APPENDIX G
TRANSIT OPPORTUNITIES
(OCTOBER 2011)

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Transit Opportunities

October 2011

I-10 and State Route 210

Federal No.: 010-E(210)A
Project No.: 010 PM 260 H7825 01 L
Tucson District – Pima County

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TRANSIT OPPORTUNITIES

At the present time, there is very little transit service in the I-10/SR 210 corridor. However, the same growth that is driving highway improvements will also create demand for transit service. Pima County has undertaken a number of efforts, including the Regional Transportation Authority (RTA) Plan, the Pima Association of Governments (PAG) 2040 Regional Transportation Plan (RTP, and the PAG High Capacity Transit Plan). Each of these efforts has identified a variety of potential transit improvements, including a number for the I-10/SR 210 corridor. Most of these are still conceptual in nature, and many would be long-term improvements. This indicates that short-term I-10/SR 210 improvements do not need to include significant transit infrastructure. However, there will be a need for effective transit services in the corridor in the longer term, and the future development of these services can be greatly facilitated if I-10/SR 210 improvements are designed to accommodate future transit opportunities (for example, some type of interchanges work much better for transit than others). This document describes:

1. Future transit opportunities in the I-10/SR 210 corridor.
2. Best practices on how to operate transit service on freeways and associated facilities.
3. Implications for I-10/SR 210 improvements.

FUTURE TRANSIT PLANS IN THE I-10/SR 210 CORRIDOR

As described above, a number of efforts have been undertaken in Pima County to determine future transit needs. These plans, and the planned or potential transit services that they include are as follows:

Regional Transportation Authority (RTA) Transportation Plan

The RTA's 20-Year Plan, which is funded with ½¢ excise tax revenues, includes (see also Figure 1):

- **Express Bus between Houghton Road and Downtown:** Express bus service between a new park-and-ride lot at Old Vail Road and Houghton Road and downtown Tucson via I-10. This is programmed as a "1st Period," or short-term project.

Pima Association of Governments (PAG) 2040 Regional Transportation Plan (RTP)

PAG's 2040 RTP includes new express bus and BRT services that would operate along I-10 and across the corridor (see Figure 2):

- **Bus Rapid Transit (BRT) along I-10 between Wentworth Road and downtown Tucson:** Plans for this service are conceptual in nature, as detailed planning has not been conducted to determine how it would operate within I-10, station/stop locations, or service frequencies.
- **BRT Between Southeast Tucson and Downtown:** This service would connect developing areas in southeast Tucson with downtown and could potentially use I-10 and SR 210.

Figure 1: RTA 20-Year Plan Transit Projects

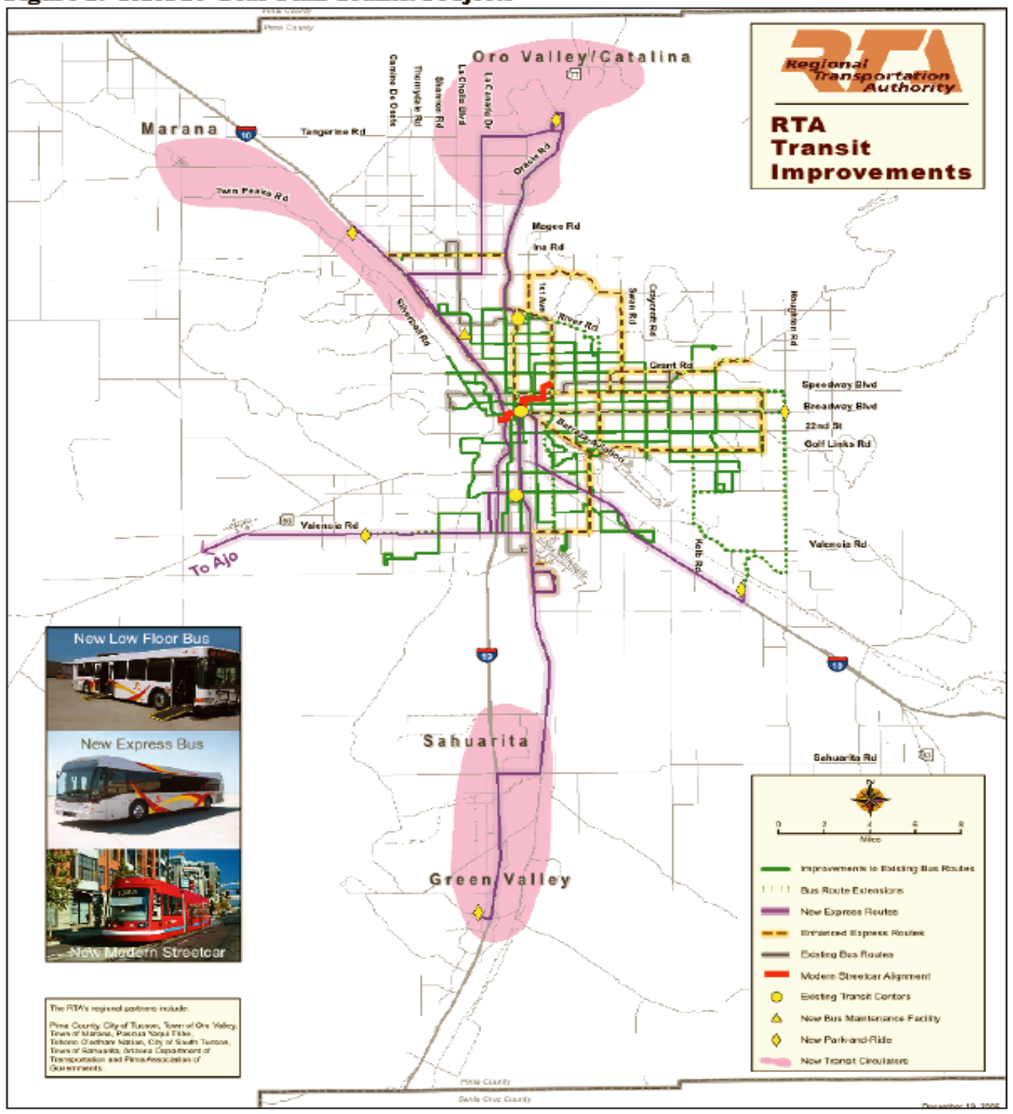
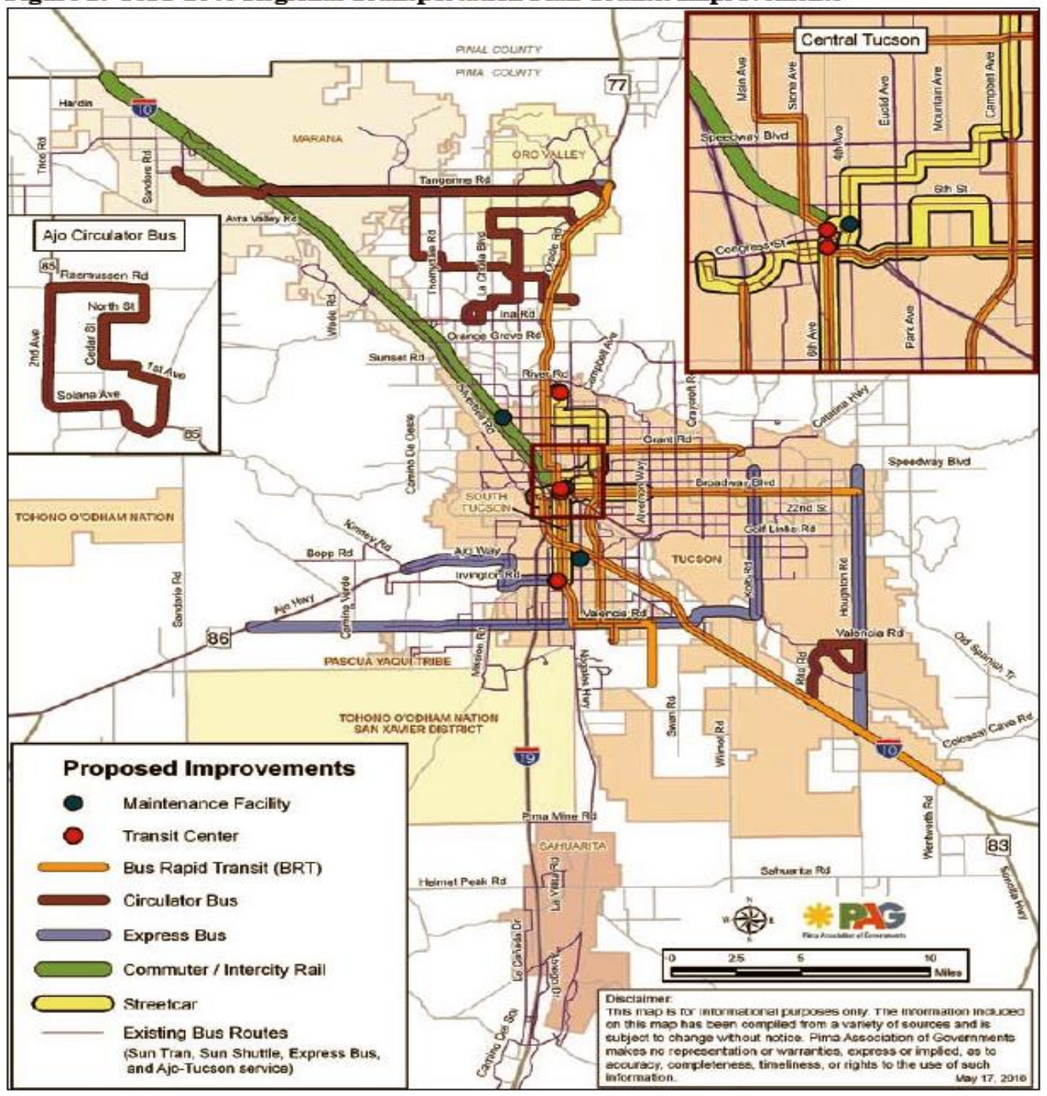


Figure 2: PAG 2040 Regional Transportation Plan Transit Improvements



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- **New Express Bus Services:** Express bus services are proposed for the Kolb Road and Valencia Road corridors. These services are also conceptual in nature, but could connect with I-10 BRT at Valencia Road.

PAG High Capacity Transit System Plan

PAG's fiscally-constrained High Capacity Transit Implementation Plan includes both express bus and BRT on I-10 (see Figure 3):

- **Express Bus along I-10 between Vail and downtown Tucson:** Express bus would be implemented along I-10 between Vail and downtown Tucson in the short-term (1 to 10 years out) as a precursor to BRT (see next bullet). This service could also use SR 210.
- **Bus Rapid Transit (BRT) along I-10 between Vail and downtown Tucson:** As demand grows, express bus between Vail and Tucson would be upgraded to BRT. Service would operate either between Vail Road or Houghton Road and downtown Tucson. Plans for this service are also conceptual in nature. This is planned as a mid-term (10-20 years out) project. As with express bus, this service could also use SR 210.

BEST PRACTICES IN FREEWAY BUS SERVICES

Most decisions about whether or not to use transit involve time and cost, and most transit services are slower than travel by private vehicle. However, when transit is faster or nearly as fast (for example, many rail services), large numbers of travelers will choose to travel by transit instead of by car. Thus, one of the most effective ways to encourage transit use is to make transit as fast as possible. Freeway bus services are designed to do this, and compared to other transit services, are unique in two respects:

1. They operate along freeways, either in regular traffic lanes, in HOV lanes, or along the shoulders.
2. They have stations within the freeway right-of-way that are designed to minimize travel times by eliminating all or most of the local circulation that is required to serve stops or stations located outside of the freeway rights-of-way.

Freeway Bus Operations

In the 1970s, exclusive bus lanes were developed on freeways in Washington D.C., New Jersey, and California. However, these exclusive bus lanes were later converted to HOV lanes, and today, all significant freeway bus services operate in general traffic, HOV lanes, and on shoulders.

Service in General Traffic

With service in general traffic, no special considerations are provided to bus service, and bus service operates in the same manner and at the same speed as all other traffic.

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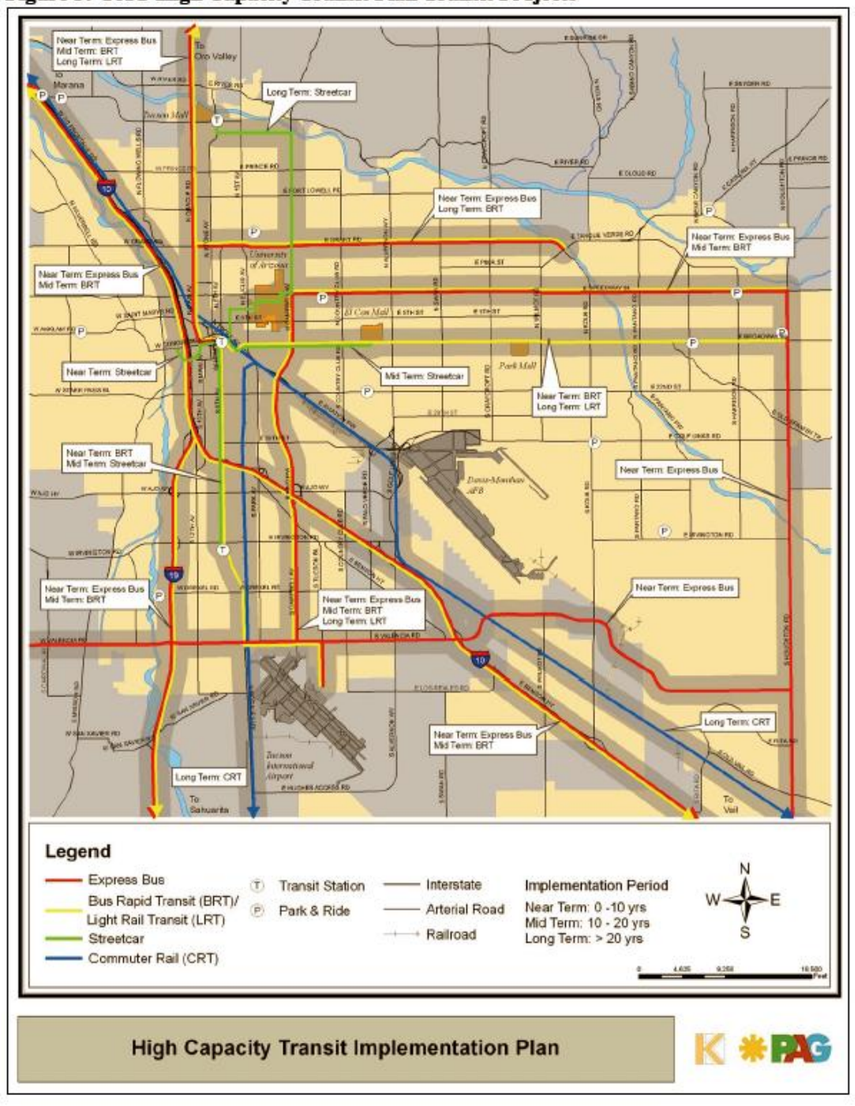
Figure 3: PAG High Capacity Transit Plan Transit Projects



High Capacity Transit Implementation Plan

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Service in HOV Lanes

Throughout the United States, freeway bus services operate in HOV lanes. One challenge for these services is that most HOV lanes are the leftmost lanes, which requires buses to weave across all lanes of traffic to serve stops that are off of highway. To avoid this situation, transit stations are now being constructed in freeway medians where they can be easily accessed from HOV lanes.

Shoulder-Running Bus Service

At least 11 states[1] (but not Arizona) have implemented policies that permit buses to operate on selected freeway shoulders in order to speed service. These policies were first implemented in Minnesota in 1992, and that state now has 300 miles of shoulder operations.

Many of Minnesota's shoulder running operations are along freeways with 10-foot shoulders (see Figure 4), which are only barely wider than a bus (approximately 9.5 feet including mirrors). In these areas, buses are only permitted to operate in the right-hand shoulder of highways when main-lane traffic speeds to fall below 35 mph and are not permitted to operate more than 15 mph faster than the general traffic lanes. To better facilitate bus operations on highway shoulders, Metro Transit and the Minnesota Department of Transportation are now widening highway shoulders throughout the Twin Cities area (where possible to 12 feet). In other areas, including Ottawa, Ontario, shoulders have already been widened for bus on shoulder operations (see Figure 5).

Figure 4: Minneapolis Bus on Shoulder Operation (on I-35W)

[1] California, Delaware, Florida, Georgia, Maryland, Minnesota, New Jersey, North Carolina, Ohio, Virginia, and Washington.

Figure 5: Ontario Bus on Shoulder Operations in Wide Shoulder

It should also be noted that there are often perceived safety issues with shoulder operations, particularly with respect to the potential for conflict with stalled vehicles or vehicles entering or exiting the highway in front of the path of a shoulder-running bus. However, there has been only one injury-crash that has been attributed to shoulder-running buses in Minnesota since 1992, and no state that has implemented shoulder running policies has ever discontinued them.

Freeway Bus Stops and Stations

One of the most time-consuming aspects of freeway bus service can be the time it takes to get off of the freeway in order to serve local stops and then get back on again. To reduce these delays, many areas have developed stops and stations that are located directly along the freeways and have done so in a number of different ways. Most have been "retrofitted" into existing freeways, but the manner in which they have been developed can provide guidance for the design of I-10/SR 210 improvements.

In general, there are three types of freeway stops and stations:

1. Stops located along freeway shoulders
2. Stops located along freeway interchange ramps
3. Stops located in freeway medians

Note that stations located in freeway medians are typically used in conjunction with bus service that operates in center or left-most HOV lanes. Although HOV lanes are not planned along either I-10 or SR 210, most of the design concepts that are used for median stations also apply to shoulder stations.

Denver – Boulder, CO

In the Denver area, the Regional Transportation District (RTD) is developing freeway BRT service between Boulder and Denver along US 36, which is the freeway that connects the two cities. The new service includes ramp and in-line stations with pedestrian bridges across the freeway. Most also include park and ride lots and connections to local bus services.

A number of different approaches have been used along US 36. The first, and most extensive, is in Broomfield, where there is a 1,500 space parking garage, bus stops that are located along exclusive bus slip ramps, and a pedestrian bridge that provides access across the freeway and with the parking garage (see Figure 6).

Figure 6: US 36 Freeway Bus Station with Exclusive Slip Ramps: Broomfield, CO

At other locations, the bus stops have been developed along the interchange ramps. At McCaslin, the bus stops have been developed on the southbound off-ramp and the northbound on-ramp. This configuration requires buses to exit from the freeway and to travel through the traffic lights at the ends of the freeway ramps (see Figure 7). This operation is slower than the exclusive slip ramps in Broomfield, but still fairly direct. For this type of station, the interchange must be developed in a manner that allows straight-through travel from the end of off-ramps to the beginning of on-ramps so that buses can directly re-enter the freeway.

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As in Broomfield, this station has a pedestrian bridge that provides access across the freeway and with the park and ride lot. Also, although not yet constructed, RTD is planning to develop bus queue jump lanes along the interchange ramps to reduce intersection delays.

Figure 7: US 36 Freeway Bus Station Along Interchange Ramps: McCaslin, CO

The third US 36 example is Church Ranch, where stops are also located along the interchange ramps (see Figure 8). There, the ramps are located along the southbound off-ramp and the northbound on-ramp of a diamond interchange, and buses operate straight through the interchange to re-enter the freeway. However, access across the freeway is via a sidewalk along a local street under the freeway rather than a pedestrian bridge. This approach is less expensive, but as shown in Figure 7, significantly increases the walking distance. As at McCaslin, RTD is planning to develop bus queue jump lanes along the interchange ramps to reduce intersection delays.

Minneapolis, MN

As part of the development of BRT service along I-35W between Lakeville and Minneapolis, MetroTransit recently opened a new transit station in the median of I-35W (see Figure 9). This station is accessed from exclusive bus slip lanes to the median station. However, unlike most freeway bus stations, the I-35W station is designed only to serve the local area and bus connections, and does not provide commuter parking.

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Figure 8: US 36 Freeway Bus Station Along Interchange Ramps: Church Ranch, CO

Figure 9: I-35W Median Station: Minneapolis, MN

This station was constructed within a narrow median and uses center platforms to reduce the station width. However, most buses only have doors on the right side, which is the wrong side for typical center platform operations. To deal with this issue, once within bus only area, buses cross over to the left side so that they can board and alight passengers through their right side doors.

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Los Angeles, CA

Los Angeles' MTA has developed the Harbor Transitway along an 11 mile stretch of I-110 in Los Angeles. Harbor Transitway services operate in I-110's HOV lanes, which consist of two lanes in each direction that are physically separated from the general traffic lanes and that are located in between the general traffic lanes. There are five transitway stations located in the freeway's median, and buses access the stations via bus-only slip ramps from and to the HOV lanes (see Figure 10). Pedestrian access to the stations is from the local streets below the freeway overpass, and in some cases, also via pedestrian bridges.

Figure 10: I-110 Freeway Median Bus Station: Manchester Road, Los Angeles, CA

Seattle, WA

Sound Transit, which provides commuter service in the Seattle area, recently opened Mountlake Terrace Freeway Station in the median of I-5 (see Figures 11 and 12). Along this section of I-5, commuter bus service operates in left-hand HOV lanes and accesses the station is via exclusive bus slip lanes from and to the HOV lanes. This station also includes 890 parking spaces, most of which are in a garage, and a pedestrian bridge across the eastern side of the freeway to connect all of the elements. The station was built in an area where there was a sufficiently wide median, which unlike the I-35W station in Minneapolis had sufficient room for outside platforms.

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Figure 11: I-5 Freeway Bus Station in Median: Mountlake Terrance, WA

Figure 12: I-5 Freeway Bus Station in Median: Mountlake Terrance, WA

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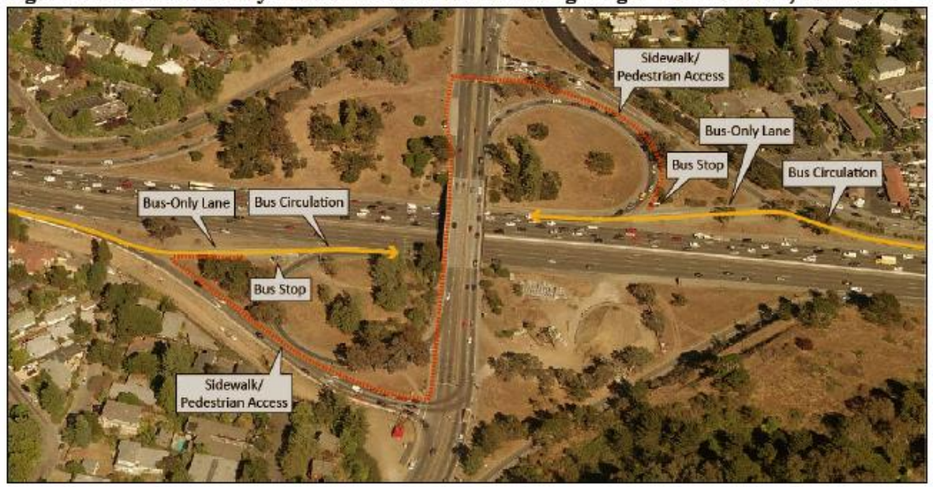
Marin County, CA

North of San Francisco, Golden Gate Transit and Caltrans have developed a number of bus stops on US 101, which is the major freeway to and from San Francisco. These freeway stops were some of the first in the county and were developed within partial cloverleaf interchanges by constructing bus-only connector lanes between off and on ramps. In comparison to the newer freeway bus stations described above, the US 101 stations are very simple, and use sidewalks built between the interchange ramps for access to and from the stops, and sidewalks along the highway overpasses for pedestrian flow from one side of the highway to the other (see Figures 13 and 14). Note that the walking distances between the opposite stations are relatively long, and at the Corte Madera stop, passengers cut across the southbound on-ramp to lessen the distance.

Figure 13: US 101 Freeway Bus Station between Interchange Legs: Corte Madera, California



KEY LESSONS FROM OTHER AREAS

As described above, there are a number of ways to provide freeway transit service. Key lessons from other areas are:

- From station-to-station, bus service can be given priority through the use of HOV lanes or shoulder operations. With HOV use, typically, buses must be able to access the stations from the center of the freeway. With shoulder running service, buses need to access stations or stops located beyond the shoulders of the freeway.

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Figure 14: US 101 Freeway Bus Station between Interchange Legs: Novato, California

- The most effective designs serve passengers within the freeway right-of-way. This type of operation is important because it greatly reduces transit travel times (compared to services that must exit the freeway and travel locally to off-line stations and stops), and thus makes transit much more attractive.
- Of the different types of freeway stations and stops, those that use exclusive bus ramps and/or pullouts along the freeway are the most attractive because they are the fastest (for example, the US 36 Broomfield Station, Minneapolis' I-35W Station, Seattle's Mountlake Terrace Station, and the Los Angeles and Marin County stations).
- Station and stops that are located along interchange ramps typically require buses to travel straight through from the off-ramp to the on-ramp (for example, the US 36 McCaslin and Church Ranch stations). With this type of station, travel times are longer because buses are subject to intersection delays at the ends of the interchange ramps. These delays can be mitigated through the use of bus queue jump lanes. Stations and stops that are located along interchange ramps also typically involve longer walk distances because of the extra right-of-way width at interchanges.
- Most newer freeway bus stations include large park and ride facilities, some of which are also major transit centers (for example, the US 36 Broomfield Station and Seattle's Mountlake Terrace Station). However, freeway bus stops have also been developed to serve only local neighborhoods and local transit connections.

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DESIGN IMPLICATIONS FOR I-10/SR 210

As described at the beginning of this document, a number of transit projects are planned that will likely use I-10 and SR 210. While detailed planning has not yet been done for any of these projects, Sun Tran management has indicated that the types of practices used elsewhere would be desirable along I-10 and SR 210. In more detail, these would include:

Transit Centers at key locations along I-10 where I-10 transit service would connect to other local transit services and to provide park and ride opportunities. Key locations would include (see Figure 15):

- I-10 at Valencia Road
- I-10 at SR 210/Alvernon Way
- SR 210 at Kino Parkway

For I-10/SR 210, to facilitate the development of transit stations at these locations, it will be necessary to ensure that suitable parcels would be available along the freeway right-of-way and that it will be possible to develop effective pedestrian connections between the transit center facilities and the freeway bus stations/stops.

Park-and-Ride Lots at major interchanges on I-10 and possibly SR 210 at least as far east as Houghton Road. Key locations would include (see also Figure 15):

- I-10 at Houghton Road
- I-10 at Rita Road
- I-10 at Wilmot Road
- SR 210 at Golf Links Road

For I-10/SR 210, to facilitate the development of park and ride lots at these locations, the same actions would be necessary as for the development of transit centers–it will be necessary to ensure that suitable parcels will be available along the freeway right-of-way, that freeway stops can be developed, and that effective pedestrian connections can be provided.

Freeway Stations/Stops on at the transit center and park and ride locations so that buses don't have to exit the freeway to pick-up and discharge passengers. These stations would also require efficient pedestrian circulation between park-and-ride lots/surface streets and the stations. For I-10/SR 210, to enable subsequent development of stations, it will be necessary to determine the types of stations that should or could be used based on right-of-way and design constraints:

- Since median HOV lanes are not planned for I-10 or SR 210, the preferred approach would be to develop stops and stations along the freeway shoulders or on-ramp.

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Figure 15: Potential Transit Center and Park and Ride Lot Station Locations

- If stations along shoulders are preferred, then sufficient space will need to be reserved between the shoulders and the edge of the freeway right-of-way.
- If stations along interchange ramps are desired, then it will be necessary to ensure that buses can easily circulate from the end of the off-ramps directly through to on-ramps.

Bus/BRT Use of HOV Lanes, which would likely require either the use of center in-line stations or exclusive bus ramps.

Transit Priority Measures, especially if stations are developed along interchange ramps, which could consist of transit signal priority at the local street end of interchanges, and bus queue jump lanes (for example, at the end of off-ramps and on on-ramps with ramp metering.

To a certain extent, the above transit measures can be "mixed-and-matched." However, to ensure that future transit services will be able to operate as effectively as possible, ADOT will need to work with PAG to determine the specific elements that should be accommodated in the design of I-10/SR 210 improvements.