.00 for trolley all-day pass, $0 additional for bus)
- What was the total travel time and how is that time spent: (e.g. how much was in-vehicle, how much was waiting)?
  45 minutes, 20 minutes in vehicle, 25 minutes out of vehicle.