ATTACHMENT A

Metro

Los Angeles County Metropolitan Transportation Authority

Draft Report

Faregating Analysis

November 5, 2007

Booz | Allen | Hamilton

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1.0 Executive Summary

Gating the Los Angeles County Metropolitan Transportation Authority (MTA) requires finding an appropriate balance between the investment required to physically gate LA Metro stations and a decrease in current fare evasion levels.

This analysis is based on the practicality of gating stations, given the existing architectural characteristics, and the level of impact on capturing or checking passengers when entering the LA Metro System to verify validity of the fare payment.

The following three gating options were developed and analyzed:

		Number of Gates	Passengers Captured
Option 1	Red Line Only	154 gates	59%
Option 2	Red and Green Line, and strategic light rail stations	275 gates	84%
Option 3	All Metro Stations, not architecturally constrained	394 gates	98%

The following technical considerations are assumed to make gating economically feasible:

- All fare media will be based on contactless smart card technology, including limited use tickets for the occasional rider. Any other ticketing technology will likely require expensive and complex ticket transports in the gate.
- For those stations where a physical barrier is not feasible, a single validator or a series of tap-on validators will be strategically placed where passengers will validate their smart card to ride the system.

The primary business case for gating Metro is based on reducing the fare inspection force while also reducing current levels of fare evasion.

- Metro recently tasked TMD to complete an independent fare evasion study. This fare evasion study is complete and provided one of the data inputs for establishing the business case for each fare gating option.
- A reduced inspection force will still be required to continue to provide passengers with a positive perception of safety, but primarily to deter fare evasion at stations without physical barriers. The residual fare inspection force will need to be optimized over time, based on measured fare evasion levels.
- Red Line stations were originally designed to accommodate physical barriers and most of the infrastructure is in place. Each station on the light rail lines will need a passenger flow analysis to optimize the layout of the physical barriers, and the location of the validators for those stations not designated for physical barriers.
- Due to the simplicity of the mechanism, Metro has expressed interest in using tripod turnstile gates which reduces maintenance expenses. All stations with turnstiles will be required to have at least one Americans with Disabilities Act (ADA) compliant, extra-wide aisle. A bi-parting leaf gate design will accommodate the extra-wide aisles.

Option 1 Installs turnstyles on the Red Line only

- The Red Line subway was originally built to accommodate future gates.
  - There is sufficient physical space available to install the fare gates.
  - Existing infrastructure, such as power and communication, accommodates gating.
  - Faregates would be installed in sheltered locations, reducing maintenance and weather-related problems.
- Fare inspection will need to be continued on the light rail lines to maintain or reduce fare evasion.
- Unless transferring to the Red Line, light rail and bus customers may still be accommodated with paper tickets at the ticket vending machines or bus farebox.
- Gating the Red Line only will capture 55% of the passengers entering Metro.

Option 2 Expands physical gating across the Green Line and includes strategic solutions on the Blue and Gold Line.

- The focus of Option 2 is to gate those stations that only require a minimum level of infrastructure modification.
- The number of inspectors patrolling Metro may be further reduced.
- Gating both Red and Green Lines, and strategic locations on the Blue and Gold Line, will capture approximately 84% of the passengers entering the Metro system.

Option 3 Installs gates at the majority of Metro rail lines

- Due to space constraints and architectural features, gates at grade-level stations may be difficult to install.
- The capital cost of civil work includes major construction required to bring power and communications to turnstyles and the addition of shelters over gated areas.
- Installing gates at the majority of Metro rail lines will result in an increase in operating costs and a decrease in net cash flow.

There are benefits and challenges with each examined option.

	Red Line Only	Red and Green Line, and strategic light rail stations	All Metro Stations, not architecturally constrained
Percent of passengers checked at gates	59%	84%	98%
Total direct capital cost ($MM) (including equipment and services, civil work, infrastructure, and project management)	$21.5	$46.2	64.9
Net change in operating cost ($MM) (including maintenance, change in police patrolling, customer service, and credit for evasion. Excludes fare media)	⇓ $4.8	⇓ $1.6	⇑ $0.8
Difficulty of implementation	Easiest	Moderate	Very difficult

2.0 Introduction

The Los Angeles County Metropolitan Transportation Authority (MTA) has requested Booz Allen to review the potential use of faregates on its rail lines and Orange busway.

- Metro currently operates as a "proof of payment" (POP) system:
  - Riders must purchase fare media before entering the marked "paid" area.
  - Los Angeles Sheriffs Department fare inspectors randomly check riders' fare media.
  - Riders without proper fare media can be cited for fines up to $250.
- Current fares are "flat" and do not increase with distance traveled, though passengers are expected to pay for transferring from one line to another.
- Metro has been concerned about fare evasion and the cost of the Sheriff's inspection program:
  - Fare inspection costs about $7.06 million per year.
  - Fare evasion, currently estimated at approximately 6% of people inspected, results in revenue loss of approximately $5.6 million out of $40 million annual revenue.
- To address concerns about fare evasion, Booz Allen is working with Metro staff to provide an assessment of the benefits and costs of gating the rail lines. Metro also believes that faregates may control entry to subways and increase safety in the subway environment.

Faregates would require passengers to present machine-readable proof of payment before entering the paid area.

- Faregates would require the passenger to "tap" a smart card to the Smart Card Reader on the gate. An indicator would signal the results of the transaction and permit the passenger to proceed through the gate. The passenger would also be required to tap a smart card to a gate upon leaving the system.

- Some of the Metro rail stations would not be gated. At those stations, passengers would tap their cards on stand alone validators (SAVs). To improve passenger's access to validators and enable compliance with the requirement to tap when entering and exiting stations, existing validators would be relocated.

- In the future, Metro may choose to adopt a distance-based fare structure.
  - By using bi-directional faregates, Metro could implement distance-based fares.
  - With the introduction of gated stations and TAP (Regional smart card), passengers would tap their smart card when both entering and exiting rail stations.

This report provides the following information and analyses:

Section 3 - Faregate Configuration: Reviews the types of faregates available and some advantages and disadvantages, including implications of fire safety standards for gating. This section also discusses screening devices to improve security.

Section 4 - System Configuration: Provides information on faregate configuration by station, based on the results of station surveys. An appendix to the report supplements this section to identify where faregates can be installed given Metro's current facilities.

Section 5 - Equipment Quantities: Identifies equipment quantities required based on ridership levels and transaction times.

Section 6 - Fare Media and Tariff Options: Identifies impact on fare media and tariff options by reviewing the implications for fare media and fare policy options of gating the rail system.

Section 7 - Qualitative Impact on Passengers: Demonstrates the impact that gating will have on passengers' interactions with the Metro Rail System.

Section 8 - Impact on Fare Evasion and Inspection: Considers the potential to reduce fare evasion by gating rail stations.

Section 9 - Cost Estimates: Identifies both direct and indirect costs of gating the Metro Rail System.

3.0 Faregate Configuration

A variety of gate styles is available for use in gating Metro's Rail System:

Tripod Turnstile Gate: The traditional "turnstile" gate used in major subways such as New York City Transit and Chicago.

Bi-parting Leaf Gate: This gate has two small "leaves" that protrude from the console on either side of the aisle. The leaves withdraw into the console when open. Leaf gates have been adopted by the Bay Area Rapid Transit (BART).

Paddle Gate: This is a relatively new design with two paddles that rotate out of the path to open. This gate has been adopted by Metropolitan Atlanta Rapid Transit Authority (MARTA) and suburban Philadelphia transit agencies.

Sliding Panel Gate: This is similar to the leaf gate, but has a much higher barrier to discourage passengers from jumping over it. It is currently being used by New Jersey Transit and many international transit agencies.

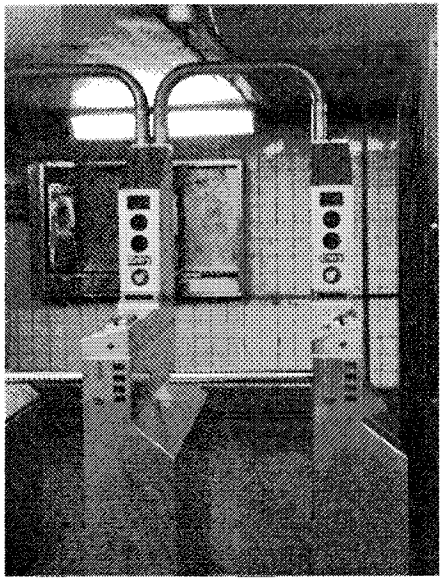
High Wheel Gate: This is a high turnstile that completely encloses the passenger. It is used for some unattended stations in New York and Chicago.

Tripod Turnstile Gates

Tripod turnstile gates have been used throughout the transit industry for many years.

- Tripod turnstiles control passenger access by employing a manually activated rotating armature that is permitted to rotate in a specified direction upon presentation of valid fare media.
- Key features of tripod gates are simplicity and low maintenance. These gates are also easy to jump over or crawl under.
- The New York turnstile (below) includes a "shelf" to prevent sliding through. However, the narrow chute can be difficult to navigate for those passengers with packages or luggage.
- Tripod turnstiles use latching mechanisms that can be configured to provide controlled access, no access, or free access in either direction.
- Tripod gates do not accommodate passengers in wheelchairs, so provisions would be required at each location to allow wheelchair access.

Tren Urbano Turnstile



New York City Turnstile

Current tripod turnstile gate users include:

- San Francisco Muni
- AT&T Park – San Francisco
- Hong Kong Ferry
- Metropolitan Transit Authority (MTA) - New York City
- Chicago Transit Authority

Agencies, in conjunction with upgrading their fare collection equipment to permit smart cards (Atlanta, New Jersey, and London), are replacing older tripod gates with newer designs.

Tripod turnstiles are a proven, economical fare gate option, but have security and accessibility limitations.

Advantages:

- Proven service in commercial and transit markets.
- Mechanical and electronic simplicity limits maintenance costs.
- Durability makes it well suited for a marine environment.

Disadvantages:

- Prone to "gate jumping" due to the low positioning of the tripod mechanism.
- Most designs do not provide a clear path of egress in an emergency situation. Passengers trailing closely can become caught in the armature as it rotates to the static position.

- Design does not provide a clear visual path when entry/exit is permitted, resulting in lower customer throughput (*approximately 30 passengers per minute*).
- ADA and bicycle access would need to be provided through a separate entrance, such as a swing gate.

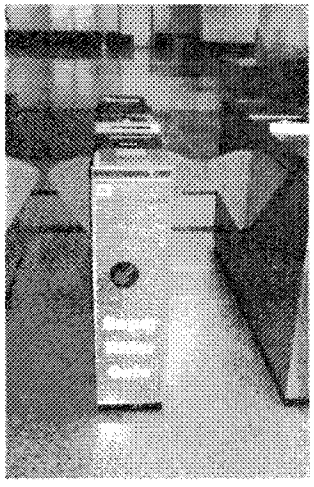
Bi-parting Leaf Gates

Bi-parting leaf gates are a removable barrier option that are passenger-friendly and multi-functional.

- Bi-parting leaf gates have a pair of electronically controlled barriers that retract into the consoles upon presentation of valid fare media.
- Mechanism can be driven using electric or pneumatic controls.
- Bi-parting leaf gates are passenger-friendly, providing a clear indication when it is "OK to enter" and accommodates passengers with packages or luggage.
- Telescoping leaves can be used to allow for wider aisles. In systems that use tripod turnstile gates, leaf gates are often used for wide ADA aisles.

Current bi-parting leaf gate users include:

- Bay Area Rapid Transit (BART)
- Washington Metropolitan Area Transportation Authority (WMATA)
- Sydney Ferries and CityRail (Sydney urban railway)
- JFK International Airport (AirTrain)



Bi-parting leaf gates allow for high passenger throughput, but do not present a strong physical deterrent to would-be "gate jumpers".

Advantages:

- Retraction of the leaves provide a clear visual cue for passengers to proceed.
- Clear, unobstructed path results in higher customer throughputs (*approximately 40 passengers per minute*).
- Can be monitored electronically to provide an alarm when evasion is attempted.
- Wide ADA compliant aisles, intended for passengers with bicycles and/or luggage, can be accommodated using telescoping barriers.
- Can be configured to remain open, closing only when an invalid or no fare is presented.

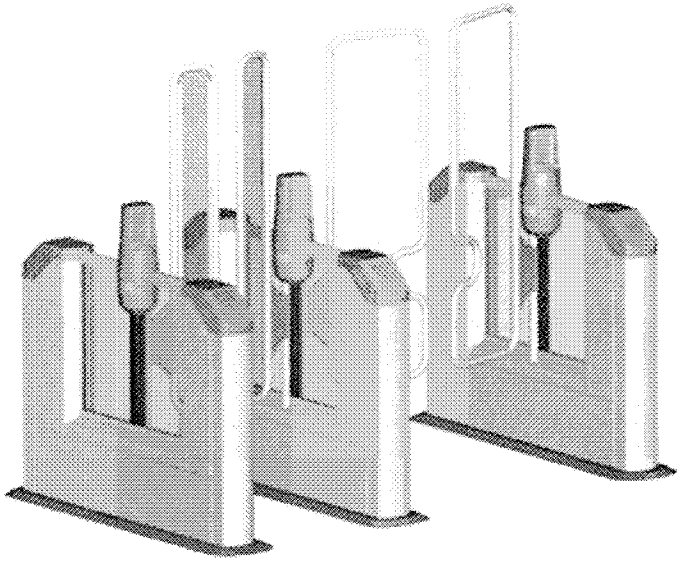
Disadvantages:

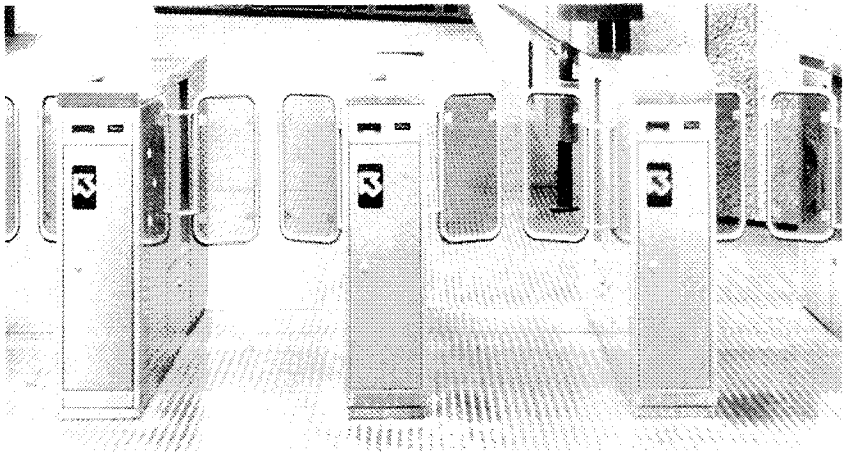
- Barriers can be bypassed by fare evaders going over or under the gate.
- Console must be wide enough to accommodate retracted leaf.
- May not be suitable for use in an exposed environment, which has the potential to increase both design and equipment costs.
- Requires relatively high maintenance.
- Has potential to close on patrons if ingress is slow or hindered.

Paddle-Style Faregates

The paddle-style faregates balance fare evasion and customer convenience.

- As illustrated below, paddle-style faregates provide a prominent barrier when closed, without limiting visibility.
- The faregates have been used by London Underground for over a decade and have exceeded their reliability requirements. These gates were also selected by MARTA (Atlanta) and PATCO (Philadelphia/New Jersey suburban).
- Paddles can be shaped to meet a variety of criteria (ADA compliance, resistance to jumping, etc.) by varying the width and height distance from the floor.





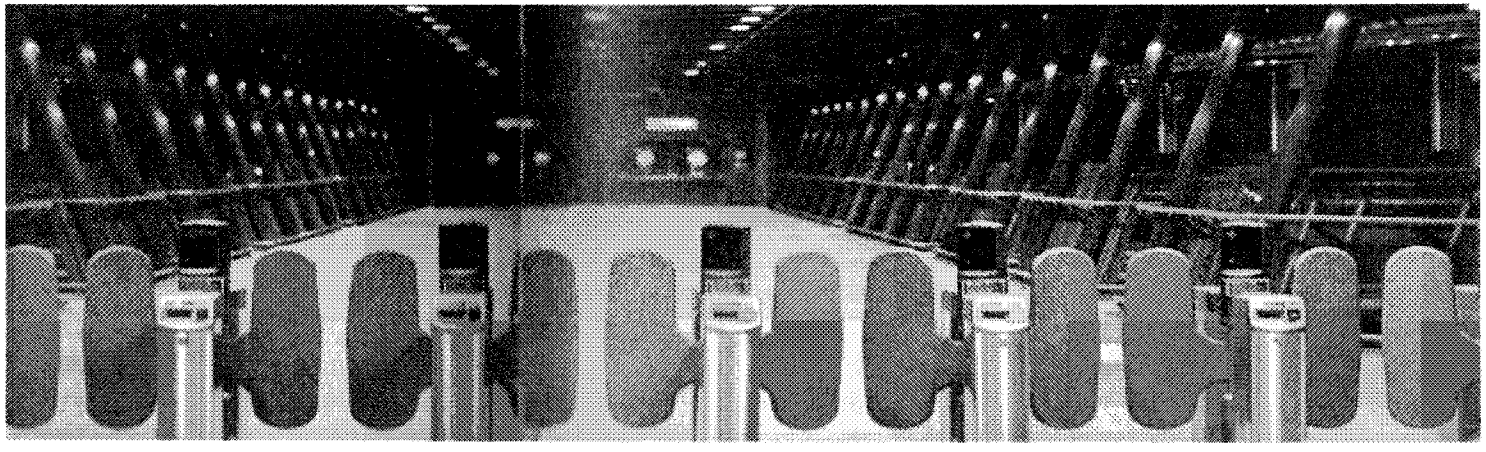
Paddle gates offer greater security, but are still susceptible to fare evasion when left unsupervised.

Advantages:

- Gates can be monitored electronically to provide an alarm when evasion is attempted.
- Tall paddles serve as a psychological deterrent to would-be gate jumpers.
- Wide paddles, along with wide aisles, can be used to enable ADA and bicycle access.
- Parting paddles provide a clear indication to customers that entry/exit is permitted.

Disadvantages:

- With minimal effort, the gates can be pushed open, reducing security when left unmonitored.
- Ensuring that the gate is suitable for use in an exposed environment has the potential to increase both design and equipment costs.



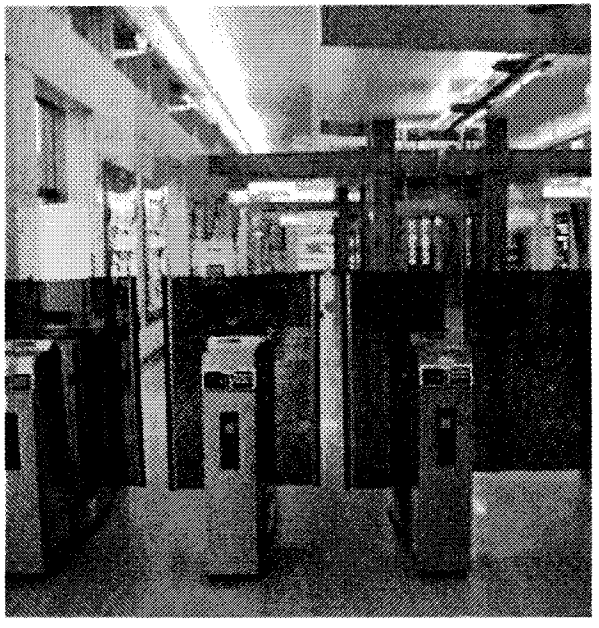
Sliding Panel Gates

Sliding panel gates combine features of paddle and bi-parting leaf gates.

- Sliding panel gates are comprised of a pair of vertical panels that retract into the console upon presentation of valid fare media.
- Aisle width can be adjusted to accommodate passenger and terminal needs.

Current users of sliding panel gates include:

- New Jersey Transit (Newark Airport)
- Metropolitan Boston Transit Authority (MBTA Boston).



Sliding panel gates offer aesthetics and security, but are better suited to protected environments

Advantages:

- Gates can be monitored electronically to provide an alarm when evasion is attempted.
- Tall panels have been shown to act as a psychological deterrent to would-be fare evaders.
- Gates of various widths can be installed to enable ADA and bicycle access.
- Retraction of the panels provide a clear visual cue for passengers to proceed.

Disadvantages:

- Minimum console width is limited by the size of the panels.
- Retraction of the panels into the top and sides of the consoles has the potential to expose the gate to the environment and increase maintenance costs.
- Higher potential maintenance costs due to gate/panel design.
- Because consoles may be wider than those of other gate styles, sliding panel gates can be difficult to use in limited space.
- This type of gate is not available from Metro's current fare collection vendor. Using such gates would require additional systems integration efforts.

High Wheel Gates

High Wheel gates provide the highest level of security, but the least customer convenience.

- High wheel gates do not accommodate passengers in wheelchairs, and therefore, could not be used exclusively.
- These gates are not considered suitable for Metro, although they might be used for seldom-used exit-only points where Metro may not wish to install automatic gates.

Current users of high wheel gates include:

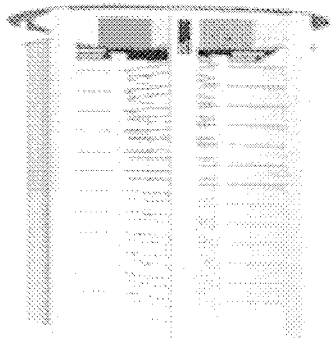
- Some stations in New York
- Some stations in Chicago.

Advantages:

- Provide the highest level of security.

Disadvantages:

- Customers can still "tailgate" and two individuals can simultaneously squeeze through these gates at the same time.
- These gates have been criticized by first-responders as creating a safety risk because station egress time is hindered.



National Fire Protection association (NFPA) standards will have to be evaluated in conjunction with selecting ultimate gating arrangement.

- Gate-type exits need to provide at least 50% of the required emergency exit capacity unless fare collection equipment provides unobstructed exiting under all conditions.
- Unobstructed exiting under all conditions implies that the fare barrier equipment is the type that does not require collection of a proof of payment to operate, and drops away to create an unimpeded egress path in a fail-safe manner when pressure is applied. Turnstile-type gates are not considered "unobstructed exiting".
- NFPA standards are still being evaluated and there is some local flexibility in their implementation.

The NFPA standard is subject to interpretation, but there are some *potential* implications to consider if a decision is made to move forward with gating.

- The NFPA standards are likely to affect the faregate implementation and the time required to implement a faregate program. It is suggested Metro's Fire-Life-Safety personnel work with the TAP Program and fare collection contractor to determine how best to comply with the standards.
- The ultimate faregate design will need to consider factors such as:
  - Tripod turnstiles having arms that fall down when power is off or an emergency alarm is triggered.
  - What redesign is required if leaf or paddle type gates are to be used?
  - How much space must be allocated to emergency egress gates vs. faregates. This tradeoff may reduce the number of gates that can be installed in some major stations resulting in excessive queuing.
  - The impact on fare enforcement/evasion if fewer stations are gated.

Faregate options need to be weighed using a number of criteria.

Cost	**The capital costs associated with the gate procurement and operating cost resulting from reliability.**
Throughput	The maximum number of passengers that can flow through the gate in an ideal situation (actual throughput is dependent upon the processing of the fare media).
Ease of Use	**The likelihood of an inexperienced patron being able to use the gate in an efficient manner.**
Durability	The ability of the gate to sustain operation in an exposed marine environment.
Reliability	**The ability of the gate to sustain operation while requiring a minimal level of maintenance.**
Security	The level of protection offered against would-be fare evaders (gate jumpers).
Bicycle/ADA	**The ability of the gate to accommodate patrons with bicycles and in wheelchair access**
Aesthetics	The way in which the physical appearance of the gate is commonly perceived by the public.

Each type of gate has relative advantages and disadvantages:

Barrier	Tripod turnstile	Bi-parting Leaf	Paddle	Sliding Panel	High Wheel
Cost	4	2	2	1	3
Throughput	2	4	3	3	0
Ease of use	1	4	2	4	0
Maintenance	4	2	2	1	4
Reliability	4	2	3	1	3
Security and resistance to fare evasion	0	1	2	3	4
ADA/bicycle/stroller access	0	4	4	3	0
Aesthetics	1	4	2	3	0

4	*Most Desirable*	⟺	0	*Lease Desirable*

Summary

- Tripod turnstiles are service proven, technologically simple, and low cost but are associated with lower passenger throughputs and are vulnerable to fare evaders.
- Bi-parting leaf gates support high passenger throughput volumes, are user-friendly and service proven, but are typically associated with higher capital costs and maintenance.
- Paddle gates act as an effective fare evasion deterrent, but still require supervision by the transit operator.
- Sliding panel gates offer both security and efficiency.

One of Metro's objectives is to develop and field a robust screening system to improve security and counter terrorism.

- One of Metro's objectives in gating the rail system is to implement a screening system that improves security.
- To service this purpose, screening technology should be:
  - Effective
  - Capable of capturing threats
  - Capable of projecting the security image to the traveling public, with a resulting deterrence effect
  - Cognizant of the trade-off between high security and passenger convenience.

Screening technologies that respond to potential threats in public use facilities, such as rail stations, include both established and developing technologies.

Technology	Description	Comments
Explosive Materials Detection[1] (EMD)	▸ Designed to detect a deadly threat from explosive substances. ▸ May include hand-held and table top equipment that analyze trace particles on baggage or clothing, or walk-through portal that has the ability to collect particles from people. ▸ Most commonly used in airports, transit stations, and international ports.	▸ Sizes vary from handheld devices to walk-in portals, some quite large. ▸ All systems require a human operator. ▸ Processing time varies between 8 and 40 seconds. At the slow end, a throughput of 90 passengers per hour may be too slow for subway application. ▸ Some of these devices also suffer from high false alarm rates. ▸ Relatively mature technology due to its use at airports.

[1] Sample explosive agents able to be detected: RDX, PETN, TNT, Semtex, NG.

Screening Technologies (cont.)

Technology	Description	Comments
Chemical Agent Detection[2]	▸ Detects harmful chemical compounds in the air or on the body of a person or inanimate object such as luggage. ▸ Events within the last 12 years, such as the release of sarin in the Tokyo subway in 1995, show need for more security in densely populated surroundings such as transit stations.	▸ Sizes vary from handheld devices to walk-in portals, some quite large. ▸ Systems range from manned hand-held devices to unmanned continuous monitoring machines. ▸ If a chemical agent is detected, an alarm will sound, followed by automated responses, such as shutting down air-handlers and sending email or pager alerts immediately.
Biological Agent Detection[3]	▸ A biological agent is an infectious disease or toxin that can be used as a means of bioterrorism or biological warfare. ▸ To date, limited development for commercial market. Several systems in development for military, but complicated to use, slow, and require training to use.	▸ Biological agents are effective in very low doses and have the ability to spread very quickly, making detection difficult in areas of high air movement, such as in subway stations. ▸ Currently expensive to purchase, requires training for use. Improvements expected in next five years. ▸ Possible unmanned continuous sampling use.

[2] Sample chemical agents able to be detected: arsine, chloroform, chloropicrin, cyanogen, diphosgene, ethyldichloroarsine, hydrogen cyanide, lewisite, methyldichloroarsine, mustard, phenyldichloroarsine, phosgene, sarin, soman, tabun, VX.

[3] Sample chemical agents able to be detected: arsine, chloroform, chloropicrin, cyanogen, diphosgene, ethyldichloroarsine, hydrogen cyanide, lewisite, methyldichloroarsine, mustard, phenyldichloroarsine, phosgene, sarin, soman, tabun, VX.

Screening Technologies (cont.)

Technology	Description	Comments
Nuclear Materials Detection	▸ Early detection of nuclear material is becoming more and more important at areas of high traffic volume. ▸ Highly Enriched Uranium is very difficult to detect in any shielded configuration due to its very low radioactive decay emissions.	▸ Size of devices can be as small as battery operated handheld sensors. ▸ With wireless technology, an array of such devices provides large area coverage. ▸ Potential benefit is to identify a threat in the area, but difficult to monitor each passenger due to throughout issues. ▸ Currently used in detection of nuclear materials around international ports and across borders.
Intelligent Cameras	▸ Intelligence added to a video as it is captured and analyzed by behavior recognition software. Generates more accurate alerts and alarms, and results in greater situational awareness of threatening situations as they unfold in real-time.	▸ Security managers can deploy fewer human resources, more accurately identify a problem. ▸ Currently used by TSA in airports. Also high security areas such as banks and power plants. ▸ Relatively inexpensive to deploy.

Screening Technologies (cont.)

Technology	Description	Comments
Facial Recognition	▸ Computer application for automatically identifying a person from a digital image. ▸ Can pick a face out of a crowd, extract the face from the rest of the scene and compare it to a database of stored images.	▸ Inexpensive to deploy as it may be built upon the existing CCTV systems. ▸ Difficult to deny access to a potential threat person due to slow response when cross referenced to watch lists. ▸ Potential privacy issues.
Biometric ID	▸ Verify the identity of people by using one or more intrinsic physical or behavioral traits, such as fingerprints, an iris scan, a photograph, and voice recognition.	▸ Difficult to deny access to a potential threat person due to slow response when cross referenced to watch lists. ▸ Potential public resistance to technology such as fingerprints or iris scanning. ▸ Slow.

Screening Technologies (cont.)

Technology	Description	Comments
Firearms and Weapons Detection	▸ In use since 1960s. ▸ Current systems can indicate appx. height of the metal object above the ground, so security personnel can quickly locate the source of the signal. ▸ Smaller hand held metal detectors used to locate a metal object on a person more precisely.	▸ Size vary from handheld devices to walk-in portals, some quite large. ▸ All systems seem to require a manned operator. ▸ Cannot discriminate between concealed weapons and other metallic objects such as belt buckles, jewelry, coins, watches, or calculators. High false alarm rates. ▸ Relatively fast processing (~500 passengers per hour at portal), but requires slower alarm resolution.
Real Time ID Checks	▸ High-level security areas can identify individuals in real-time.	▸ Difficult to deny access to a potential threat person due to slow response when cross referenced to watch lists. ▸ Privacy issues in maintaining a list of people with varying threat levels. ▸ Requires coordination between government entities (DHS, FBI, etc.)

Screening Technologies (cont.)

Technology	Description	Comments
Millimeter Wave	▸ Detects millimeter-wavelength radio waves reflected off a target, converts the reflected signal into a 2D image. Computer software searches the image for incriminating objects. ▸ There is minimal radiation (less than from a cell phone call); private areas are blurred in this system. Millimeter-wave radiation passes through clothing easily and is absorbed and reflected by other materials to different degrees, making it well suited to security screening. ▸ Can spot hidden handguns and knives, and even non-metal weapons such as ceramic knives.	▸ Human operator has been needed to pick out the concealed weaponry. ▸ In a transportation setting, passenger delays would range from several seconds to a couple of minutes. ▸ If an image shows a potential threat, follow-up screening must be conducted ▸ In trials at Jersey City PATH train station.
Backscatter X-Ray	▸ Newer imaging system detects radiation reflected from x-rayed target. ▸ Very good at imaging organic material, detecting scatter patterns of drugs, explosives and body parts. ▸ With "Flying Spot" technology, can by highly accurate and lifelike.	▸ Privacy issues. ▸ Radiation dose issues (although manufacturers claim doses are negligible, there are public perception issues). ▸ Potentially high false-positive rates.

Systems can be broken down into two categories, active and passive screening. While both systems deploy similar techniques, active screening relies more heavily on manned operations than does passive screening.

	Active Screening	Passive Screening
General characteristics	▸ Requires manned operation or using the system in order to detect potential hazardous weapons associated with individual passengers. ▸ These systems are most commonly used in places where a type of screening may be required such as in airports, transit stations, and international ports.	▸ Monitor an area for change in factors like air quality, suspicious packages or people located on a screen, hidden objects located through various x-ray systems. ▸ Allow security managers to deploy less human resources ▸ Allow security to pinpoint more accurately a problem or situation that may occur in an enclose area.
System components	▸ Explosive materials detection, chemical agent detection, biological agent detection, nuclear agent detection, biometric ID, firearms and weapons detection, and real time ID checks	▸ Chemical agent detection, biological agent detection, intelligent cameras, facial recognition, millimeter waves, and backscatter x-rays.
False Alarms	▸ Some of these devices suffer from high false alarm rates	▸ Potentially high false-positive detection rates. ▸ Systems that monitor air quality may be ineffective an a transit environment due to the rapid movement of air running through the terminal.

Active and passive screening (cont.)

	Active Screening	Passive Screening
System Maturity	▸ Systems range from relatively mature (i.e. metal detectors), to fairly new that have not been tested in the commercial market as of yet (i.e. biological agent detection equipment)	▸ Most systems are mature and are currently being used by our military and law enforcement in airports, international ports, banks, power plants, and border crossing areas.
Throughput	▸ Throughput ranges from a few seconds up to a minute, however, all active screening devices are likely to cause significant queuing and delays if deployed in the current state of technology that it stands in today.	▸ Wide-ranging in throughput, ranging from a few seconds to almost a half-hour; however, since scanning is done outside of individual passenger checks, these systems will not impact passenger travel times. ▸ Potential benefit is to identify a threat in the area, but difficult to monitor each passenger due to throughput issues.
Staffing and Response	▸ In order to operate at full capacity, all systems seem to require a manned operator. ▸ Additional resources are required for on-site alarm resolution	▸ All systems require advance intelligence components that can run as continuous monitoring systems either in the area of detection, linked up to a central computerized system, and or alarm system.

No single security system will be able to detect all possible threats that could potentially occur within the area of focus.

- These technologies are most effective when used together; they allow for a more complete and secure area.
- Unlike airports, transit stations do not have the luxury of screening each passenger as they enter the secure area.
  - A combination of technological systems allows the area in question to be screened as a whole, rather than focusing on specific passengers.
  - Individual active passenger screening can only be feasible if the throughput of the passenger portals are significantly faster than what their current state is today.
- Another critical issue is the procedure for resolving a threat.
  - Installing screening portals provides a deterrence effect, but once the alarm is raised, there is a need for a resolution process.
  - Alarm resolution requires significant staffing and potentially law enforcement presence at station entrances.

4.0 System Configuration

Booz Allen, together with Metro staff, surveyed rail and Orange busway stations to determine the feasibility of installing faregates using the following criteria:

- Architecture and Infrastructure
  - Adequate space for the number of gates required to serve ridership at each station.
  - Infrastructure, such as availability of communications and power.
  - Conduit runs or need for new conduit.
  - Adequate space leading to gate (both in and out) to allow for passenger queuing.
  - Without impeding contraflow movements.
  - Without crowding along platform edges, trackways, curbs, planters, trip hazards, or locations where vehicles or trains may be moving and potentially create a hazard of being struck, or passengers falling over obstructions.
  - In front of elevators, escalators and stairways.
  - Ticket vending machines.
  - Sufficient space for TVMs (including queuing, maintenance work, etc.,) in the unpaid space.
  - Whether and where to relocate existing TVMs
  - If stations were not gated, provision and location of additional validators to improve passengers' access.
  - Depending on the type of selected gate, weather protection for the gate area may be required.
  - Provision of Add-Fare devices and location of station or passenger assistance booth, should Metro desire those options.

Booz Allen, together with Metro staff, surveyed rail and busway stations to determine the feasibility of installing faregates using the following criteria (cont.):

- Operations:
  - Passenger safety.
  - Working space and access for maintainers, such that working on one gate or console does not impede access to the station. Working space for lifts and other equipment was also considered.
  - Emergency egress and access for police, fire and facilities maintenance
- Fare Enforcement:
  - Effectiveness for fare enforcement.
  - Ability to provide effective barriers separating paid from non-paid areas.
  - Minimize potential for fare evaders to bypass gates through track right-of-way or other paths.

The survey of Metro rail lines indicates there are three distinct station types:

Type	Description	Sample Stations	Challenges
Grade separated	The boarding platform is in subway tunnel or on elevated structure.	▸ Red Line: All stations are in tunnel. ▸ Green Line: All stations are below or above grade. ▸ Blue Line: Firestone and Slausen	▸ Most of these can readily be gated. ▸ A few have no provision for gates, and will require underfloor duct, fencing and other modifications to establish paid areas.

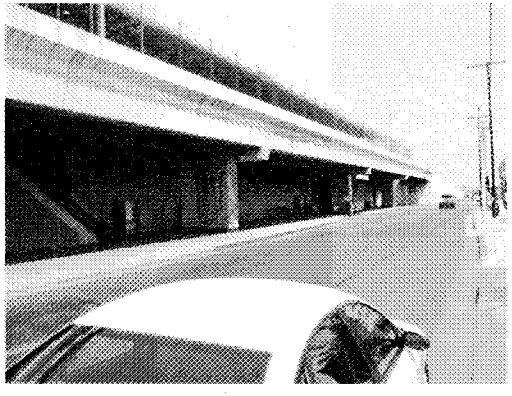
		are elevated stations	▸ Some artistic elements will have to be restored.
Grade level	Slightly raised platform in the center median of streets or in private right-of-way near street intersections, but at grade level	▸ Blue Line: All stations in Long Beach. ▸ Gold Line, Southwest Museum.	▸ Insufficient space at most to provide fare gates and emergency egress gates. ▸ Fare evaders can climb onto the platform from the track.
Other, non-typical	Stations of non-standard configuration that present special challenges.	▸ Blue Line: Transit Mall. ▸ Gold Line: Chinatown, Union Station, Memorial Park	▸ Narrow passage or walk ways restrict space for gates. Multiple complex entries.

Grade separated and subway stations are relatively easy to gate.

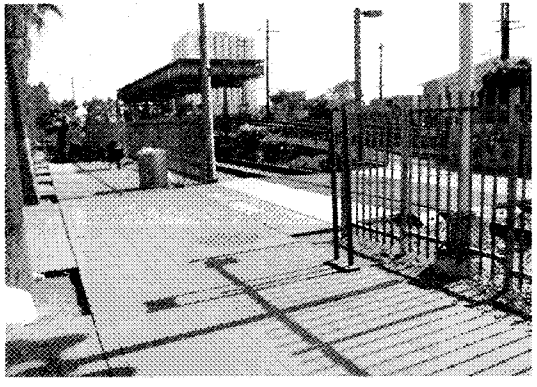
- Red Line subway was designed with provisions for gates, including under floor ducts for power and signals and designated areas for installing gates.
- Green Line stations and selected stations on the Blue and Gold Lines do not have similar provisions, but means are available (such as surface conduits) to provide power and communications. However, emergency egress and surges due to arriving trains may be problematic at some stations, such as Norwalk and North Hollywood.
- Additional fencing would be provided at all stations to channel passengers to gates and resist fare evasion.
- In addition to subway/elevated stations, there are a few grade level stations where the distance from cross streets and access paths allow gates to be installed. Compton and Artesia are examples of such stations.

Grade level platforms might be gated by providing two gates at the entry point

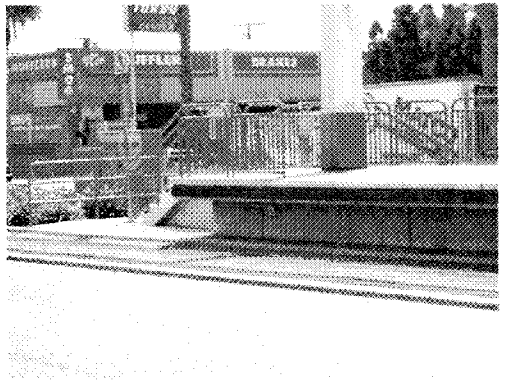
- Grade level stations generally can be gated using two gates at the entry. However, some platforms may be too narrow to provide two gates, particularly if emergency egress requires a swing gate.
- Columns block gate location in some stations *(e.g. Pacific Coast Highway station, see below)*
- A safety issue may arise if more gates are required for passenger loads than available space permits.
- Fire/life/safety and facilities maintenance have previously asked for 44" clear opening for access, which is wider than any known available faregate. Installing faregates on these platforms would block this access. Installing the 44" safety exit gate would allow for only one faregate.
- At all center street platforms, one can avoid the gates by climbing up from the trackway to the platform.



Firestone Station (grade separated)
can fence in "paid" area under trackway



Compton Station
(new "paid" area in plaza)

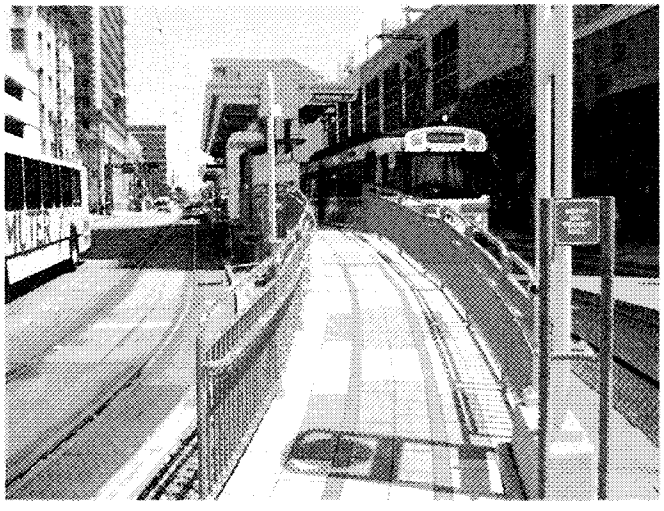


Pacific Coast Highway

If grade level stations are not gated, validators may be added in locations that will be more readily accessible to passengers as they enter and leave the system.

Some stations present special challenges to placing gates:

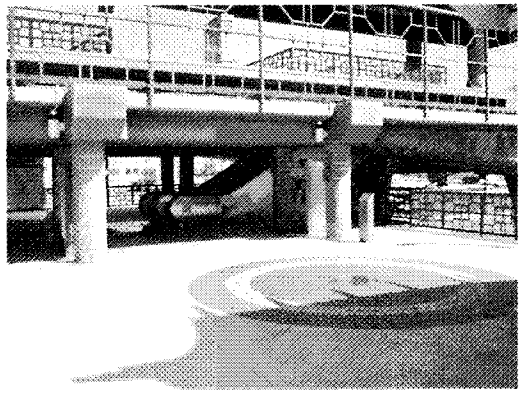
- Long Beach CBD stations are too short to mount gates on platforms.
- Insufficient space for the number of gates required may result in excessive queuing times or safety issues for passengers at:
  - LA Union Station, at the Gold Line tunnel into the station
  - North Hollywood Station
  - Imperial Station transfer mezzanine for the Blue and Green Lines.



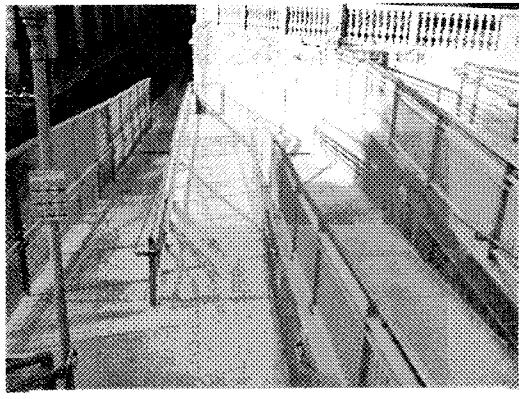
Long Beach Transit Mall (train stops with doors at end of platform, and narrow curved ramp leave no space for gates)

At some stations, installing gates may require major reconstruction of access stairs and/or ramps.

Gold Line Union Station,
space allows too few gates for "surge"
of arriving passengers.



Chinatown (decorative flooring)

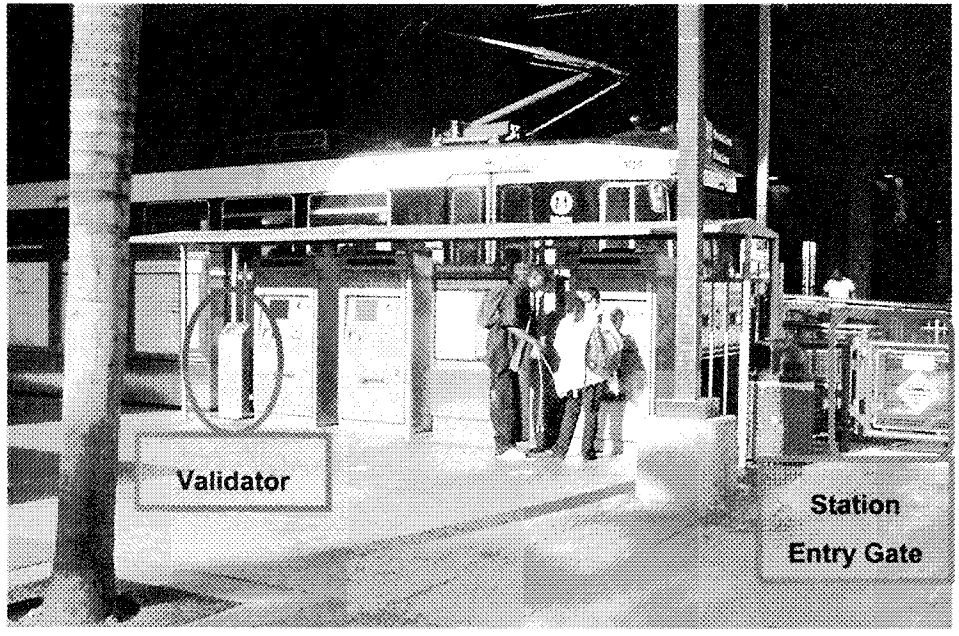


Memorial Park (complex ramps and narrow
entry leave no space for gates)

As an alternative to gating, Metro could improve passengers' ability to validate fares by moving existing validators and installing additional ones.

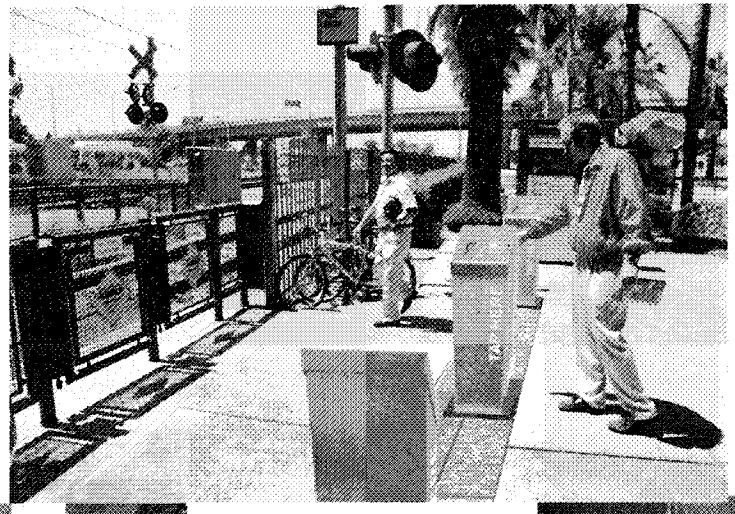
- Existing validators were placed along conduit routes. As a result, they are not always in line with customers' paths requiring passengers to find them to validate fares.
- Passengers must find validators to use them.
- Validators were not installed at all entrances.

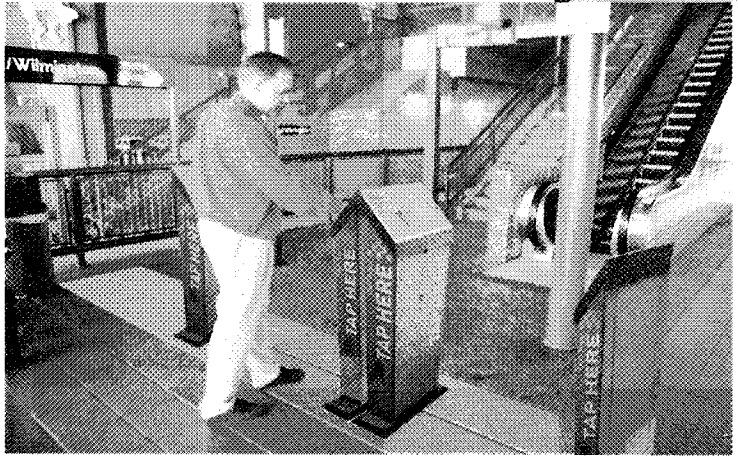
Validators should be placed in the logical flow of passengers entering and leaving the stations



Validator installations require simple improvements:

- For ungated stations, validators are needed at every station entrance and elevator. In some cases, the additional validators needed could be made available from stations that would be gated.
- Signage and color could be used to draw attention and clearly mark paid area boundaries.





Based on the these considerations, three options were developed for installation of faregates:

Option 1

- Red Line only

All other stations receive additional validators in convenient locations

Option 2

- Red Line
- Green Line
- Blue Line, 6 stations:
  - Imperial
  - Slauson
  - Firestone
  - Compton
  - Artesia
  - Del Amo
- Gold Line, 3 stations:
  - Sierra Madre
  - Allen
  - Lake

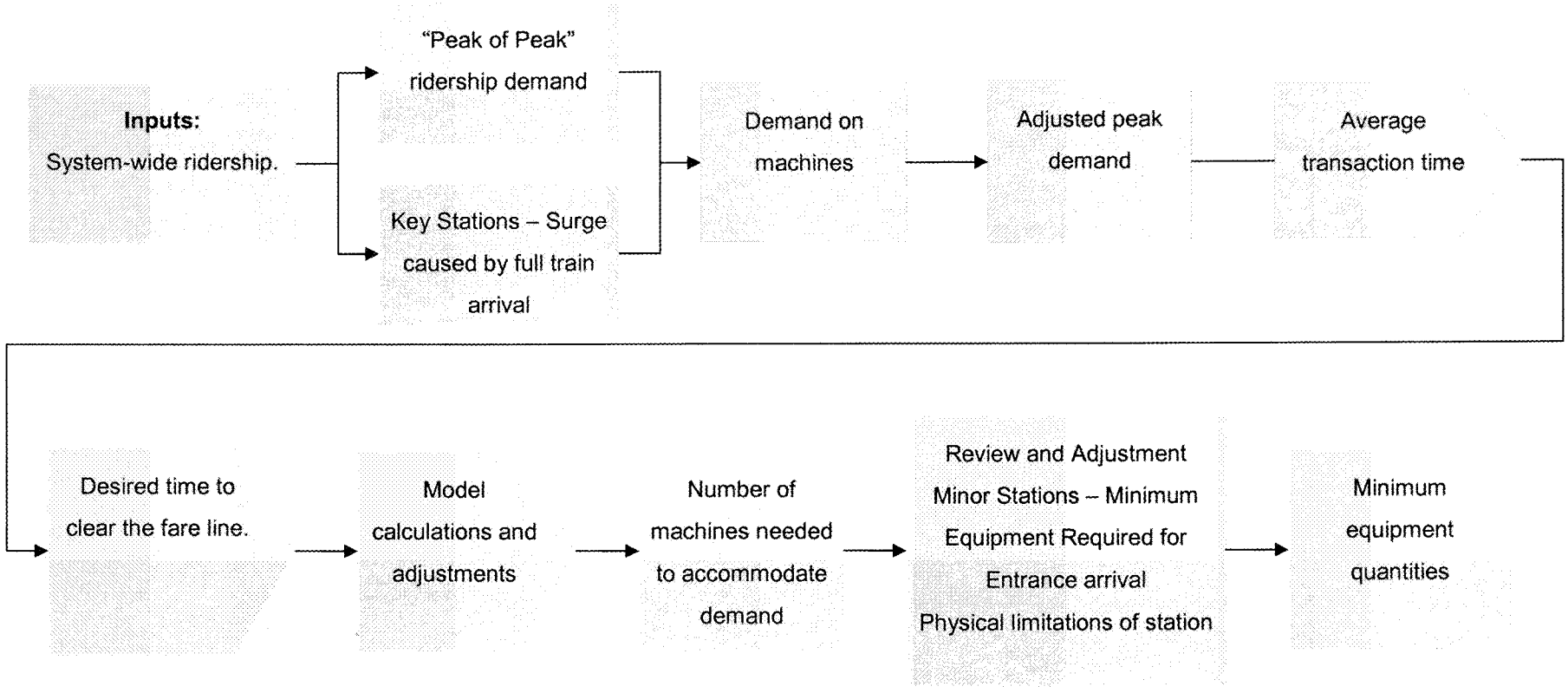
Option 3

- Red Line
- Green Line
- Blue Line, all stations except:
  - Transit Mall
  - 1st Street
  - 5th Street
  - Pacific
  - Florence
- Gold Line, except:
  - Mission

Appendix __ provides detailed breakdowns of equipment quantities and placement by station entrance

5.0 Equipment Quantities

Booz Allen reviewed the equipment quantities required to support current and projected ridership.



Assumptions used in the equipment quantities estimates were previously discussed with Metro, but are subject to further adjustment as necessary.

Maximum throughput time	4 seconds
Maximum ridership growth from current levels (system wide)	50%
Peak ridership (as percent of total)	85%
Peak hour as percent of peak	50%
Seasonal adjustment	18%
Light rail surge potential	300 passengers
Red Line surge potential	400 passengers
Percent of transferring passengers between lines at key stations	33%

The system will require a facility for passengers to call remote Customer Service Attendants (CSA) for help. This should include:

- Passenger telephones on both sides of the fare line.
- A card reader by the passenger telephone that can transmit card status to the CSA.
- Ability for the CSA to supervise the fare line and passenger telephone area with closed circuit TV.
- Ability for the CSA to open a gate.
- Workstations for the CSA(s).

Required equipment quantities vary with the three gating options:

Option	Stations	Entrances	Standard Width Fare Gates	ADA Fare Gates	Total Gates
1. Red Line Only	**16**	**24**	**127**	**27**	**154**
2. Red and Green Line, and strategic light rail stations					
Red	16	24	127	27	154
Green	14	31	62	37	99
Blue	6	6	21	7	28
Gold	3	3	4	3	7
Totals	**39**	**64**	**214**	**74**	**288**
3. All Metro Stations, not architecturally constrained					
Red	16	24	127	27	154
Green	14	31	62	37	99
Blue	16	21	36	22	58
Gold	12	19	21	20	41
Totals	**58**	**95**	**246**	**106**	**352**

The Orange Line is not included in this analysis because gating Orange Line stations would be ineffective and transferring passengers would be checked at North Hollywood and other red line gates.

There may be a need for some additional investment outside of the rail system:

- There will be a need to allow passengers to call for assistance at remote monitoring and customer service locations. This should include the ability to remotely open gates and should be staffed whenever rail lines are operational.
- Changes to Cubic's central computer will be required. A tap-on/tap-off system will generate more total transactions to be reconciled and software will need to be developed for this purpose.
- Changes to the Regional Customer Service Center may be needed to support new fare policies.
- If paper smart cards are sold on buses for day passes, a "draw box" may be desirable for drivers to store and issue cards. This does not need to be automated; it can be a simple spring-loaded box near the driver's position, but it will reduce wastage of costly cards while avoiding the need for major modifications to the farebox.

6.0 Impact on fare media and tariff options

Gating the rail system creates opportunities to introduce new fare strategies:

- In the current proof of payment environment, Metro passengers may use a one-way ticket, day pass, weekly pass or monthly pass as a valid proof of payment. Passengers who do not have a pre-paid fare product (e.g., day pass, weekly pass, monthly pass, regional transfer), must purchase a ticket at a TVM.
- Currently, regional transfers issued on Muni buses and Metrolink tickets are also valid on Metro Rail.
- With the transition to a gated system, all rail passengers will need a valid fare product on a fare card that can be read by a faregate or a Stand-Alone Validator (SAV).
- With the introduction of the TAP program, it is assumed that all riders will "tap-on/tap-off." That is, their fare cards will need to be read at a faregate or SAV upon entering the system and again upon exiting. By taking into consideration inter-agency transfers and enabling distance-based fares in the future, "tap-on/tap-off" will provide the data required both to charge the correct fare for the trip taken and to allocate fare revenue to the appropriate operator or mode.

Passengers who do not have pre-paid fare products will need another way to access the system.

- For riders who do not have long-term passes, one-way tickets, day passes and regional transfers are currently accepted as valid fare products on the Metro Rail system:
  - One-way tickets and day passes may be purchased at rail station TVMs.
  - Day passes are also available on-board Metro buses.
  - Regional transfers are sold on Muni buses.

- If pre-paid weekly or monthly passes are available only on TAP cards, riders using those fare products will have a TAP card that can be read at a faregate or SAV. In FY06 passes (including regional EZ Pass and college and student passes, but excluding day passes) accounted for 44.8% of rail boarding:

	Rail		Rail + Orange		METRO	
Cash boardings	15,082,665	18.3%	16,214,946	18.2%	64,507,304	13.4%
Day pass boardings	22,431,393	27.3%	24,424,460	27.5%	150,474,272	31.1%
Pass boardings	36,822,149	44.8%	39,915,845	44.9%	237,984,004	49.3%
Transfer boardings	4,468,894	5.4%	4,686,004	5.3%	7,594,592	1.6%
Free/non-paid boardings	3,423,571	4.2%	3,724,695	4.2%	22,600,547	4.7%
Total	82,228,671	100.0%	88,965,950	100.0%	483,160,718	100.0%

Note: Data obtained before the semi-monthly pass was eliminated and price of the day pass was increased from $3 to $5.

- Provision will need to be made to accommodate the remaining 55.2% of rail boardings (approximately 45.4 million) that are a combination of cash (18.3%), day passes (27.3%), transfers (5.4%) and free/non-paid boardings (4.2%), at the faregates/SAVs.

Passengers who do not have pre-paid fare products will need another way to access the system (cont.)

- TAP users will have the option of purchasing one-way tickets, day passes and regional transfers using the stored value portion of the TAP card and encoding the fare product on the smart card. There may be some passengers who currently pay cash fares or use day passes or regional transfers on a regular basis who will choose to use a TAP card.

- Provision must be made for riders who do not have TAP cards and who prefer to use a ticket, a day pass, a Metrolink ticket or a regional transfer to access Metro Rail. To continue to accept these fare products, they will need to be issued in a machine readable format accepted at faregates or SAVs. Alternatively, these products could be eliminated, or all passengers could be required to have a long-life smart card.

- Passengers entitled to "free" boardings (e.g., employees, conference attendees, marketing programs) will also need IDs or fare cards that can be read by faregates/SAVs. Currently, this group currently accounts for 4.2% of Metro Rail (about 3.4 million) boardings.

- Fare payment options that could be considered for these purposes include:
  - Limited use smart cards
  - Bank cards deploying smart card based credit/debit cards
  - NFC (Near Field Communication) technology using cell phones enabled with smart card chips
  - Manually operated gates (with agent booth)
  - Other electronic payment modalities to allow the occasional or non-TAP customer to gain entrance and exist with barrier system.

Limited use (LU) smart cards are one option for short-life fare products.

- Limited use smart cards are paper smart cards that are less durable, and less costly, than the plastic TAP cards.
- Unit costs of limited use smart cards have been coming down and are currently at about $0.15-$0.25, depending on volumes. Fare policies may offset the cost, such as providing bonuses to riders who re-use limited use smart cards.
- This approach has been implemented in Atlanta, by MARTA, where limited use smart cards (Breeze Tickets) are available for one-way tickets, multiple trips/days, or cash value. A surcharge of $0.50 is applied to each purchase of a new Breeze Ticket.
- In the Metro environment, under the current fare structure, consideration could be given to using limited use smart cards for products such as the day pass. Based on FY07 ridership levels at 158 million day pass and transfer rides/year, it is estimated that 40 million limited use smart cards would be sold. This translates to a cost to Metro of approximately $8 million per year (Assuming 20¢/day pass), depending on usage rates and cost of the cards. Metro would need to consider whether some or all of this cost would be passed onto the patron.
- Metro has been considering LU smart cards for day passes to reduce abuse (theft and resale) of paper day passes. Once fare gates are implemented, requiring electronic media to enter the paid area, the decision to use LU smart cards is moot.
- Further analysis is recommended to determine the cost and revenue implications of this option given rider responses to fare structure changes implemented in July 2007.
- An alternative to LU cards is to require passengers to have a regular plastic smart card. In either case, the cost of the fare media must be borne by either Metro or its riders, or shared between them.
- In a smart card environment like TAP, a limited use smart card could also be used to provide new fare products such as ten-trip tickets, which could replace Metro's tokens.

Over the next few years, banks will be converting credit and debit cards to incorporate contactless capability.

- Bank cards may present a substantial opportunity to reduce the cost of purchasing, producing and distributing fare media such as tickets, limited use smart cards, etc. Transit agencies are examining the business case and several are already experimenting with acceptance of these cards.
- Passengers could ride without pre-registering or buying a card, as long as they have a credit card.
- The business case is still in development. Some issues that may relate to Metro:
  - Metro's smart cards maintain the customer's account. Bank cards will not carry this "transit application," so all data must be collected by the gate/farebox and processed in Metro's back end (an "account" based vs. card-based system). This will require major change to Metro's fare collection system.
  - Bank cards will require compliance with recent Payment Card Industry regulations wherever they are accepted, including gates and bus fareboxes.
  - Each transaction is subject to bank fees.

Bank smart cards provide an intermediate term solution that should be considered.

Mobile phones with an NFC (Near Field Communications) chipset can be used to enable fare payment.

- NFC is a set of standards enabling cell phones to emulate smart cards and to communicate securely at ranges up to 1.5 inches. NFC-enabled phones can be used to read 'smart posters' on buses and faregates and pay fares through a back-end account system.
- Cell phones and transit payments may be a natural fit and have been piloted in New York, Paris, London and Taipei. The telco infrastructure provides a strong platform for transit ticketing that includes the ability to buy tickets "on-line," pay for tickets with a credit card or through a telco billing, delivery of the ticket to the rider, and delivering additional value with the ticket, such as schedule information.
- Transit may be an everyday purchase or use for telco users – and cell phones may have higher penetration than credit cards among transit riders, driving user acceptance of NFC payments.
- Cell phone-based payments can save fare media distribution and management costs for the operator and reduce cash handling.

Manually operated gates, with an attendant booth, could be used to accommodate cash-paying riders.

- Gates are controlled by a customer service attendant in a booth at the fare line. The attendant can handle exceptions (such as verifying fare payment for riders with non-readable fare products):
  - In San Francisco, the Muni light rail system is proof of payment. Riders at underground stations board through faregates that accept cash and pre-paid fare products. Ticket agents collect token coupons and inspect transfers. At least one ticket booth is staffed at any open station.
  - BART, Washington, Chicago and New York have attendants present who can admit customers through the fare line for "exception" transactions.

- Similar approach could be used to handle Metro Rail cash fares, but would require staffing an agent booth at all gated stations:
  - For Option 1, this approach would require staffing 16 stations, some of which have multiple entrances.
  - For Option 2, 39 stations would need to be staffed. Many of these have insufficient space for an attendant booth.
- This approach provides flexibility for riders who have questions or problems, whether with fares or other aspects of using Metro Rail, as well as security. However, cost of staffing Red Line stations only could be as much as $6.2MM annually, and this would not allow for the distance-based fares LA Metro may wish to implement in the future.

Due to high cost, insufficient space at Metro's light rail stations, and limited fare options, Metro agreed to not utilize attendants. However, policing will be increased to assist customers as discussed later in this report.

One objective for gating Metro rail is to decrease the number of riders whose fares require inspection.

- Estimates of the proportion of riders whose fares would be checked at faregates were developed using FY07 unlinked boardings by line and by station, and the following assumptions regarding transfer rates:

	Alightings	% checked	Gated Boardings	assumptions
Transfer Assumptions				
Red > Blue @ 7th/Metro	6,808,816	33.0%	2,246,909	33% Red Line riders alighting at 7th/Metro transfer to Blue Line
Blue > Red @ 7th/Metro	4,540,328	33.0%	1,498,308	33% Blue Line riders alighting at 7th/Metro transfer to Red Line
Red > Gold @ LAUS	5,026,936	39.0%	1,960,505	39% Red Line riders alighting at LAUS transfer to Gold Line
Gold > Red @ LAUS	1,844,921	95.0%	1,752,675	95% Gold Line riders alighting at LAUS transfer to Red Line
Blue > Green @ Imperial	3,274,466	33.0%	1,080,574	33% Blue Line riders alighting at Imperial transfer to Green Line
Green > Blue @ Imperial	2,668,714	33.0%	880,676	33% Green Line riders alighting at Imperial transfer to Blue Line
Red > Orange @ North Hollywood	4,255,016	48.0%	2,042,407	48% Red Line riders alighting at North Hollywood transfer to Orange Line
Orange > Red @ North Hollywood	3,369,082	95.0%	3,200,628	95% Orange Line riders alighting at North Hollywood transfer to Red Line

Three gating options have been evaluated:

- Option 1: Gate Red Line stations only.
- Option 2: Gate all Red and Green Line stations plus three Gold Line stations (Sierra Madre, Allen, Lake) and six Blue Line stations (Imperial, Slauson, Firestone, Compton, Artesia, Del Amo).
- Option 3: Gate all Red and Green Line, plus all Blue and Gold stations that have sufficient space, regardless of the cost of required civil work. This excludes six stations. The Orange Line was not included, as transferring riders are checked at North Hollywood.

Based on FY07 unlinked ridership data, the proportions of rail and orange line riders whose fares would be checked were estimated.

- Since unlinked boardings are used as the base for this analysis, riders who transfer from one line to another and whose fares are checked on one line have been counted as having been checked for both lines.
- The estimated percentages of rail passengers who would go through a faregate are as follows:
  - **Option 1**: Red Line only - 59%
  - **Option 2:** Red, Green and easiest light rail stations - 84%
  - **Option 3:** All Metro Station, not architecturally constrained - 98%

Faregates will enable the implementation of zoned or distanced-based fares in the future.

- As noted previously, smart card "tap-on/tap-off" requirements will enable implementation of distance-based fares. As riders enter the system, the entry point will be captured; as they leave the system, the exit point will be captured, making it possible to calculate either the number of zones traveled or the point-to-point distance traveled.
- There are three primary approaches to zoned or distance-based fares:
  - Fixed zones – each rail station is associated with a specific zone and a price is set for each zone.
  - Floating zones – permit riders to purchase distance (measured in number of stations or zones) from the origin
  - Point-to-point fares – provide travel between specific locations
- For cash fares, the fare deducted would be determined by the system based on the entry and exit points. For passengers with zoned pass products, the system could verify the validity of the pass for the trip taken.
- Passengers traveling beyond the zone limits of a pass could be assessed the additional cash fare equivalent for the extra zones traveled. This could be accomplished by requiring riders to go to an "add fare" machine to pay the additional cash fare equivalent or by deducting the additional fare from the TAP card's stored value purse. (***Note***: Metro staff have directed that "add fare" equipment will not be considered.)
- As fare vending alternatives are evaluated, strategies that minimize TVM transactions should be considered.
- Reducing transactions at TVMs will reduce queuing at TVMs and the need for additional equipment.
- Pricing strategies are one way to encourage riders to pre-purchase fares instead of using TVMs – e.g., by discounting fares or offering bonuses for fares purchased or value added in other ways (e.g., on-line or using auto load).
- An "accumulator" would reduce the need for day pass users to make cash transactions at fareboxes and TVMs.

- Fare payments or trips would be accumulated
- When the value of the day pass is reached, the rest of the rider's trips that day would be free.
- Chicago uses this approach on the Chicago Card Plus.

Additional policies for insufficient card balances will also be needed.

- In a partially gated system, there is the potential for passengers with an insufficient balance on their cards to enter the system. This is particularly a problem for a tap-on-tap-off, distance-based fare system.
- Metro must provide for passengers whose fare card balances are not sufficient to cover the cost of a trip.
- Faregates can prevent the rider from entering the system unless there is sufficient balance on the card to exit.
- This consideration also applies to riders who do not have a pass product that is valid for a particular trip, since the cash value of the trip would be deducted from the stored value purse.
- One option is to allow the fare card to go negative until the next time value is added to the card. At that time, the negative amount is deducted from the added cash value. One advantage of this approach is that it prevents leaving a rider stranded. The most the agency stands to lose is the value of a cash fare, because once a card has a negative balance, it cannot be used to enter the system.
- Support systems (remote passenger attendants, preferably with the ability to obtain data from the card through a local reading device, and trigger a gate to exit) must be available.
- Autoload policies can also help to address insufficient card balances by not allowing the balance to fall below a specified level. With autoload, riders link their fare cards to a credit or debit card and specify an amount that should automatically be added to the stored value purse when it falls below a defined amount.

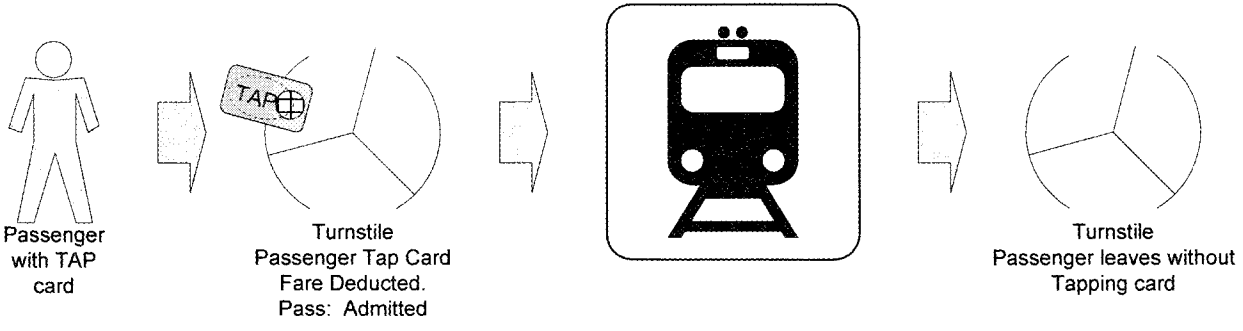
7.0 Qualitative impact on passengers

For passengers, the biggest change will be the need to tap their cards when entering and exiting rail stations.

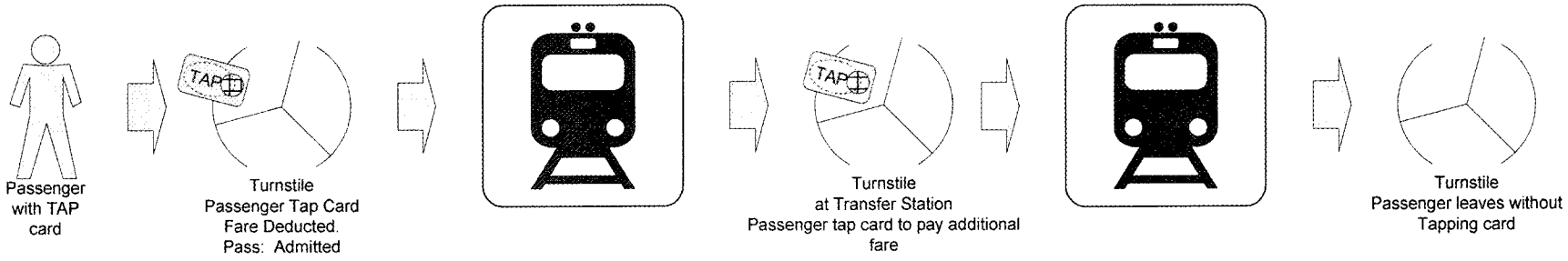
The graphics that follow illustrate how passengers would interact with the fare system under the following conditions:

- **Flat fare** – Passengers with Tap Cards
- **Flat fare** – Passengers without TAP cards
- **Distance-based fare** – Passengers with TAP cards
- **Distance-based fare** – Passengers with insufficient value on TAP cards
- **Distance-based fare** – Passengers without TAP cards
- **Distance-based fare** – Passengers determined to evade fare payment

Currently, METRO operates as a flat fare system. With the addition of gates, passengers would tap on entry.

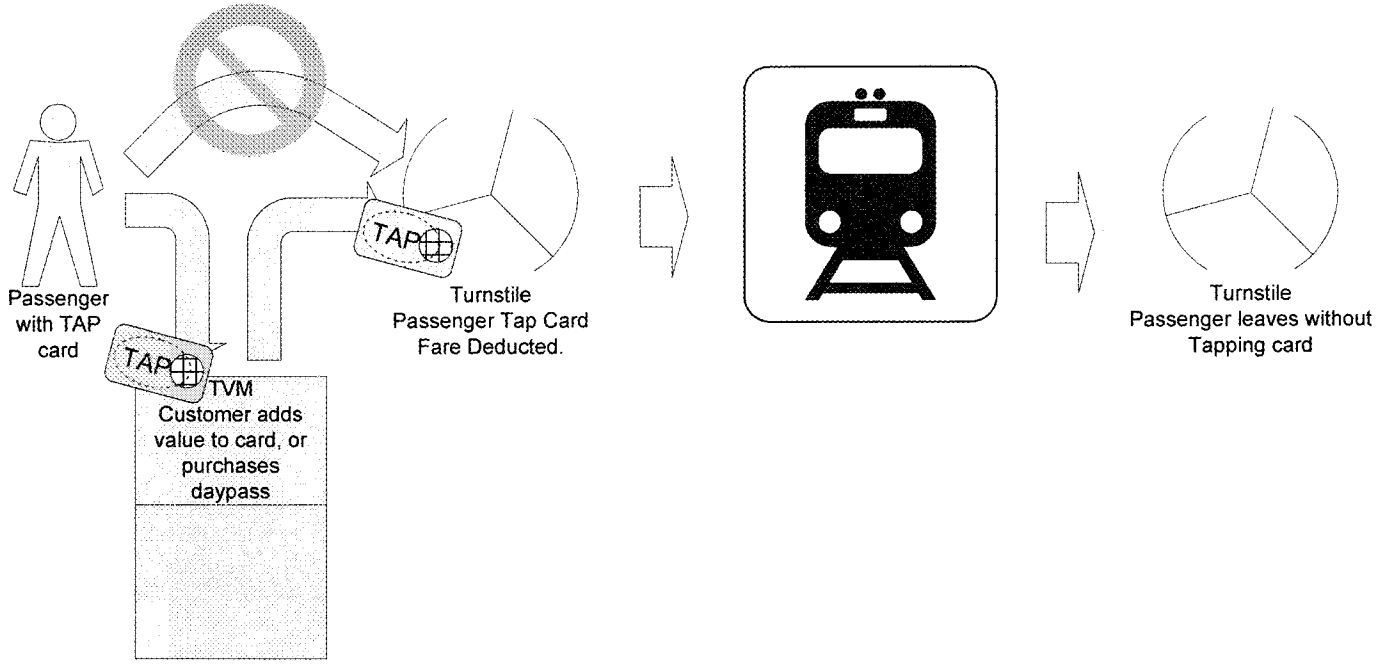


Metro collects an additional fare for transferring between lines. This would require gates in the connecting mezzanines at transfer stations.



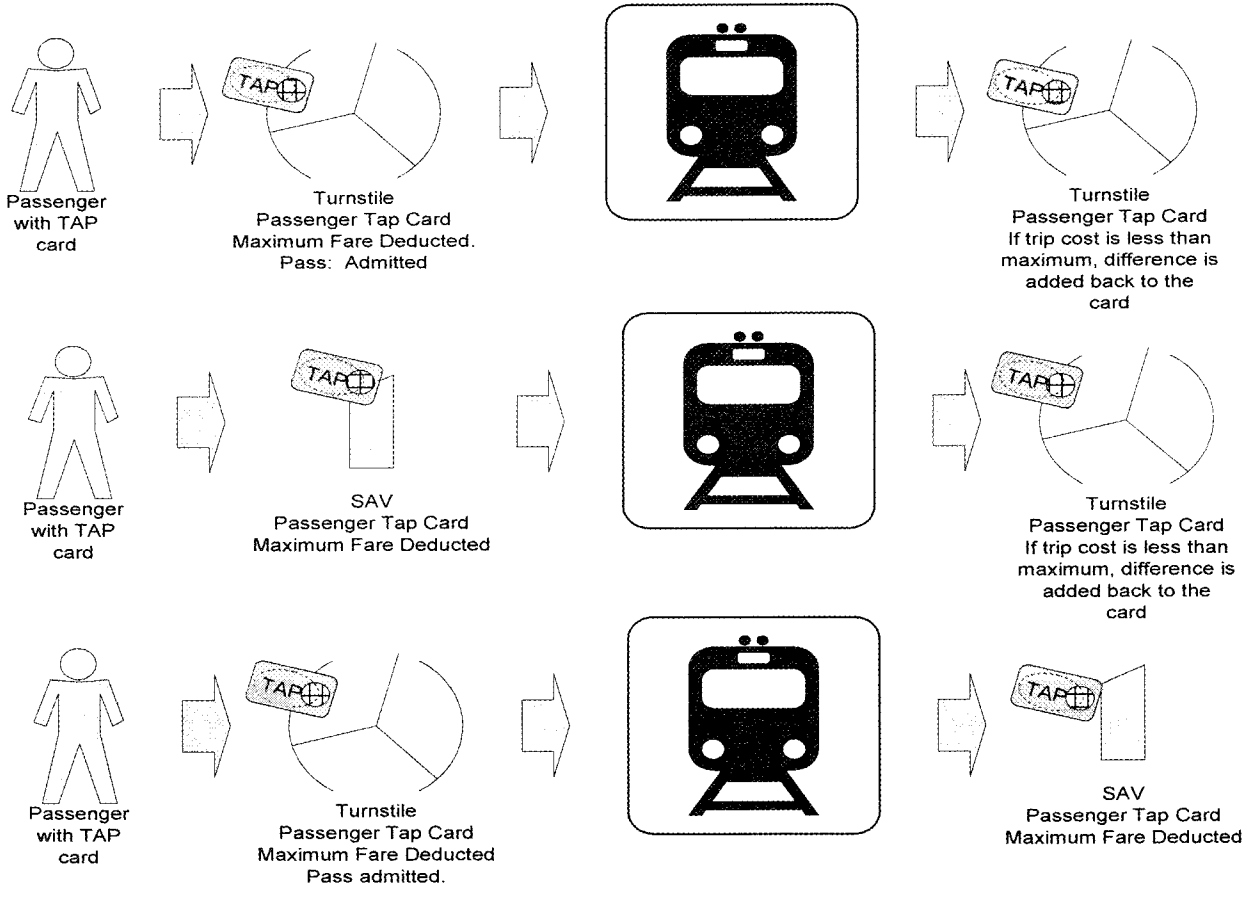
Note: *Graphics assume turnstiles, though other faregates would be used the same way.*

In a flat fare system, passengers with insufficient balance on their cards must reload at the TVM first.



If Autoload is used, card can automatically load value at the gate, without passenger going to the TVM.

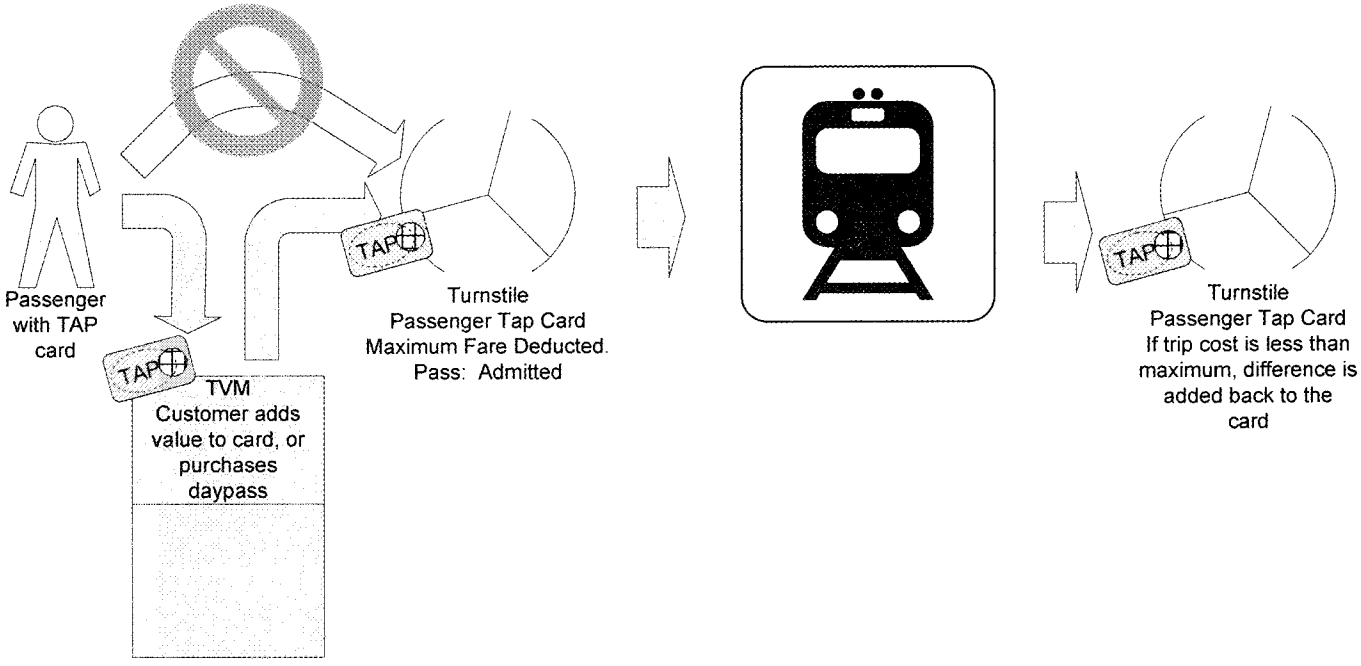
If Metro moved to a distance-based fare system in the future, passengers would have to tap as they come in to the system and as they leave ("Tap-on-Tap-off").



- There would be no need for turnstiles at transfer points … the system would automatically calculate the correct fare including transfer or day pass.

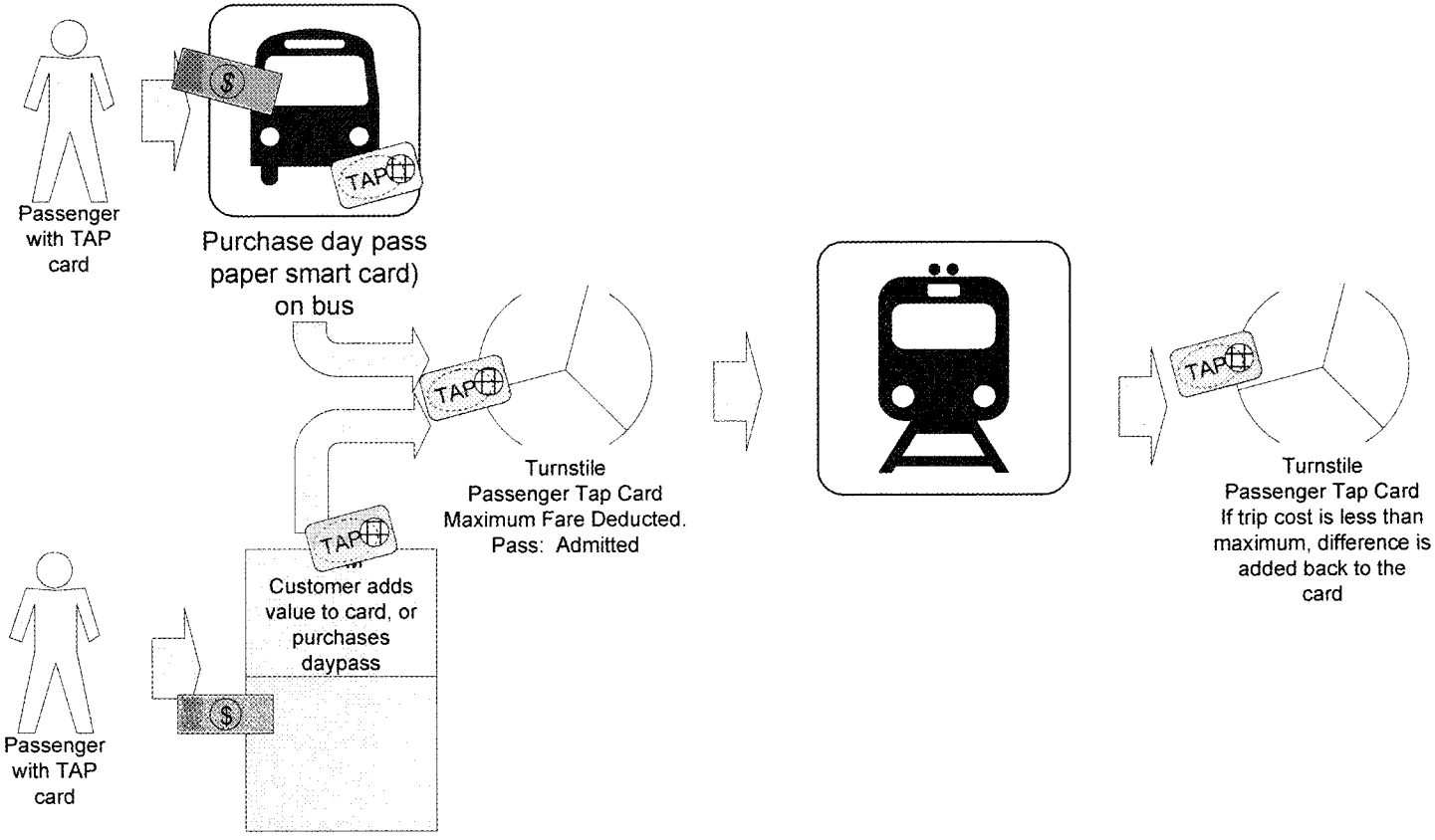
- Tap-On-Tap-Off also provides better compliance with fares vs. flat tap-once/flat fare

Passengers with insufficient value on TAP cards:



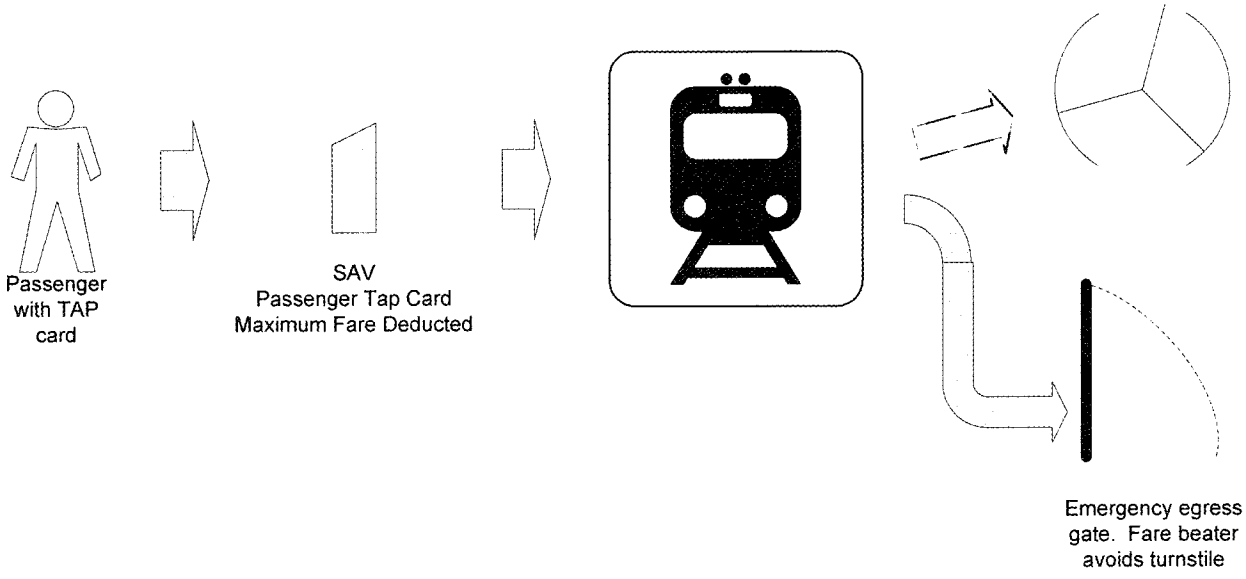
- Passengers without TAP cards must purchase paper smart card (day pass) from a TVM.
- Passengers with insufficient balances on their cards must add value before entering, though Metro may allow negative balance on the card.

Passengers without Tap Cards must purchase day passes on the bus or from the TVM. The day pass will be a limited use smart card.



Alternatively, Metro may require all passengers riding rail to have a long-life smart card. This can be purchased from the TVM, but at a higher price. However, it is reusable.

A gated system does not prevent all fare evasion. Fare evaders can take advantage of emergency egress provisions, or simply jump over faregates



As with any change, addition of faregates to Metro's rail lines will require education and marketing.

- Tap-on/tap-off requires passengers to comply at both ends of the trip. Since transit users today do not need to comply upon exiting, this change is not intuitive. For the passenger who does not tap-off, the alternative is that the passenger will pay the maximum fare for each trip.
- Metrolink passengers will probably need to carry separate TAP cards and Metrolink passes. Metro and Metrolink may wish to examine joint sales opportunities (e.g., tickets by mail or internet sales) that will allow these passengers to order a monthly pass and TAP card autoload at the same time.
- The ADA population should not be negatively impacted by gating, since special gates will accommodate their needs.

8.0 Impact on fare evasion and inspection procedures

Faregates should reduce the potential for fare evasion on the gated rail lines.

- Based on the study recently done by TMD, the evasion rate is lowest during the peak period and rises during off-peak periods. Current fare evasion rates are as follows:
  - Weekdays: 5 percent
  - Saturdays: 6 percent
  - Sundays: 7 percent
- Based on current estimates of fare evasion, total fare losses are up to $5.6 million annually.
- The extent of gating will determine how many passengers are checked at one or both ends of a journey. Metro will remain exposed to fare evasion for passengers who are not checked. Fare inspection must continue at ungated stations and line segments to control evasion.
- It is estimated that approximately 55%-98% of fares lost to fare evasion could be recovered, depending on the extent of gating as shown below ($millions)[4]:

	Option 1 Red Line Only	Option 2 Red and Green Line, and strategic light rail stations	Option 3 All Metro Stations, not architecturally constrained
Increased Revenue, fare evasion reduction ($-millions annually)	$2.72	$3.81	$4.54

While it is expected that faregates will reduce fare evasion at gated rail stations, gates will not completely eliminate fare evasion. Some passengers are determined fare beaters, and will not be deterred by most gate types.

While there are no firm industry-wide guidelines, anecdotal information and observation indicate that "full compliance" with fare collection requirements probably leaves about 1%-2% of passengers determined to evade payment. In addition, gates that accommodate ADA requirements may allow fare evasion:

- Leaf gates: Passengers step over
- Paddle gates: Passengers open and allow others to pass through.

Emergency egress gates, which must be provided to meet fire protection requirements, may also enable fare evasion:

- Gates can be left open, or can be opened by an accomplice who enters through a faregate
- Persons who board at an ungated station and do not tap a fare card can exit by pushing the "smash bar" on the emergency gate.

At light rail stations, where the trackway is easily accessible from the street, passengers can climb up onto the platform behind the gates.

Fare inspection, which is currently provided by the Los Angeles Sheriffs Department, would be restructured if the rail system is gated.

- Fare inspection is contracted to the Los Angeles Sheriffs Department, but is conducted by non-sworn personnel. The current cost of fare inspection is $7.06 million per year.
- Metro staff has advised that the Sheriffs' separate non-sworn inspection force will be ended if gates are installed. Inspection will be conducted by Los Angeles Sheriffs Department in the normal course of patrolling the system and by non-sworn Metro Transit Officers, who will be Metro employees. .

- It is assumed for purposes of this report that patrolling by LASD would not increase after the fare inspection force is removed. This would yield a savings of $7.06 million annually.

- The Metro Transit Officers would provide fare enforcement. This would include two components:

  — Inspection of fares at remaining ungated stations. For purposes of Booz Allen's cost analysis, we have utilized the current level of LASD fare enforcement effort and adjusted it proportional to the remaining population that will not be checked at fare gates. We have also used the lower rate for Metro Transit Officers.

  — Presence at gated stations to reduce gate-jumping as well as provide customer assistance. Metro is currently reviewing the staffing levels this may require. In practice, this is a dynamic situation, and staffing levels and assignments are adjusted in response to current needs. For purposes of the cost analysis, we have assumed that there would be one officer available for every five gated stations for all operating hours.

9.0 Cost Estimates

Gating Metro's rail lines carries a variety of direct and indirect costs. The contractor has primary responsibility for equipment and related services.

- Faregates
- Engineering design and software
- Installation
- Minor site preparation *(drilling, wiring, etc.)*
- Modifications to station computer and communications equipment to support faregates
- Modifications to central computer(s) and regional computer to support new fare policies and increased transactions from tap-on/tap-off system
- Modifications to TVMs and other existing equipment to support new fare media *(if needed)*
- Add fare devices *(optional, depending on fare policy)*
- Parts, documentation, training and miscellaneous services
- Project management by the Contractor and Metro.

There will also be a cost for civil construction and site preparation where stations must be modified for gates and associated equipment.

- Engineering for station modifications
- Minor site preparation where provisions are already in place
- Major reconstruction
  - Ramps
  - Fences, walls or other barriers, plus emergency egress gates
  - Concrete pads for new or relocated equipment if not mounted on existing structure
- Power
- Communications
  - New duct, which has to be trenched into the station area for gates, relocated TVMs and relocated validators.
  - Communications and power lines
  - Passenger telephones (additional telephone so there is one on both side of the fare line) for remote customer support
  - Closed circuit TV for security monitoring.
- Shelter for gates if provided in an open area. Shelter is also required for TVMs by Metro policy.
- Relocated validators to improve customer compliance, including communications and structural infrastructure.
- Attendants' booths *(not included)*

Booz Allen's estimate of civil construction represents an initial estimate, subject to further discussion with Metro.

The estimate includes:

- Relocation of some TVMs off-platform where needed, and infrastructure (canopies, duct, foundation, trenching) for them
- Public telephones, including cabling and PBX upgrade
- Closed circuit television where needed to comply with Metro policy, including cabling.
- Relocation or removal of stand-alone validators.
- Faregate Installation by console
- Swing Gates for emergency egress and maintenance access
- Fence Railing, for a simple steel fence.
- Drilling and coring of holes for equipment installation
- Conduit
- Installation of cabling and wiring

In addition, there will be cost for design and oversight cost:

- Architectural design and drawings.
- Metro management of the project, including civil construction management and technical support.

There are other potential costs that were not included in the estimate, but may impact overall project cost:

- If limited use smart cards are to be used, and if MTA prefers not to have bus drivers carry a supply of the cards, it will be necessary to have a means of issuing them on buses. Associated costs would likely include:
  - Farebox modifications
  - Cost for a simple "card box" that would hold limited use cards for drivers to draw from
  - Modifications for Muni buses to support interagency transfers or regional day passes.
- There will also need to be a means for MetroLink passengers to obtain fare media that allow them entry to the Red Line. Costs for the following alternatives have not been evaluated however:
  - Metrolink has been provided regional funding to ensure interoperability with Metro and all regional Municipal Operators participating in TAP that may require upgrades to their existing equipment.
  - MetroLink passengers will be required to carry a TAP card in addition to a MetroLink pass with the installation of barrier gates.
- Consideration should be made of the artistic features at the rail stations design to avoid any possibility of damage via implementation fare gates. Costs associated with restoring these features has not been included in the estimate.

Operations costs and savings have been identified in several areas:

- Maintenance, including labor and parts.
- Station attendants – it is assumed that mobile station attendants are shared at a rate of one per every five stations.

- Additional customer service/passenger telephone response – it is estimated that two attendants will be required during all operating hours.

- Metro staff has advised that all contracted civilian fare inspectors will be replaced with Metro Transit Security officers. Fare inspection at the remaining ungated stations would be performed by this security force (rather than the current civilian fare inspectors under contract with the Los Angeles Sheriffs Department) in the course of their normal patrols.

- Credit for reduced fare evasion.

Fare media cost does not change under the options examined.

- Installation of gates may require implementation of limited use (LU) paper smart cards in place of the current paper day pass transfer slips. This was discussed above (Fare Media and Tariff Options).
- The estimated annual cost of LU cards would be about $8-million system wide, before accounting for wastage.
- In addition, TVMs must be modified to issue LU cards. This one-time cost has not been determined.
- Metro staff has advised that limited use smart cards are already planned, to combat fraud with the current day pass.
- Given Metro's current day pass price, and the current cost for long-life plastic smart cards (about $5), a better policy may be to simply require all passengers entering Metro Rail to have a plastic smart card, sold for the cost of the card plus the value encoded. This would also encourage more Metro riders to carry the long-life card and reduce net operating costs.

While fare media cost has not been attributed to the gates, the gate system cannot operate without addressing this issue. Implementation of Limited Use cards, or revised fare policies to achieve more use of long-life cards, is a necessary condition for gating Metro rail lines.

Booz Allen has performed an independent estimate of project capital cost *($-millions)*

Item ($-millions annually)	Option 1 Red Line Only	Option 2 Red and Green Line, and strategic light rail stations	Option 3 All Metro Stations, not architecturally constrained
Contractor Equipment and Services (Faregates, engineering, installation)	$9.01	$15.28	$18.48
Engineering -- Station Modifications	$0.80	$1.95	$2.95
Civil Construction (conduit, electrical, fences, emergency egress gates, etc.)	$1.80	$6.72	$10.42
Minor site prep	$0.19	$1.76	$3.19
Additional passenger telephones	$0.54	$1.62	$2.80
Additional CCTV monitoring	$0.95	$2.84	$4.90
Project and Construction Management - MTA	$3.23	$5.35	$7.14
Total Direct Capital Cost	$16.51	$35.51	$49.88
Contingency	$4.95	$10.65	$14.96

Analysis shows that the operating cost of the faregate system is very sensitive to certain assumptions. In particular, the level of additional patrolling Metro wants when the faregates are implemented will determine the overall operating cost. *($-millions annually)*

Item ($-millions annually)	Option 1 Red Line Only	Option 2 Red and Green Line, and strategic light rail stations	Option 3 All Metro Stations, not architecturally constrained
Costs			
Maintenance	$0.44	$0.83	$1.01
Parts annual	$0.08	$0.16	$0.20
Fare inspection at remaining ungated stations and supervision/customer support at gated stations	$1.41	$2.40	$2.83
Additional customer service/PTEL response	$0.55	$0.73	$1.10
Total Costs	$2.48	$4.11	$5.13
Credits			
Inspection program (credit)	($7.06)	($7.06)	($7.06)
Fare evasion (credit)	($2.72)	($3.81)	($4.54)
Total Credits	($9.78)	($10.87)	($11.60)
Net Increase (Decrease) in cost	**($7.30)**	**($6.76)**	**($6.46)**

Metro wishes to explore a lease arrangement whereby the contractor would build and operate the faregate system. The following table explores this approach as a cash flow analysis with the following assumptions:

- Ten year lease, amortized evenly over the life of the lease
- Interest rate of 5%
- Lease includes maintenance.
- Analysis does not include one-time cost to build infrastructure for gates and manage the project (shown at the bottom of the table)

Item ($-millions annually)	Option 1 Red Line Only	Option 2 Red and Green Line, and strategic light rail stations	Option 3 All Metro Stations, not architecturally constrained
Contractor build/operate lease, 10 years, 5%, including contingency	$2.01	$3.51	$4.27
Fare inspection at remaining ungated stations and supervision/customer support at gated stations	$1.41	$2.40	$2.83
Additional customer service/PTEL response	$0.55	$0.73	$1.10
Inspection program (credit)	($7.06)	($7.06)	($7.06)
Fare evasion (credit)	($2.72)	($3.81)	($4.54)
Net Increase (Decrease) in cost	($5.81)	($4.23)	($3.40)

Infrastructure cost and project management (one time cost, including contingency)	$12.46	$30.89	$46.35

Public Transit Security Expert Opinion
October, 2007

Police chiefs of various transit agencies responsible for law enforcement within gated rail systems were contacted to solicit their independent and voluntary opinions. Attached are observations and opinions from several Chiefs contacted. These comments are informal "for information" purposes from responsible experts. It is not intended to necessarily represent the views of the associated agency.

WMATA (Washington Metropolitan Area Transit Agency)
Interim Chief of Police, Mike Daly.

1.) Do fare gates in rail stations in anyway reduce crime?

Fare gates reduce fare evasion. The main way that officers detect fare evasion is to watch for individuals "piggybacking" through behind another customer. Piggybacking is the most common method employed by fare evaders. Without the fare gates this would not be possible.

2.) If so, what type of crime and to what degree?

The folks we catch evading the fare come from all socio-economic levels. It seems like everyone will try and beat the Metro if given the opportunity. That notwithstanding, since it is known on the street that we do look for fare evaders, and also known that we do a computer check on them even if we let them go with a warning, wanted persons and common criminals are doubtless somewhat deterred from entering the Metro when they can't afford the fare. It is not possible to measure how many other crimes they don't commit in the Metro because they have been deterred from coming in.

3.) Do fare gates add an order of crowd control to an otherwise open system?

Absolutely! Imagine trying to work a concert/ballgame/special event with large crowds entering and no fare gates. You can forget about trying to make them pay. The fare gates provide one more potential control point, even though we don't use them that way very often.

5.) In general what are the pros and cons of fare gates in stations in regards to law enforcement?

In addition to the pros outlined above, experience with large crowds shows that the limiting factor is normally the ability of Rail to run sufficient trains to clear the crowd. Getting folks into the station, through the fare gates, and onto the platform is not normally a limiting factor. Some have expressed a concern for the delay introduced by fare gates, but experience has not proven it to be a problem in handling large crowds at special events.

6.) The electronic trip data that can be retrieved from the WMATA system when a suspect uses a uniquely serialized ticket of smart card, is this of any help to back tracking where the suspect may been?

The data we now have available is invaluable to law enforcement.

7.) To prove he was or was not at a specific location within the system?

It can provide evidence of not only where he was, but when, and perhaps who he was with. Good stuff for the police.

8.) Do fare gates minimize passengers that have objectives other than to get to a specific destination?

To the extent that they effectively establish a cost to enter the station.

9.) Please add any other comments as to fare gates in support of law enforcement.

The amount of fare media sold via credit cards comprises a large and growing proportion of sales. The ability to negative list the fare media when it is purchased with a stolen credit card (or if we get a charge back for any other reason) is a critical element in holding down credit card losses. Selling fare media on the street that doesn't work entails certain occupational hazards. Moreover, buying fare media with a stolen credit card is much less attractive when it is known that we will turn the media off. It is important to keep this so, because Metro fare media is very liquid. A thief can sell it for a higher percentage of its value than he can most stolen merchandise. A fur coat, for example, must be the right size, has storage and transportation limitations, and can cause a thief all sorts of other problems. Everyone (or almost everyone) can use Metro fare media and one size fits all. We would prefer the thieves rush to the nearest shopping mall (or telephone) when they acquire a stolen credit card and stay out of the Metro. There is no telling how many other crimes are prevented by encouraging thieves to go elsewhere (robberies, pickpockets, etc.). The fare gates and enforcement of fare evasion statutes play an indirect, but vital, role in holding down our credit card losses. This is a good thing, because if we had ten times as many officers as we do, we still couldn't hope to do anything about people defrauding us with stolen credit cards. The amount of this type of crime nationally is staggering. I don't have the numbers in my head, but could get them if you needed them. We need to keep the lid on this type of loss or we could lose our shirt.

Baltimore Metropolitan Transit Agency
Captain Fred Damron, MTA Transit Police

The technology of utilizing serialized ticketing and/or a smart card system with fare gates greatly enhances the abilities of Transit Police agencies to:

a.) Follow-up on Stations of Entry and Exit electronic data (Possible Suspects)

b.) Time and date the system was used by possible suspects
c.) Prevent counterfeit and/or fraud through electronic reading and backend system monitoring devices
d.) Track a suspect's activity throughout the system over a duration of time.
e.) Block a patron from entering system if their card number is known or of threat to the system (Revocation of Riding Privileges)

ATTACHMENT B

Public Transit Security Expert Opinion
October 2007

Police chiefs of various transit agencies responsible for law enforcement within gated rail systems were contacted to solicit their independent and voluntary opinions. Attached are observations and opinions from several Chiefs contacted. These comments are informal "for information" purposes from responsible experts. It is not intended to necessarily represent the views of the associated agency.

Tom Savage is a 36 years of public transportation veteran who presently holds the appointed title of New York MTA Bus President for the 10th largest bus fleet in North America. He formally held the position of **Chief of the MTA Police Department.** Mr. Savage provided his expert opinion regarding security and rail fare gates in public transportation systems.

1.) Do fare gates in rail stations in anyway reduce crime?

The current NYCT turnstiles were designed to make it difficult for fare evaders to jump thru and/or 'backcock'the arms of the fare gates. This design was helpful in identifying fare evaders in the act to transit police teams. The design slowed the fare evader and allowed the transit police teams to react in a timely and safe manner during the actual arrest.

2.) If so, what type of crime and to what degree?

Fare evasion sweeps stops criminals at the turnstile/fare gates and allows for warrant checks and weapon searches. Fare evasion tactics and sweeps have apprehended people wanted on warrants, including criminals wanted on murder and many other serious crimes. Transit police have confiscated hundreds of illegal weapons. Most importantly the sweeps have stopped criminals before they can victimize subway riders and incidentally the casual farebeater when apprehended experiences the daunting shock of being arrested for a crime. In addition, it is well understood in the industry that minimizing fare evasion directly correlates to a reduction associated with in-system criminal activity including graffiti.

3.) Do fare gates add an order of crowd control to an otherwise open system?

Yes. In the event of a major disruption to service – flooding, rolling stock malfunction, crime investigation – the ability to open/close turnstiles is an effective tool and often used.

4.) In general what are the pros and cons of fare gates in stations in regards to law enforcement?

Also see comment #2. Additionally, turnstiles assist transit police and subway operations staff in eliminating an 'out-of-control' environment and reducing fear by preventing crime which in turn increases ridership. The turnstile area allows for full enforcement of rules and regulations to maintain an orderly subway environment providing a clear line of in-system management (also known as the paid area) that limits the opportunities for crime.

5.) The electronic trip/ticket data that can be utilized to retrieve travel information from the backend/database system when a suspect uses a uniquely serialized ticket of smart card; is this of any help to back tracking where the suspect may been for law enforcement?

Law Enforcement agencies frequently use MetroCard usage/travel data in the investigation and prosecution of criminals. Watch a few reruns of the various *'Law & Order'* TV series which depicts similar use by real law enforcement in NYC.

6.) Please add any other comments as to fare gates in support of law enforcement...

It is simply a valuable tool used not only to improve fare collection revenue but a tool to help make transit systems safer overall.

ATTACHMENT D

TMD COST OF FARE EVASION

	Weekday				Total Weekday	Saturday			Total Saturday	Sunday			Total Sunday	TOTAL
	5a - 9a	9a - 3p	3p - 7p	7p - 11p		5a - 10a	10a - 6p	6p - 11p		5a - 10a	10a - 6p	6p - 11p		
Blue Line														
Average Ridership	19,386	20,845	26,343	6,404	**72,979**	10,547	31,810	10,714	**53,070**	6,640	26,841	8,613	**42,094**	**168,143**
Sample	744	1,155	783	368	**3,050**	436	1,131	370	**1,937**	230	986	297	**1,513**	**6,500**
Evasion Rate	3.09	4.85	4.85	11.96	**5.01%**	2.98	5.66	9.09	**5.82%**	10.43	6.59	11.78	**8.26%**	**6.08%**
Evasion Estimate	599	1,011	1,278	766	**3,654**	314	1,800	974	**3,089**	693	1,769	1,015	**3,476**	**10,218**
Annual Evasion	152,756	257,802	325,801	195,301	**931,660**	16,343	93,624	50,641	**160,608**	43,629	111,435	63,921	**218,985**	**1,311,253**
Estimated Annual Revenue Loss	***$190,945***	***$322,253***	***$407,251***	***$244,126***	***$1,164,575***	***$20,429***	***$117,030***	***$63,301***	***$200,760***	***$54,536***	***$139,294***	***$79,901***	***$273,731***	***$1,639,066***
Red Line														
Average Ridership	31,010	36,166	45,140	12,364	**124,680**	15,502	48,109	17,811	**81,422**	10,311	43,118	15,280	**68,709**	**274,812**
Sample	1,470	1,993	1,668	1,189	**5,131**	771	1,127	954	**2,852**	649	669	624	**1,942**	**9,925**
Evasion Rate	2.72	5.02	3.90	6.39	**4.18%**	4.28	5.86	8.7	**6.18%**	4.8	5.86	9.62	**6.54%**	**5.36%**
Evasion Estimate	843	1,816	1,760	790	**5,210**	663	2,819	1,550	**5,032**	495	2527	1,470	**4,492**	**14,733**
Annual Evasion	215,085	462,964	448,919	201,466	**1,328,434**	34,501	146,598	80,578	**261,676**	31,179	159,185	92,608	**282,972**	**1,873,082**
Estimated Annual Revenue Loss	***$268,856***	***$578,706***	***$561,148***	***$251,832***	***$1,660,542***	***$43,126***	***$183,247***	***$100,722***	***$327,095***	***$38,974***	***$198,981***	***$115,760***	***$353,715***	***$2,341,352***
Green Line														
Average Ridership	10,148	8,861	12,256	3,559	**34,825**	4,801	11,564	4,390	**20,755**	3,355	9,146	3,439	**15,940**	**71,519**
Sample	784	772	1,542	206	**3,304**	416	316	199	**931**	284	199	129	**612**	**4,847**
Evasion Rate	3.32	9.72	4.8	11.65	**6.32%**	5.77	10.13	8.54	**8.79%**	4.93	18.09	9.3	**13.42%**	**8.62%**
Evasion Estimate	337	861	588	415	**2,201**	277	1,171	375	**1,823**	165	1,655	320	**2,140**	**6,164**
Annual Evasion	85,914	219,639	150,010	105,737	**561,300**	14,405	60,914	19,495	**94,814**	10,420	104,237	20,146	**134,803**	**790,917**
Estimated Annual Revenue Loss	***$107,393***	***$274,549***	***$187,513***	***$132,171***	***$701,625***	***$18,006***	***$76,143***	***$24,369***	***$118,518***	***$13,025***	***$130,296***	***$25,183***	***$168,504***	***$988,646***
[illegible]														
Average Ridership	4,985	5,041	6,698	1,767	**18,492**	1,611	7,062	2,609	**11,281**	1,138	6,505	1,991	**9,634**	**39,407**
Sample	340	877	935	286	**2,438**	---	784	---	**784**	---	875	---	**875**	**4,097**
Evasion Rate	3.82	1.71	3.21	5.59	**3.19%**	---	4.21	---	**4.21%**	---	4.34	---	**4.34%**	**2.97%**
Evasion Estimate	190	86	215	99	**590**	---	297	---	**297**	---	282	---	**282**	**1,170**
Annual Evasion	48,562	21,983	54,826	25,185	**150,556**	---	15,460	---	**15,460**	---	17,787	---	**17,787**	**183,803**
Estimated Annual Revenue Loss	***$60,702***	***$27,479***	***$68,533***	***$31,481***	***$188,195***	---	***$19,324***	---	***$19,324***	---	***$22,234***	---	***$22,234***	***$229,753***
[illegible]														
Average Ridership	5,767	6,181	7,205	2,046	**21,199**	3,050	7,094	2,498	**12,642**	1,916	5,975	2,076	**9,967**	**43,808**
Sample	551	410	401	349	**1,711**	433	537	246	**1,216**	192	241	---	**433**	**3,360**
Evasion Rate	3.09	6.1	2.74	10.89	**4.60%**	6	4.47	9.76	**5.88%**	3.13	7.05	---	**6.10%**	**5.02%**
Evasion Estimate	178	377	197	223	**976**	183	317	244	**744**	60	421	---	**481**	**2,201**
Annual Evasion	45,438	96,147	50,342	56,826	**248,754**	9,515	16,488	12,680	**38,683**	3,779	26,537	---	**30,316**	**317,753**
Estimated Annual Revenue Loss	***$56,797***	***$120,184***	***$62,928***	***$71,033***	***$310,942***	***$11,894***	***$20,610***	***$15,849***	***$48,354***	***$4,724***	***$33,171***	---	***$37,895***	***$397,191***
SYSTEM TOTAL:	***$684,693***	***$1,323,170***	***$1,287,373***	***$730,643***	***$4,025,879***	***$93,455***	***$416,355***	***$204,241***	***$714,052***	***$111,259***	***$523,976***	***$220,844***	***$856,079***	***$5,596,009***

11/6/2007

Attachment C

LA Metro
Fare Evasion Assessment

Prepared for:

Metro

Metro Board
October 25, 2007

Prepared By:

TMD TRANSPORTATION MANAGEMENT & DESIGN, INC.

Supported By:

T.E.M.P.S., INC.

Independent Assessment - Fare Evasion Rates

All Metro Rail + Metro Orange Lines

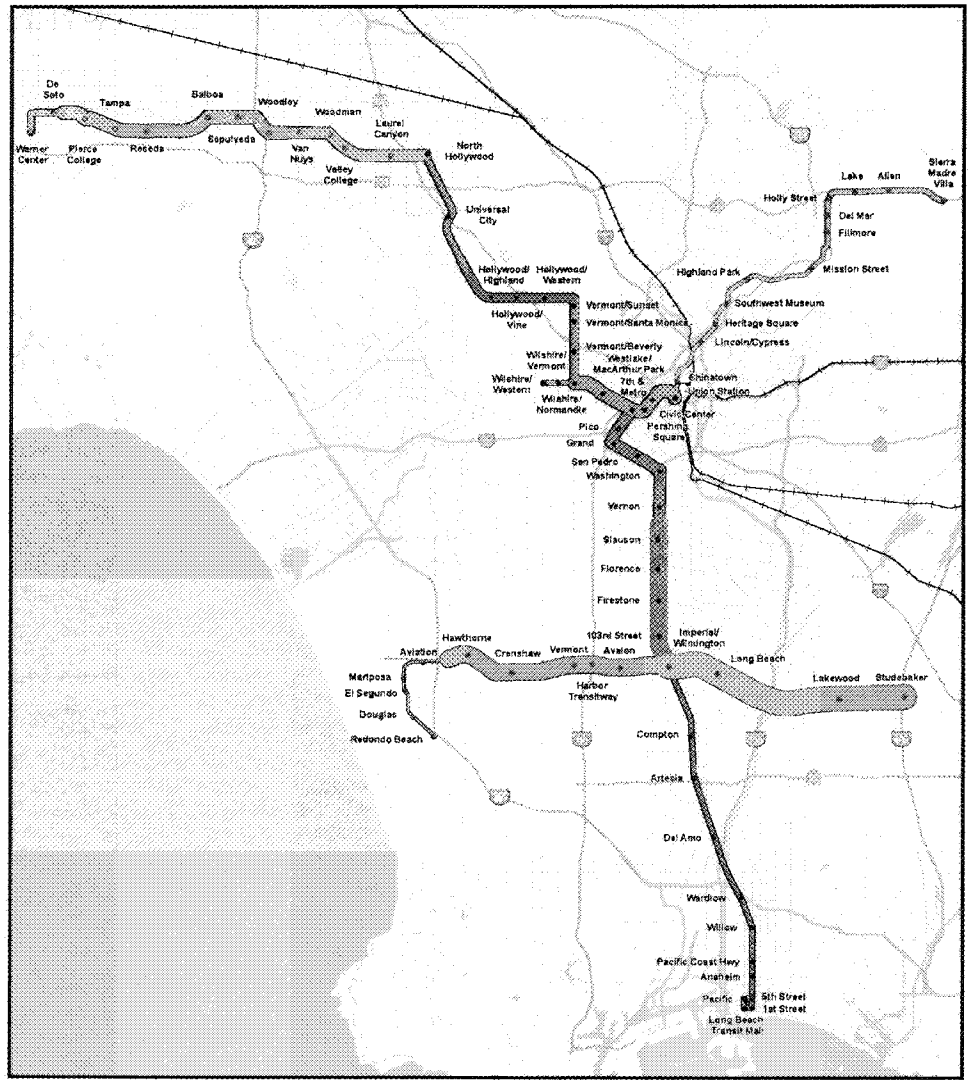
- Systematic sampling of Red, Blue, Gold, Green, Orange
  - **16 hours for weekday**
  - **8-12 hours for weekends**
- Inspection teams consisted of LA County Sheriffs, Metro Security with TMD staff recording findings
- Performed in "plain clothes"
- Passengers lacking correct fare were not fined
  - asked to leave the vehicle at the next station to purchase a ticket

Sample Recording

- 100% sampling of each train car or bus
- Recorded total load, total valid fares and areas of evasion:

  - Valid Ticket
  - No ticket
  - Incorrect Fare
  - Fraudulent ticket
  - Not cited for good reason
  - Metro employees with internal passes

Weekday



Los Angeles Metro Rail System Fare Evasion Study

Metro

Percentage of Total Vehicle Passenger Load Without a Valid Ticket or Pass

9.0% 8.0% 7.0% 6.0% 5.0% 4.0% 3.0% 2.0% 1.0%

Weekday

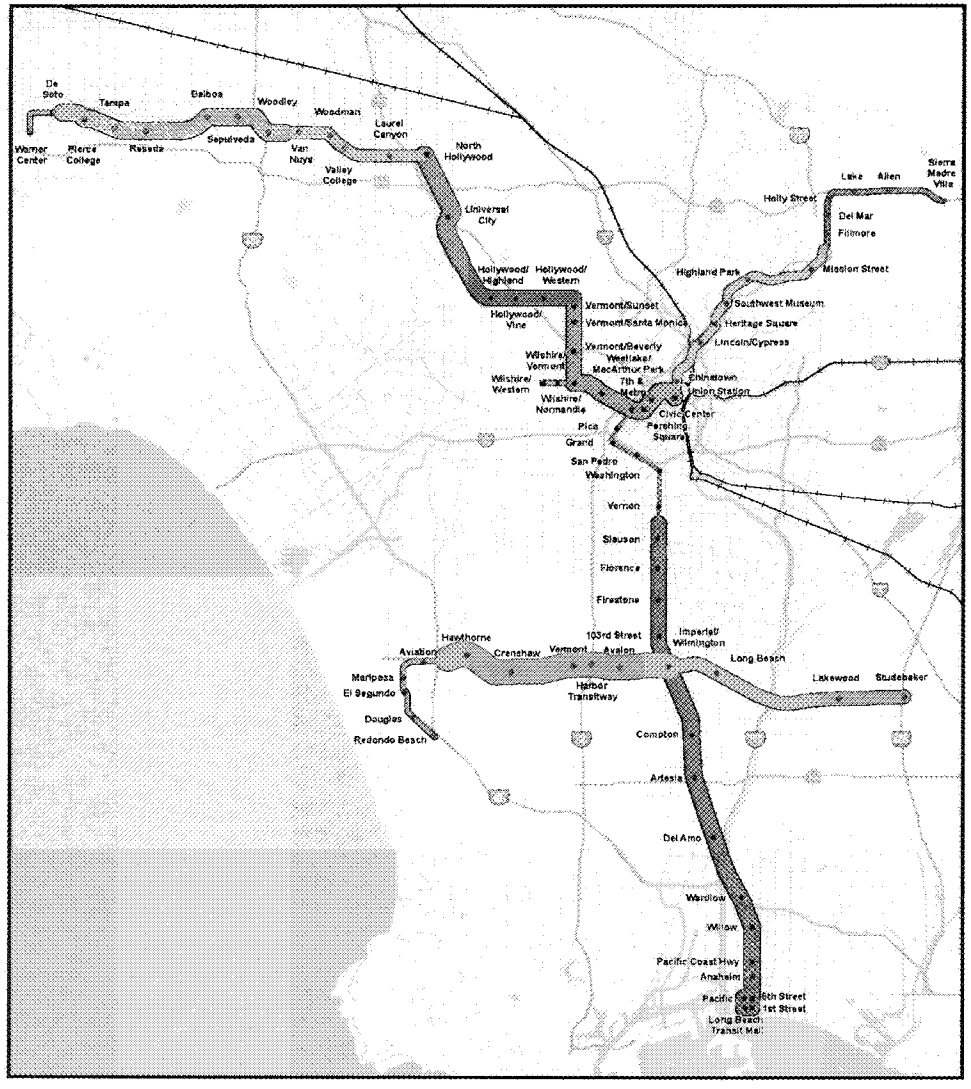
No Data Collected
Freeway
Major Road

Date Created
October 2007

0 2 4 Miles

TMD

Saturday



Los Angeles Metro Rail System Fare Evasion Study

Metro

Percentage of Total Vehicle Passenger Load Without a Valid Ticket or Pass

9.0% 8.0% 7.0% 6.0% 5.0% 4.0% 3.0% 2.0% 1.0%

Saturday

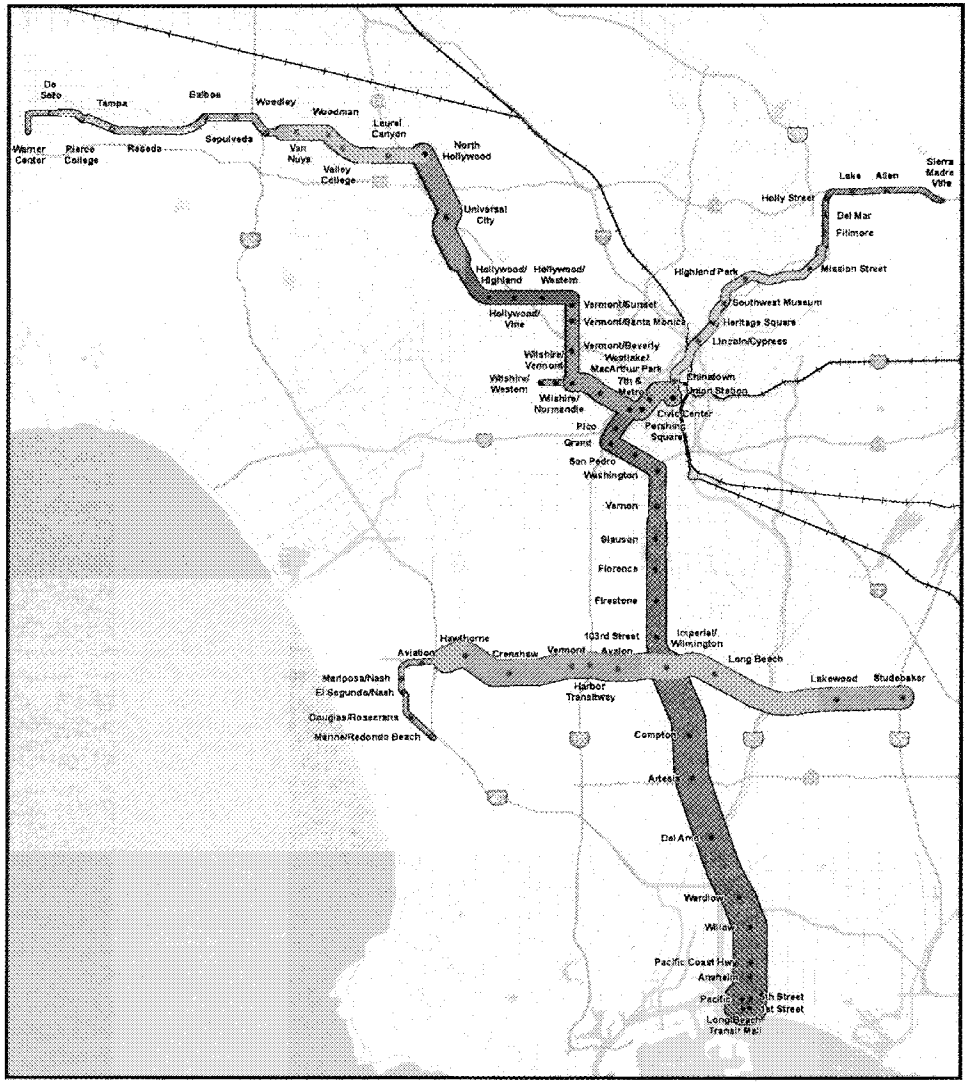
No Data Collected
Freeway
Major Road

0 2 4 Miles

TMD

Date Created
October 2007

Sunday



Los Angeles Metro Rail System Fare Evasion Study

Metro

Percentage of Total Vehicle Passenger Load Without a Valid Ticket or Pass

12% 11% 10% 9% 8% 7% 6% 5% 4% 3% 2% 1%

Sunday

No Data Collected
Freeway
Major Road

Date Created
October 2007

0 2 4 Miles

TMD

System Wide

Weekday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-9am	3,770	112	7	3,889	3.06%
9am-3pm	4,936	256	15	5,207	5.20%
3pm-7pm	5,111	192	26	5,329	4.09%
7pm-11pm	2,200	167	31	2,398	8.26%
Total:	16,017	727	79	16,823	4.79%

Saturday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	2,007	87	9	2,103	4.56 %
10am-6pm	3,676	163	56	3,895	5.62 %
6pm-11pm	1,575	140	14	1,729	8.91 %
Total:	7,258	390	79	7,727	6.07%

Sunday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	1,277	70	5	1,352	5.55%
10am-6pm	2,771	144	51	2,966	6.57%
6pm-11pm	943	82	25	1,050	10.19%
Total	4,991	296	81	5,368	7.02%

Overall Totals

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
Red	10,561	519	74	11,107	5.34%
Green	4,513	292	42	4,847	6.89%
Blue	6,068	322	70	6,460	6.07%
Gold	3,952	117	28	4,097	3.54%
Orange	3,172	163	25	3,360	5.60%
Overall Total for all Lines	28,266	1,413	239	29,918	5.52%

Key Systemwide Observations

- Overall evasion rates across all lines were
  - 5 percent Weekdays
  - 6 percent Saturdays
  - 7 percent Sundays
- Evenings systemwide had the highest evasion rates of 8-10 percent
- Midday weekday and weekend daybase also evasion of 5-7 percent.
- Peak period evasion rates lowest noted, between 3-5 percent.

Key Evasion Observations

- Overall evasion rates across all lines were dominated by no fares.
- Of those with incorrect fares, most were not adhering to the rules regarding transfers between lines.
- Fraudulent tickets were rarely seen, though harder to determine during onboard inspections.

Key Line Segment Observations

- Highest evasion noted on the Green Line
  - weekdays between Hawthorne and Norwalk,
  - weekends more between Hawthorne and Imperial/Wilmington
- Other higher evasion segments weekdays were:
  - Weekdays, Slauson to Imperial-Wilmington on Blue Line
  - Red Line between Union Station and Wilshire/Vermont
  - Orange Line
- Higher evasion more widespread geographically for weekends, covering the full length of most lines.
  - Exception with lower evasion rates was the Gold Line
  - Blue Line south of Imperial-Wilmington was high

Red Line

Weekday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-9am	1,430	40	0	1,470	2.72%
9am-3pm	1,893	94	6	1,993	5.02%
3pm-7pm	1,603	52	13	1,668	3.90%
7pm-11pm	1,113	68	8	1,189	6.39%
Total:	6,039	254	27	6,320	4.45%

Saturday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	785	30	3	771	4.28%
10am-6pm	1,061	46	20	1,127	5.86%
6pm-11pm	871	78	5	954	8.70%
Total:	2,717	154	28	2,852	6.38%

Sunday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	615	27	4	646	4.8%
10am-6pm	626	29	10	665	5.86%
6pm-11pm	564	55	5	624	9.62%
Total	1,805	111	19	1,935	6.72%

Green Line

Weekday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-9am	758	24	2	784	3.32%
9am-3pm	697	70	5	772	9.72%
3pm-7pm	1,468	69	5	1,542	4.80%
7pm-11pm	182	18	6	206	11.65%
Total:	3,105	181	18	3,304	6.02%

Saturday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	392	22	2	416	5.77%
10am-6pm	284	24	8	316	10.13%
6pm-11pm	182	16	1	199	8.54%
Total:	858	62	11	931	7.84%

Sunday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	270	14	0	284	4.93%
10am-6pm	163	28	8	199	18.09%
6pm-11pm	117	7	5	129	9.30%
Total	550	49	13	612	10.13%

Blue Line

Weekday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-9am	721	23	0	744	3.09%
9am-3pm	1,099	53	3	1,155	4.85%
3pm-7pm	745	36	2	783	4.85%
7pm-11pm	324	41	3	368	11.96%
Total:	2,889	153	8	3,050	5.28%

Saturday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	423	11	2	436	2.98%
10am-6pm	1,067	43	21	1,131	5.66%
6pm-11pm	300	25	5	330	9.09%
Total:	1,790	79	28	1,897	5.64%

Sunday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	206	23	1	230	10.43%
10am-6pm	921	47	18	986	6.59%
6pm-11pm	262	20	15	297	11.78%
Total	1,389	90	34	1,513	8.20%

Gold Line

Weekday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-9am	327	9	4	340	3.82%
9am-3pm	862	14	1	877	1.71%
3pm-7pm	905	25	5	935	3.21%
7pm-11pm	270	12	4	286	5.59%
Total:	2,364	60	14	2,438	3.04%

Saturday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	0	0	0	0	---
10am-6pm	751	27	6	784	4.21%
6pm-11pm	0	0	0	0	---
Total:	751	27	6	784	4.21%

Sunday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	0	0	0	0	---
10am-6pm	837	30	8	875	4.34%
6pm-11pm	0	0	0	0	---
Total	837	30	8	875	4.34%

Orange Line

Weekday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-9am	534	16	1	551	3.09%
9am-3pm	385	25	0	410	6.10%
3pm-7pm	390	10	1	401	2.74%
7pm-11pm	311	28	10	349	10.89%
Total:	1,620	79	12	1,711	5.32%

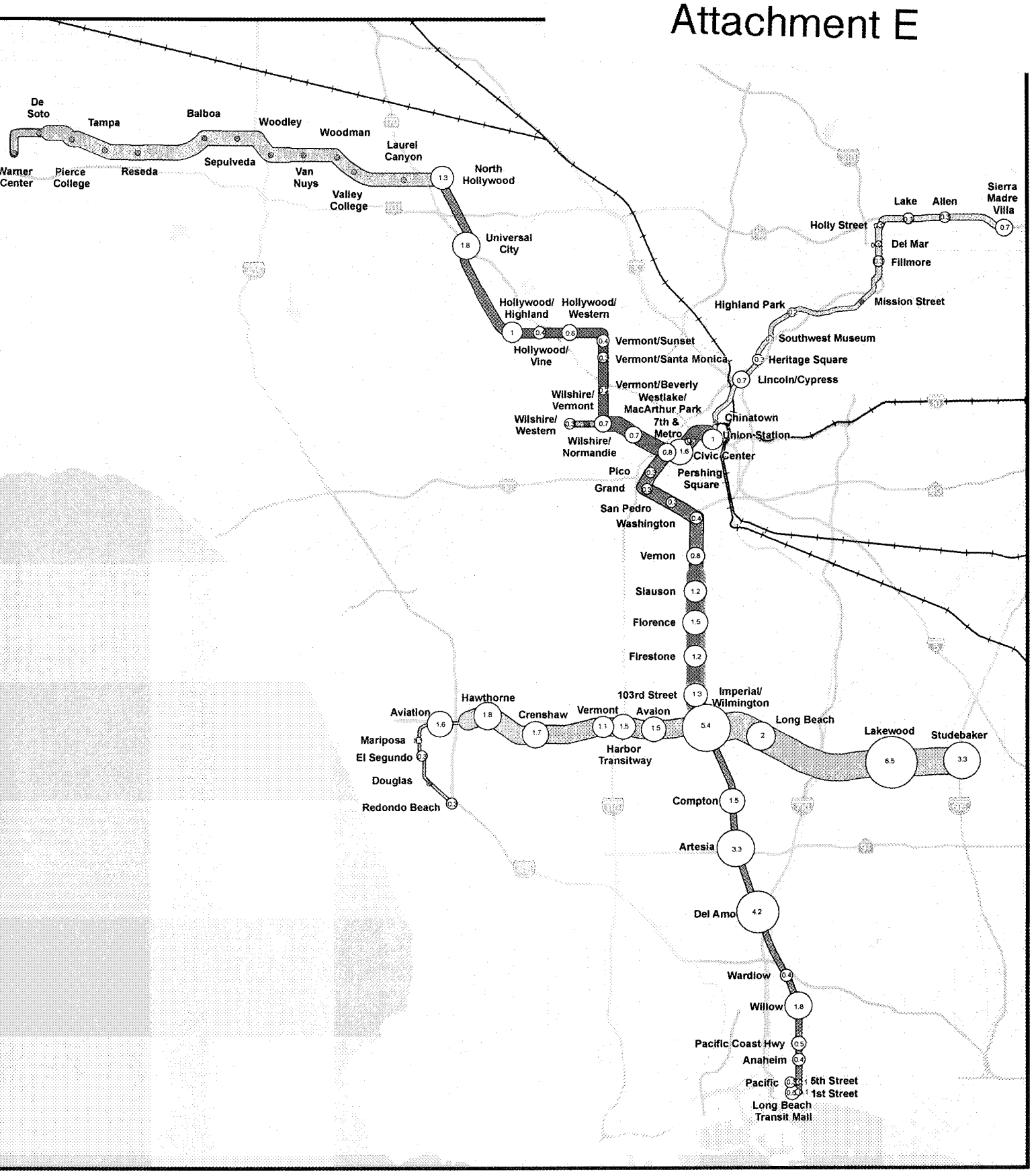
Saturday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	407	24	2	433	6.00%
10am-6pm	513	23	1	537	4.47%
6pm-11pm	222	21	3	246	9.76%
Total:	1,142	68	6	1,216	6.09%

Sunday

	Total Valid Fares	Total No Fares	Total Incorrect Fares	Total Checked	Percentage
5am-10am	186	6	0	192	3.13%
10am-6pm	224	10	7	241	7.05%
6pm-11pm	0	0	0	0	---
Total	410	16	7	433	5.31%

Attachment E



Los Angeles Metro Rail System Fare Evasion Study

Metro

Percentage of Total Vehicle Passenger Load Without a Valid Ticket or Pass

12% 11% 10% 9% 8% 7% 6% 5% 4% 3% 2% 1%

Weekday

No Data Collected
Freeway
Major Road

Crime Levels Per Month

0 2 4 Miles

Date Created
Novemeber 2007

ITMD

Executive Management & Audit Committee Item # 27
Operations Committee Item # 43

FINAL DRAFT

Metro Rail Gating Study

Los Angeles, California
November 15, 2007

Briefing Contents

- Executive Summary
- Methodology
- Option 1 Red Line only
- Option 2 Red Line and Green Line, and Strategic Stations
- Option 3 System-Wide Gating
- Summary

LACMTA Board has directed staff to study installation of fare gates on Metro rail and Orange lines to achieve the following key objectives

- Improve revenue recovery by reducing fare evasion
  - Fare evasion is currently estimated at 6% for a revenue loss of $2.6 million annually
- Enable alternative fare policies, such as distance based fare structure
  - Current fares are flat
  - Passengers are expected to pay for transfers
- Reduce vulnerability to terrorist threat and passenger perception of security

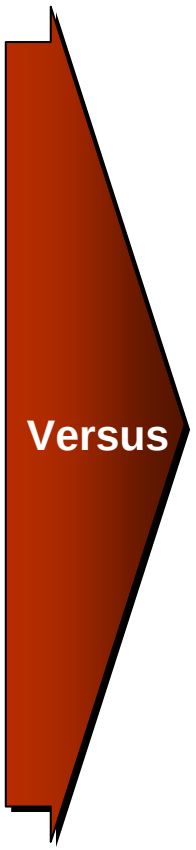
Booz Allen and Metro staff surveyed rail and Orange busway stations to determine the feasibility of installing faregates using the following criteria

- **Architecture and Infrastructure**
  - Adequate space for the number of gates required to serve ridership at each station
  - Infrastructure considerations, such as availability of communications and power
  - Adequate space leading to the gate (both in and out) to allow for passenger queuing
  - Passenger crowding along platform edges, trackways, curbs, planters, etc…
  - Sufficient space for TVMs, add-fare devices, and additional validators
- **Operations**
  - Passenger safety
  - Working space and access for maintainers, lifts, and other equipment
  - Emergency egress and access for police, fire and facilities maintenance
- **Fare Enforcement**
  - Effectiveness for fare enforcement
  - Ability to provide effective barriers separating paid from non-paid areas
  - Minimize potential for fare evaders to bypass gates

Gating the Metro stations balances the investment for physical barriers against the level of inspection required to decrease evasion levels

Fencing and Barriers

- Installing fare gates to automatically verify valid fare has been paid
  - Fare Gates
  - Tag-on validator located outside paid area
- Fencing to control access to paid area and control passenger flow
- Migrating customers to contactless smart card technology



Degree of Fare Inspection

- Manually verify fare has been paid
  - Readers on-board vehicles
  - Bus driver inspection
  - Fare inspection force
- Fare inspection effectiveness is driven by the court's enforcement when a violation has occurred

Based on the station surveys, number of passengers captured, and operational impacts, three implementation options were developed

	DESCRIPTION	KEY DRIVERS
Option 1	Installs gates on the Red Line only	*Red Line subway was originally designed for fare gates* *–Sufficient space for gates* *–Existing infrastructure* *–Sheltered location* *Fare inspection needs to be maintained at current levels on light rail lines*
Option 2	Expands physical gating across the Green Line and includes strategic stations on the Blue and Gold Line	*Focus is on light rail stations that require minimum infrastructure modifications* *Number of fare inspectors further reduced*
Option 3	Installs gates at all Metro rail line where architecturally NOT constrained	*At grade stations most challenging and costly to physically gate* *Bringing power and communications, weather shelter to fare gate and relocated TVM locations is the most costly component*

The cumulative results of the station surveys resulted in the following physical gating strategy

Implementation Scenario	Physical Gating Strategy	Number of Gates	Passengers Checked at Gates During Their Journey
Option 1	Red Line only	154 gates	59%
Option 2	Red and Green Line, and strategic light rail stations	275 gates	84%
Option 3	All Metro Stations, not architecturally constrained	394 gates	98%

- All fare media will be based on contactless smart card technology
- For those stations where a physical barrier is not installed, a single tap-on validator or a series of tap-on validators will be strategically placed so that passengers can validate their fare media

The business case for gating is based on reducing the fare inspection force and improving fare evasion rates and increasing fare recovery. Options to "buy" or "lease & maintain" were analyzed.

CAPITAL ACQUISITION MODEL	Option 1 Red line only	Option 2 Red & Green Lines	Option 3 All Metro Stations
Direct capital cost – ONE TIME			
Equipment	$9 million	$15.3 million	$18.4 million
Civil Station Modifications*	$12.4 million	$30.9 million	$46.4 million
Net Change in Annual Operating Costs			
Maintenance	$0.5 million	$1.0 million	$1.2 million
Police patrolling, fare inspection	$1.4 million	$2.4 million	$2.8 million
Customer Service	$0.5 million	$0.7 million	$1.1 million
Annual Benefits			
Contracted civilian inspectors	($7.06) million	($7.06) million	($7.06) million
Reduced fare evasion	($2.7) million	($3.8) million	($4.5) million
Net Decrease Annual Cost	**($7.30) million**	**($6.77) million**	**($6.47) million**

The business case for gating is based on reducing the fare inspection force and improving fare evasion rates and increasing fare recovery. Options to "buy" or "lease & maintain" were analyzed.

LEASE & MAINTAIN MODEL	Option 1 Red line only	Option 2 Red & Green Lines	Option 3 All Metro Stations
Direct capital cost – ONE TIME			
Civil Station Modifications*	$12.4 million	$30.9 million	$46.4 million
Net Change in Annual Operating Costs			
Equipment Lease & Maintenance	$2.01million	$3.51 million	$4.27 million
Police patrolling, fare inspection	$1.4 million	$2.4 million	$2.8 million
Customer Service	$0.5 million	$0.7 million	$1.1 million
Annual Benefits			
Contracted civilian inspectors	($7.06) million	($7.06) million	($7.06) million
Reduced fare evasion	($2.7) million	($3.8) million	($4.5) million
Net Decrease Annual Cost	**($5.81) million**	**($4.23) million**	**($3.40) million**

* includes 30% contingency

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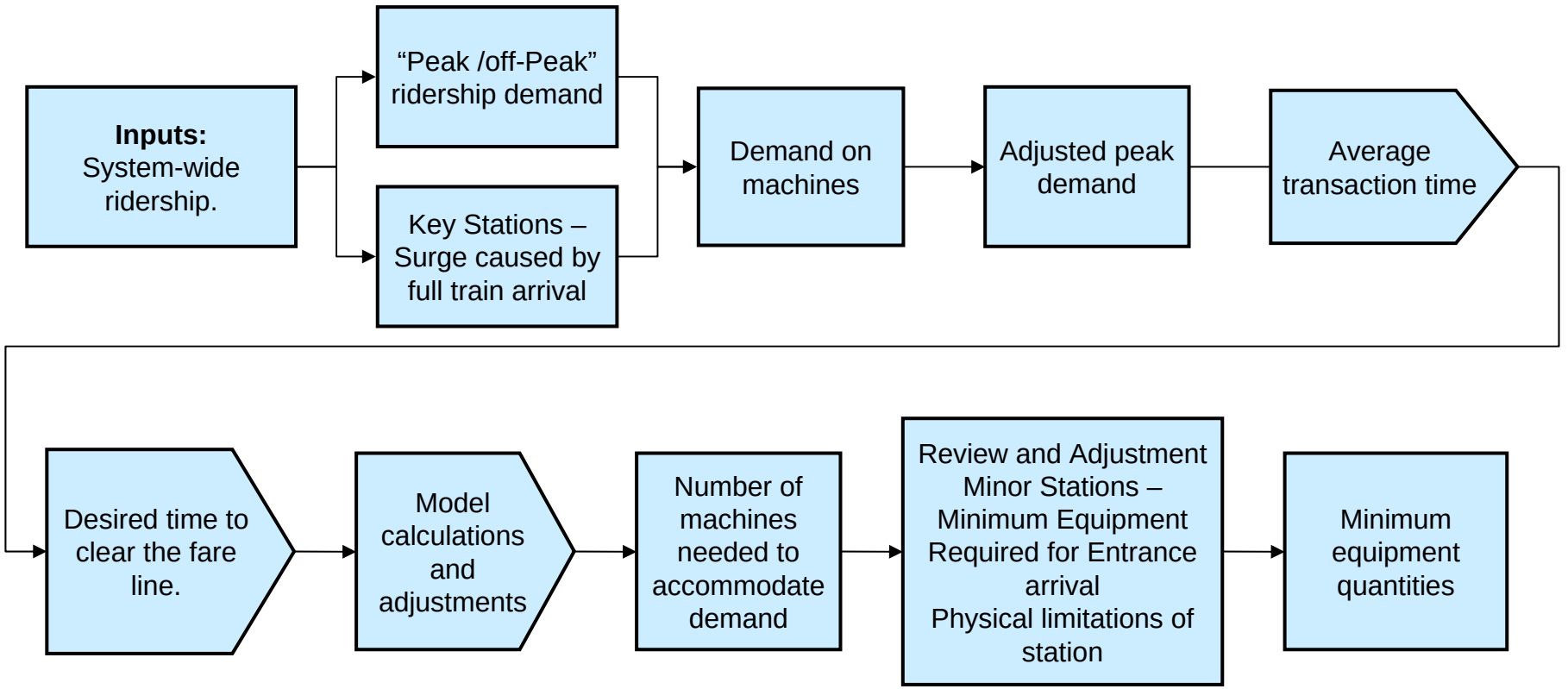
Booz Allen provided an assessment of the benefits and costs of gating the Metro rail lines based on an evaluation of multiple factors

- **Faregate Configuration** – Reviewed the types of faregates available and some advantages and disadvantages, including implications of fire safety standards for gating
- **System Configuration** – Provided information on faregate configuration by station based on the results of station surveys and the transactions which will be sent to the TAP back-office as a single integrated system
- **Equipment Quantities** – Identified equipment quantities required based on ridership levels and transaction times
- **Fare Media and Tariff Options** – Identified impact on fare media and tariff options by reviewing the implications for fare media and fare policy options of gating the rail system
- **Qualitative Impact on Passengers** – Demonstrated the impact that gating will have on passengers' interactions with the Metro Rail System
- **Impact on Fare Evasion and Inspection** – Evaluated the potential to reduce fare evasion by gating rail stations
- **Cost Estimates** - Identified both direct and indirect costs of gating the Metro Rail System.

The methodology used to analyze gating the Metro System consisted of the following key steps

- Each line has unique characteristics that impact how it is gated. Therefore, an analysis of each line considering the following was being completed:
  - Physical (Architectural) features drive the gating configuration
  - Infrastructure such as power and communications availability
  - Operational characteristics that impact passenger throughput
- The most common types of fare gate designs were evaluated
- The survey data formed the basis for developing a detailed cost model to serve as a bench mark for evaluating supplier proposals and providing an independent estimate for Metro
- Key data input was provided by Metro for the following items:
  - TMD fare evasion report for most recent fare evasion rates
  - Current cost of fare inspection services

The basis for the capital investment used in the cost model was determined by analyzing the operational characteristics of each station



The equipment quantities may be adjusted during the detailed station design process to ensure meeting emergency egress requirements

Each possible fare gate design was evaluated against the following criteria

Cost	The capital costs associated with the gate procurement and operating cost resulting from reliability.
Throughput	The maximum number of passengers that can flow through the gate in an ideal situation (throughput is dependent upon the processing of the fare media).
Ease of Use	The likelihood of an inexperienced patron being able to use the gate in an efficient manner.
Durability	The ability of the gate to sustain operation in an exposed marine environment, due to the proximity of Green Line stations to marine air.
Reliability	The ability of the gate to sustain operation while requiring a minimal level of maintenance.
Security	The level of protection offered against would-be fare evaders (gate jumpers).
Bicycle/ADA	The ability of the gate to accommodate patrons with bicycles and in wheelchair access
Aesthetics	The way in which the physical appearance of the gate is commonly perceived by the public.

Each Metro Line has unique characteristics that drive the investment and required modifications to infrastructure

- **Red Line –**possible to completely gate all stations, because the stations have been designed for gating
- **Blue Line –** there are stations where physical gating is possible, add fencing and barriers to direct passengers to dedicated corridors, use strategically placed smart card validators for tag-on
- **Green Line –** all stations can be physically gated, placing fencing and barriers to direct passengers to dedicated corridors will improve operations
- **Orange Line –** place fencing and barriers to direct passengers to dedicated corridors with validators
- **Station related Fare Policy –** transfers should not be an issue with the use of smart cards and limited use cards
  - To accommodate transfers to and from Metrolink, placing a smart card validator in Metrolink stations to record the ride is required
  - Gating will enable the adoption of a distance based fare structure in the future

The following three baseline implementation options where developed for cost modeling

Option 1
Red Line only

- Gate all Red Line stations

Option 2
Red and Green Line, Strategic Light Rail Stations

- Gate all Red Line stations
- Gate all Green Line stations
- Blue Line, 6 stations
  - Imperial
  - Slauson
  - Firestone
  - Compton
  - Artesia
  - Del Amo
- Gold Line, 3 stations
  - Sierra Madera
  - Allen
  - Lake
- Improve validator placement at remaining light rail stations

Option 3
Gate all Metro Stations

- Gate all Red Line stations
- Gate all Green Line stations
- Blue Line, all stations except
  - Transit Mall
  - 1st Street
  - 5th Street
  - Pacific
  - Florence
- Gold Line, all stations except
  - Mission
- Improve validator location at exception stations

The cost model included the following key elements:

Capital Investment

- Supplier provided equipment
- Engineering station modifications
- Civil construction station modifications
- Passenger communications
- Additional CCTV surveillance
- Project management
- Contingency

Operating Cost Impacts

- Maintenance of gates
- Fare inspection and enforcement at gates
- Customer service

Revenue Impacts

- Reduced fare evasion
- Increased fare recovery
- New fare policies

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Option 1 requires the installation of turnstiles on the Red Line only

- The Red Line subway was originally built to accommodate future gates, therefore, there is sufficient physical space available to install the fare gates
- Existing infrastructure, such as power and communication, accommodates gating
- Faregates would be installed in sheltered locations, reducing maintenance and weather-related problems

Option 1 presents the lowest implementation challenges, however the lowest passenger rate of capture

- All other stations would require additional validators in convenient locations
- Additional fencing would be provided at all stations to channel passengers to gates and resist fare evasion
- Fare inspection will need to be maintained at current levels on the light rail lines to maintain or reduce fare evasion
- Gating the Red Line will only capture 59% of the passengers entering Metro

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Option 2 expands physical gating across the Green Line and includes strategic locations on the Blue and Gold Line

- The focus of Option 2 is to gate those stations that only require a minimum level of infrastructure modification
- The number of inspectors patrolling Metro system-wide will be further reduced
- Gating both Red and Green Lines, and strategic locations on the Blue and Gold Line, will capture approximately 84% of the passengers entering the Metro Rail system

Option 2 presents several challenges for gating across Green, Gold, and Blue lines

- Some stations have narrow passages or walk ways that restrict space for gates
- Some stations have multiple entries
- Emergency egress and surges due to multiple trains arriving in close succession need to be explored in detail

Briefing Contents

- Executive Summary
- Methodology
- Option 1 Red Line only
- Option 2 Red Line and Green Line, and Strategic Stations
- Option 3 System-wide Gating
- Summary

Option 3 requires the installation of gates at the majority of Metro rail lines

- Due to space constraints and architectural features, gates at grade-level stations may be difficult to install
- There is insufficient space at some stations to provide fare gates and emergency egress gates
- Many stations have no provision for gates, and will require underfloor duct, fencing, and other modifications to establish paid areas
- The capital cost of civil work includes major construction required to bring power and communications to turnstyles, and the addition of shelters over gated areas

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Summary - Gating the Metro Rail system will present advantages and a reduction in net operational costs over the life cycle of the equipment

- The business case for gating Metro Rail assumes one time capital and civil investments which are overcome through cost savings realized from reduction in fare inspection expenditures
  - This investment over the life cycle of the equipment will result in cost recovery from fare evasion
- In addition, other fare recovery strategies, distance based and congestion pricing fare structures can then be implemented
  - Fare policies, such as enforcement of rail-to-rail transfer payments can then be implemented
  - Bank card programs and cell phone technology will have easy transitions with gate infrastructures in place as these future programs are developed
- Gating the Metro system will allow future retrofit to include advanced detection technologies increasing passenger security

Booz Allen identified the following next steps

- Complete line by line conceptual design for gating
- Identify fare policies that need to be changed and new fare policies that need to be added for gating
- Develop implementation plan and schedule