Report No: 18-004
Meeting Date: February 14, 2018

Alameda-Contra Costa Transit District

STAFF REPORT

TO: AC Transit Board of Directors
FROM: Michael A. Hursh, General Manager
SUBJECT: Headway-based Scheduling Opportunities

BRIEFING ITEM

RECOMMENDED ACTION(S):

Consider receiving a report on opportunities and challenges for implementing headway-based scheduling on high-frequency lines in the AC Transit system.

BACKGROUND/RATIONALE:

Schedule reliability is an essential attribute of transit service quality, and is consistently ranked as a top concern by AC Transit customers. Without intervention, bus schedule reliability readily degrades: early buses pick up fewer passengers and tend to catch up with the buses in front of them, while late buses tend to fall further behind. The resulting "bus bunching" phenomenon annuls the schedule and increases waiting time for passengers (as headway variability increases, so does average waiting time for customers.

To address this, conventional scheduling inserts extra time into the schedule, requiring the bus to hold at certain points if early. While this strategy helps the bus maintain a published schedule, it slows bus speed, increases agency costs, and delays and frustrates on-board passengers.

"Headway-based" scheduling is a term used to define dynamic scheduling wherein the customer can expect a bus on a given line or corridor on a regular interval as opposed to arrivals at specific published scheduled times. In contrast to conventional scheduling, the objective is to maintain even spacing between buses rather than meet precise time points. This can reduce running time, agency cost, and customer wait time.

AC Transit experimented with headway based scheduling on Line 72R when it initially launched in 2003. In the first year of operation, the 72R saw a 17% reduction in travel time over the 72L, ridership on the San Pablo corridor grew 3%, and 84% of customers reported a decrease in travel time (the reduction in travel time was principally due to increased stop spacing on the 72R compared to the 72L) (GM Memo No. 04-22).

Ultimately, the District abandoned headway based scheduling on the 72R and returned first to timepoints not visible to the public, and then eventually published schedules that exist today. The capabilities of the radio-based CAD/AVL system installed at the time to manage headways in real time were overpromised, as were the travel time benefits of the early generation Transit Signal Priority (TSP) system installed on the San Pablo corridor. In addition, traffic congestion has increased along the corridor since inception of the 72R. The system also required dedicated

active road supervision. Similar issues have surfaced at other agencies; Los Angeles Metro, for example, moved away from headway based scheduling on its rapid lines in recent years, citing on time performance issues, lack of resources dedicated to supervision, and overpromised TSP benefits.

Recommended Parameters for Future Headway Based Scheduling Trials

Staff recommends that future headway based scheduling implementation focus on high frequency lines with headways of 10 minutes or less, such as Lines 1, 6, 40, 51A, 51B and the future International Bus Rapid Transit (BRT) or "Tempo" line. In a headway based strategy, operator runs would look similar to today with terminal departure and arrival times, but there would be no intermediate time points. Similarly, there would be no published schedules, save for start and end times and the frequencies in between.

Short headway lines are critical because they allow customers to arrive randomly at stops without the need to consult schedules (average wait time being half the headway when customers arrive randomly, headways longer than 10 minutes could result in uncomfortably long wait times). Additionally, these routes are in denser areas of the district and have higher ridership, meaning the benefit of reducing overall passenger travel times would be greater.

Other elements of headway based scheduling systems could include:

- Infrastructure improvements, such as dedicated travel ways or queue jump lanes
- Transit signal priority (TSP)
- CAD/AVL systems that allow real time headway monitoring
- Active supervision and line management

Dedicated guideways and queue jump lanes reduce travel time variability by isolating the bus from traffic congestion, which helps maintain a consistent headway.

Advanced TSP systems can track buses in real-time and grant priority to each individual bus depending on its status, i.e. the number of minutes behind schedule coupled with available signal cycle time as the bus approaches the intersection, helping the schedule maintain even headways. In the past, TSP was more static and would grant priority based on a preset time interval. Signal *coordination* has also advanced to signal *actuation*, which allocates time to signal phases based on real-time conditions. In either case, there is an important distinction between transit priority (an extended green if a bus approaches at the right time in the cycle) and transit preemption (a signal turning green on approach). Because in short headway situations, a bus missing a single green can lead to bunching, the latter is more important but has rarely been delivered in TSP implementation. It should be noted that effective TSP requires coordination & a "transit first" commitment from the various municipalities responsible for traffic signal maintenance & operation.

The District's forthcoming CAD/AVL system will improve upon the current. The polling rate will be every 30 seconds via a cellular connection as opposed to every 2 or 3 minutes for the current SATCOM system. This will allow more accurate tracking of buses and for headway management tools to be more precise and viable.

Critical to any headway based scheduling strategy (and to maintaining on time performance in general) is supervision and active line management. The District would need to train and dedicate staff both in the Operations Control Center and line supervisors in the field to monitor vehicle locations and communicate with operators to maintain consistent headway spacing.

Another important element is the development and adoption of standard operating procedures for vehicle operators and supervisors. The following are an example of service policies adopted by Los Angeles Metro for its Rapid service, with additional discussion below:

- Always leave the terminal exactly at the scheduled departure time
- Maintain a safe speed, but never exceed the posted speed limit
- If another bus is encountered, fall back or slow down until the other bus is no longer visible

Most transit agencies strive to avoid vehicle passing and skip stop operation except in extreme situations (i.e. a vehicle breakdown, onboard issue, major traffic incident, etc.) While the strategy can return a lagging vehicle to its schedule, the effect on downstream and onboard passengers whose stops may be skipped can be significant. The strategy requires active supervision and is most appropriate on high frequency lines (e.g. headways less than 5 minutes) Furthermore, most theoretical studies assume passing does not occur, so the research is scant. Staff therefore does not recommend a headway based scheduling strategy that relies on vehicle passing or skip stop operations. Staff further cautions against a strategy where individual runs are based on supervisor's orders, or are inserted mid-route to maintain headways. This would require standby operators and buses, which would nullify any cost savings associated with a headway based strategy.

Furthermore, Staff does not recommend implementing headway based schedules unless policy, regulations and guidelines are in place to enforce the parameters and requirements detailed above. Without proper management, headway based schedules could result in more bunching and unreliability.

BUDGETARY/FISCAL IMPACT:

There is no budget impact associated with this informational item. Active (dedicated) line supervision has a significant operating cost impact.

ADVANTAGES/DISADVANTAGES:

The advantages of headway based scheduling include:

- Reduced slack time in schedule. This would reduce overall running time, which could reduce the cost of service to the District. The increased running speed will also reduce customer travel time.
- Improved reliability. Reducing headway variability will also reduce passenger waiting time.
- No need for published schedules.

The disadvantages of headway based scheduling include:

- Increased cost to staff and train dedicated supervisors at the Operations Control Center and in the field.
- Retraining of operators on headway based operations as opposed to conventional schedule based operations

ALTERNATIVES ANALYSIS:

In lieu of strict headway or conventional scheduling, some agencies have adopted a hybrid approach. Since abandoning headway based scheduling on its rapid routes, LA Metro, for example, has implemented a schedule based system that drastically reduces the number of time points along a route to a maximum of two or three. Operators are given essentially free running time between time points but can never leave early from the in route schedule points. This is similar to how AC Transit's Line 72R operates today. Metro developed the following set of standard operating procedures for rapid vehicle operators:

- Always leave the terminal exactly at the scheduled departure time.
- Maintain a safe speed, but never exceed the posted speed limit.
- If another bus is encountered, fall back or slow down until the other bus is no longer visible.
- If directed to do so by the Bus Operations Control Center (BOC), reduce speed.
- Reduce running speeds to 10 mph through all intersections.
- Dwell for 15-20 seconds at station stops.

Metro found this hybrid approach improved on time performance over the headway based scheduling initially implemented on rapid lines. Active performance monitoring is still required through road supervisors and the operations control center. In addition, Metro has worked to implement a culture of reliability, scheduling periodic review of on-time performance with individual operators and developing an acknowledgement and rewards system for top performers. Implementing a culture shift would be key for any agency that hasn't placed strong emphasis on reliability in the past.

Other implementation methods for headway based scheduling systems decrease reliance on active supervision, relying only on the arrival times of the current bus and its leading bus to decide the holding time of the current bus en route or at a given station. The method can be implemented on any line of any frequency. The information needed to maintain consistent headways is conveyed to the operator through a small transponder (e.g. an iPhone or Android device) that signals when the bus is approaching too close to the leading bus or when the bus should speed up. The system has been implemented on the UC Berkeley Shuttle system and in a demonstration project in San Sebastian, Spain. The Washington, D.C.'s Department of Transportation is implementing a similar system on Circulator lines.

Under the District's new CAD AVL system, Staff could manage and operate a headway based system on similar technology available through Clever Devices, rather than requiring a separate transponder. Similar information will be available to the operator via the Transit Control Head (TCH), which is Clever's equivalent to the Mobile Data Terminal (MDT). The same information will be displayed to Supervisors at the Operations Control Center (OCC).

PRIOR RELEVANT BOARD ACTION/POLICIES:

- GM Memo No 02-086A - Contract Changes to SATCOM CAD/AVL SYSTEM
- GM Memo No. 04-221 - San Pablo Corridor Analysis - Phase 2 of Nelson\Nygaard Evaluation

ATTACHMENTS:

None.

Approved by: Ramakrishna Pochiraju, Executive Director of Planning & Engineering
Reviewed by: Robert del Rosario, Director of Service Development and Planning
Michael Eshleman, Manager of Service Planning
Prepared by: John Urgo, Transportation Planner