Transit Fare Review Phase 3 Technical Backgrounder: Summary Evaluation of Options for Fares by Distance

November 14, 2017

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1 Introduction

In mid-2016 TransLink launched a comprehensive four-phase review of the way we price transit in Metro Vancouver. Phase 1 sought to understand customers' concerns and issues regarding the current fare structure and ideas for a future fare structure. The majority of residents we heard from across Metro Vancouver told us the current fare system does not work well. The public's desire for change combined with the new opportunities provided by the Compass system offer an opportunity to review the way we price transit in Metro Vancouver to improve the overall customer experience.

Phase 2 presented a broad range of options for varying fares by distance travelled on the transit system, among other components. Now in Phase 3, the number of options for varying fares by distance has been narrowed down to two. The options being presented to the public and stakeholders for consideration are:

C1) Fares priced by km on rapid transit and flat fare on bus
(Option 1 in Phase 3 Discussion Guide)

C2) Fares priced by km across the transit system
(Option 2 in Phase 3 Discussion Guide)

The Phase 3 Discussion Guide provides a summary of the two shortlisted options. This document complements the Discussion Guide by presenting the evaluation of the longer list of options for pricing by distance, and the shortlisting process that led to the two options presented in the Discussion Guide. The public feedback received in Phase 3 will be used to help evaluate the two options and determine the preferred solution.

1.1 Transit Fare Review goal and objectives

The overall goal of the Transit Fare Review is to explore changes to the fare structure that will improve the customer experience. The following objectives support this goal and have been used to guide the evaluation:

- Make it simple to learn and use
- Make it fair
- Keep it affordable and minimize the negative impacts of fare changes
- Grow ridership
- Improve service by making the system more efficient and reducing overcrowding
- Maintain revenue to operate the system

> The Fare Review aims to maintain the current revenue stream. Since each option compared here raises the same amount of revenue, revenue was not included as a separate criterion. In this way, each option is evaluated according to how it influences the distribution of fare costs across users rather than its ability to raise extra revenue.

1.2 Current approach to pricing by distance

Since 1984, zones have been used as a proxy for distance travelled when calculating fares in the region. This system divides the region into three zones, and fares are calculated according to the number of zones that you travel through.

Figure 1 - Current Fare Zone System for SkyTrain and SeaBus

In October 2015, zones were temporarily eliminated on buses so that all bus-only trips became a one-zone fare regardless of the distance travelled or zones crossed. This was done to facilitate the rollout of the Compass Card to the general public.

In Phase 1 of the Fare Review, survey results indicated that 27% of residents think the current 3-zone fare structure works well. A number of shortcomings were raised with the current system that are perceived as unfair:

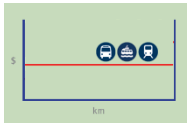
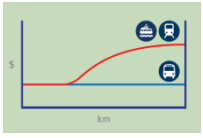
- The zone boundary penalty in which short trips crossing a zone boundary must pay a two-zone fare,
- There is a steep jump in price when crossing each zone boundary,
- Large zones do not accurately reflect distance travelled, and
- Zone boundaries are inherently arbitrary.

1.3 Options for fares by distance

For Phase 3, we investigated a range of options for fares by distance to address issues of fairness. Three main options, with associated variations, are listed below and summarized in Table 1:

A. *System-wide flat fare* – price all trips the same regardless of distance travelled
B. *Refined zones* – adjust the number and placement of zones and fare rules to address boundary issues through either:
    1. A modified 3 zone system with overlapping zones; or
    2. A new zone system with approximately 22 zones and a two-zone base fare (meaning first zone crossing is free)
C. *Measured distance* – vary fares based on the measured distance between journey origin and destination through:
    1. Measured distance by km travelled on rapid transit, with a flat bus fare (Option 1 in the Phase 3 Discussion Guide)
    2. Measured distance by km system-wide, including buses (Option 2 in the Phase 3 Discussion Guide)

Table 1: Summary of Fare by Distance Concepts

Fare by Distance Concepts		Bus Fares	Rapid Transit Fares*
A) System-wide flat fare			
One flat fare to travel anywhere on the system within the allowable transfer period. Free transfers between vehicles and modes		Flat	Flat
B) Refined zones			
B1) Modified 3-zone system with overlapping zones A 3-zones system similar to today that applies to both bus and rapid transit. Each zone overlaps slightly with the adjacent zone[1]. The overlapping area is a common zone that counts as an extension of each adjacent zone. Trips to and from the common zone to adjacent zones are treated as one zone fares.		By zones	By zones
B2) New 22-zone system with two-zone base fare New zone system with approximately 22 zones that apply to bus and rapid transit. Base fare covers first two zones[2], with fares increasing for each additional zone travelled.		By zones	By zones
C) Measured distance			
C1) Fares priced by km on rapid transit and flat fare on bus (Option 1 in the Discussion Guide) Rapid transit fares include a base distance and fares would increase with additional kilometres travelled after the base distance. Unlimited bus travel is included in rapid transit fare before and after rapid transit trip within 90 minute transfer window.		Flat	By km
C2) Fare priced by km across the system (Option 2 in the Discussion Guide) Fares are calculated based on the total distance travelled on all modes, with no added transfer charge between modes or vehicles.		By km	By km

*Fares for SeaBus would work the same as for the rapid transit system.

[1] This concept is similar to the former fare structure in which some locations, such as Annacis Island in the Fraser River, were identified as a Common Zone (Zone 2/3).

[2] The two-zone base fare concept is similar to the previous HandyDART structure, which consisted of 10 zones with the first zone boundary crossing was free and a max of a 3-zone fare.

2 Option evaluation

2.1 How we did the evaluation & inputs to the evaluation

A multiple criteria analysis was undertaken to evaluate the proposed options for varying fares by distance. Multiple criteria analyses are used to help make more informed decisions when undertaking complex projects. A variety of methods were employed to evaluate the options, including:

- Public and stakeholder consultation in Phases 1 and 2 (the current round of public consultation will also be used to inform the final decision)
- User experience testing with the public assessing simplicity, legibility, fairness, and predictability of fares by distance concepts
- Technical analysis on the feasibility, operational and customer experience impacts of tapping out on buses, as well as a review of emerging technology that facilitates charging by distance travelled on bus without requiring customers to tap out
- Scan of future payment technologies and public transit trends to ensure any new fare structure is future-ready
- Ridership and revenue modelling broken down by demographic group, household income, geography and trip type

The performance of options across objectives and evaluation criteria was compared to understand how the options perform relative to each other and to identify key trade-offs.

2.2 Objectives and evaluation criteria

The objectives of the Transit Fare Review were broken out into more specific criteria to provide a means of assessing the performance of the different options relative to today's fare structure. Each of the Transit Fare Review objectives are influenced differently across the options. Other important considerations such as public support to date and ease of implementation were also added to the evaluation as these influence the larger goals and objectives of the Transit Fare Review. The objectives and associated evaluation criteria are described in the table below. All options are designed to be revenue neutral, so revenue was held constant across the options and not included in the criteria below.

Table 2: Objectives and Criteria Used for the Options Evaluation

Objectives	Evaluation Criteria	Brief description
Make it simple to learn and use	Logical and intuitive to understand	The ease with which one can understand the underlying logic and general rules of the fare structure
	Usability & predictability	How easy the fare structure is to use, and how easy it is to predict fares for unfamiliar trips
Make it fair	Alignment with user pay principle	Proportion of and degree to which fares align with distance travelled. This principle is endorsed in both the Mayors' Council10-Year Vision and the Regional Transportation Strategy
	Addresses customer concerns over the zone boundary penalty, arbitrary boundaries and steep jump in fares	The degree to which zone boundary issues are addressed, as well as the jump in fares between trips of different geographies and lengths.
	Fares aligned with a mode's quality of service	Degree to which fares reflect level and quality of service and perceived value to the customer
Keep it affordable	Minimize negative impact of fare changes	Proportion of trips whose fares will increase, decrease or stay the same and by how much.
Grow ridership and transit use	Ridership (% change from current system)	Forecasted ridership when the option is implemented under a revenue neutral scenario.
	Transit use - PKT (transit Passengers Km Travelled - % change from current system)	Forecasted number of total kilometres travelled by all passengers on all transit vehicles. This measure supplements ridership with information on how far passengers are travelling.
Public support to date	Level of public support to date	Level of public support to date indicated in previous phases of the Transit Fare Review.
Impact of implementation	Near term ease of transition on customers and amount of change	Degree of change for customers, including learnability of new system, customer education, new customer behaviour, technology requirements, and adjusting to new ways of using the transit system
	Technical cost, risk and complexity	Upfront cost, technical complexity and risk to implement.

2.3 Summary of the evaluation

Table 3 – Summary of evaluation of fare by distance options

Scale (evaluated relative to current system)		Much worse	Worse	Neutral	Better	Much better
		Options				
Objectives	**Criteria**	Current system (3-zones for rapid transit, flat fare on bus)	A) System-wide flat fare	B1) Refined zones - 3 overlapping zones	B2) Refined zones - 22 zones with 2-zone base fare	C1) Fares priced by km on rapid transit and flat fare on bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
Make it simple to learn and use	Logical and intuitive to understand	-	Much better	Worse	Worse	Better	Much better
	Usability & Predictability	-	Much better	Worse	Worse	Worse	Much worse
Make it fair	Alignment with user pay principle	-	Much worse	Neutral	Better	Better	Much better
	Addresses customer concerns	-	Better	Better	Better	Much better	Much better
	Fares aligned with a mode's quality of service	-	Neutral	Neutral	Neutral	Better	Neutral
Keep it affordable	Minimize negative impact of fare changes	-	Much worse	Neutral	Worse	Neutral	Worse
Grow transit ridership and use	Ridership (% change)	-	2-3% decrease	No significant change	No significant change	No significant change	No significant change
	Transit Use - (PKT - % change)	-	No significant change	1% to 2% decrease	No significant change	1% to 2% decrease	2% to 3% decrease
Public support to date	Level of public support to date	-	Much worse	Worse	Worse	Much better	Better
Implementation considerations below evaluated on an absolute scale							
Ease of implementation considerations	Near term impact of transition on customers	-	Low	Moderate	Moderate	Low	Moderate
	Technical cost, risk & complexity	-	Low	Moderate	Moderate	Low	Moderate-High

A more detailed evaluation including scoring of the sub-objectives for all options can be found at the end of the document.

2.4 Shortlisting of the options

Phase 2 consultations presented three options for how to vary fares by distance for public feedback (system-wide flat, refined zones and varying fares by measured distance). The Phase 3 Discussion Guide presents a more detailed and thorough description of the two shortlisted measured distance options.

To present these options and inform the public in an easy-to-follow and understandable way, a Phase 3 Discussion Guide was created with a summary of only the two shortlisted options. This section describes the details of the evaluation and shortlisting process that led to the advancement of these two options. It also provides more detail on the two shortlisted options and explores some of the trade-offs between the two.

There is no single option that performs best across all the objectives, and thus trade-offs must be made between competing objectives. The options were evaluated based on how they met the objectives as a whole, in addition to how well they satisfied key challenges identified in Phase 1 of the Fare Review.

A) System-wide flat fare

A system wide flat fare (Option A) is not being advanced by TransLink for consideration in Phase 3. A flat fare would increase prices by more than 20% for two-thirds of trips. This increase in fares would be across Metro Vancouver, with at least half of the trips in each municipality increasing in price. The flat fare would increase the cost for one zone trips that already pay the highest average price per kilometre travelled under the current system. Finally, a revenue neutral fare level would reduce overall transit ridership by 2% to 3%.

In addition to ridership and price impacts, a system-wide flat fare was not supported by the Phase 1 survey results, in which 70% of respondents indicated that fares should be lower for shorter trips and higher for longer trips. The higher fares for long trips, particularly on rapid transit, reflect the higher perceived value provided to the customer, and better support the regional transportation strategy that calls for transportation to be priced closer to what people use. Finally, Phase 1 consultation respondents identified a lower fare for shorter trips as a key consideration for a new fare structure. While a system-wide flat fare has been rejected, a flat fare on bus is still viewed as a viable option because it is widely supported by the public and simplifies the fare structure.

B) Refined zone options

No refined zone options are being advanced by TransLink for consideration in Phase 3 on the basis that they were neither simple nor fair. Incremental modifications to the current 3 zone system that proposed overlapping zones (Option B1) were explored, and it was determined that they did not sufficiently address the fairness issues identified in the current system. Furthermore, the overlapping zones were complicated to explain and recreated zone boundary issues in new locations.

Zone-based systems are made fairer by increasing the number of zones; however, an increase in zones also increases the level of complexity for customers. The number of zones required to alleviate issues such as the zone boundary penalty and reduce large jumps in fares resulted in a highly complex and illegible system with about 22 zones (Option B2).

Results of user experience testing showed that people found the refined zone options compromised simplicity while still being perceived as less fair than measured distance options. In addition, as the zones become smaller, the boundaries become less legible and harder to remember, decreasing the efficacy of zones in helping to predict fares. The Phase 2 survey results supported these findings, with participants expressing that zones are widely perceived to be confusing and difficult to interpret.

C) Measured distance options

Options C1 and C2 offer a logical and intuitive way to price fares by distance that does not rely on arbitrary zone boundaries and high jumps in fares. Although customers are often not familiar with the exact distance they are travelling on public transit, the concept of paying by distance travelled is both intuitive and familiar from other modes of transport such as taxi fares. Both options score highly on the fairness scale by addressing the problems with the current system. The options also enjoyed strong public support, at least for varying fares by measured distance on the rapid transit system.

Compared to the current system, both Option C1 (fares priced by kilometre on rapid transit and flat fare on bus) and Option C2 (fares priced by kilometre across the system):

- **May be more fair:**
  - trips of the same length on the same mode cost the same amount
  - Offer more gradual pricing with no steep jump in fares
- **May better reflect the user-pay-principle:** the more transit service you use, the more you pay
- **Are well supported in principle**: 61% of survey respondents in Phase 2 support measured distance for rapid transit

Several iterations of the measured distance concepts were initially considered and evaluated in addition to Options C1 and C2, including **pricing by kilometre with a base fare, but no maximum fare**. This option was rejected for a number of reasons:

- The lack of a maximum fare results in significant price increases for longer distance trips which reduces transit ridership and increases auto usage (measured by vehicle kilometres travelled). These outcomes do not support key regional objectives around reducing auto usage.
- The lack of a maximum fare reduces the predictability of the fare structure, especially for longer trips.

Options C1 and C2 both include a base fare that covers a base distance and a maximum fare. As described above, a maximum fare helps to ensure transit remains competitive with private automobile travel, especially for longer distance trips. A base fare helps to maximize predictability for short trips, while also minimizing the degree to which transit competes with walking and cycling for short trips (increasing walking and cycling mode share is a key objective of the Regional Transportation Strategy). The final prices for these components, including the price curve between the base and maximum fare, will be considered in more detail in Phase 4.

Options C1 and C2 have both been presented as fare by kilometres measured in 1km increments in the Discussion Guide, where the fare increases by a certain number of cents for each kilometre travelled. The increments for fare increases will be further refined in Phase 4, and the result could be a structure where the fare increases with every 3, 5 or 7km travelled (which are sometimes called distance "bands"). Different cities worldwide have various increments for increasing fares, from 1km (or 1 mile) increments in Singapore and Washington, DC, to 5-7km increments in Sydney, Australia. Larger increments may provide better legibility and increased predictability of fares through fewer price points for customers, but larger distance increments need to be weighed against the impact of larger jumps in fare between the different distance increments.

Option 1 in the Discussion Guide indicated all buses would be priced with the same flat fare. It is possible that some routes, such as long distance express buses, could be priced per kilometre travelled or have a higher flat fare, reflecting the fact that they tend to involve much longer trip lengths and some are of a higher quality of service. If Option 1 is selected, this will be explored more in Phase 4.

Table 4: Options evaluated in Phase 2 and advanced for public consultation in Phase 3 (green options)

	A) System-wide flat fare	B1) Refined zones - 3 Overlapping zones	B2) Refined zones - 22 Zones with 2-zone base fare	C1) Fares priced by km on rapid transit and flat fare on bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
Advanced for further consideration	🔴	🔴	🔴	🟢	🟢

3 Detailed comparison of the shortlisted options

Based on the detailed evaluation, two measured distance options were selected for further investigation and consultation in Phase 3. This section describes the detailed evaluation of the two measured distance options: Option C1 *Measured distance by km on rapid transit and flat bus* and Option 2 *Measured distance by km system-wide,* using the main criteria described earlier in this document.

> For simplicity, the current analysis is based on adult stored value fares on the conventional transit system (bus, SkyTrain, Canada Line and SeaBus). Concession fares, pass products, HandyDART fares and transfers, West Coast Express fares and transfers and the YVR AddFare are not included in this backgrounder and will be addressed in Phase 4.

Fare Curves

Both proposed options are based on revenue neutral pricing that will provide the same overall revenue as the current fare structure. Both options have a base fare that includes a base distance of about 5 km, with the fare increasing until a maximum adult stored value fare of about $4.30 is reached.

The two options for varying fares by distance have contrasting prices for most trips. This is a result of the difference in how bus trips are priced. In Option C1 (fares priced by km on rapid transit and flat fare on bus) the flat bus fare of $2.20 covers unlimited travel by bus within the transfer window, including anything from a short to a very long trip. The fare therefor needs to be higher to cover the cost of customers taking long trips. In Option C2 (fares priced by km across the system) the base fare of $2.10 is lower for those taking short bus trips, and those making long trips pay more. The base fare can be lower for short trips because the bus price varies in Option C2.

Similarly, the fare for a given distance on rapid transit is lower in Option C2 than Option C1. In Option C1, the rapid transit fare is the same whether the customer made only the rapid transit trip or took a long bus ride to arrive at the station before or after their rapid transit trip. The rapid transit fare for Option C1 therefor needs to be higher to incorporate the cost of the average bus trip taken with each rapid transit trip, whether or not each individual customer took a bus trip or not. In Option 2, the fare for the rapid transit covers only the rapid transit trip. Those who are making a rapid transit only trip will pay a little less in Option 2, and those who take long bus trips before and/or after their rapid transit trip in Option 2 will pay a little more depending on how long their bus trip is.

Further work will be done in Phase 4 to determine the exact shape of the curve, base fare, base distance, maximum fare and maximum distance. The graph below shows a conceptual price curve for the two shortlisted options.

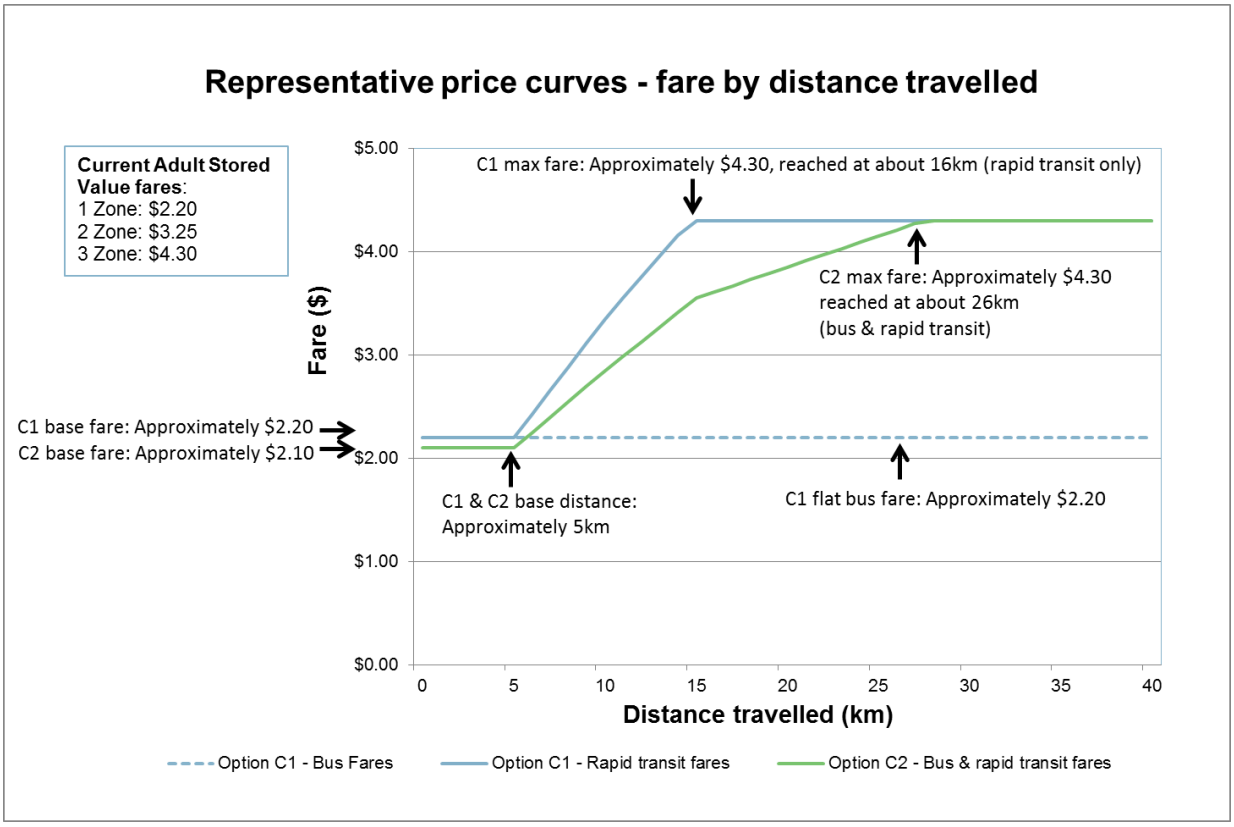


Figure 2 - Price curves for shortlisted fare by distance options

3.1 Make it simple and easy to use

Both shortlisted options are relatively easy to understand and explain (you pay a bit more for each kilometre you travel), however they are both more difficult to precisely predict your fare in advance compared to the current system without referring to an app or station fare map. Option C1 is simpler and easier to learn than Option C2 because fares for bus trips are always the same regardless of how far a customer travels on bus within the 90 minute transfer window.

In Option C1, the fares for all trips can be communicated in a static, unique display at each station showing the price to travel to each station from the current station. Fares for specific bus trips don't need to be shown as the bus fare is always the same for bus-only trips, and included in the rapid transit fare.

Under Option C2, it would be necessary to refer to a trip planning website or app in order to determine precise fares for bus trips in advance as there are too many bus stops to include in any static map. However, the rider would always know what the maximum fare is and that their fare would never exceed that amount. The majority of riders who are using a Compass Card would not be required to know the precise fare in advance as the Compass system would calculate this for them upon completion of their trip. For customers paying cash on bus, a simplified fare structure using only a few pricing intervals could be explored to help make it easier to pay the correct fare.

3.2 Make it fair

There are many different conceptions of fairness reflected in the transit system, and people's sense of fairness can vary from individual to individual. This evaluation focuses on three components of fairness that vary both between the options and within each option.

Structure avoids large and arbitrary jumps in fares: Both Option C1 and Option C2 eliminate the jump in fares across zone boundaries from the current system, and implement a more gradual increase in fares with distance travelled.

Fares aligned with distance travelled: Both options align fares with distance travelled on rapid transit, and thus both are more aligned with the user pay principle than the current system. Option C2 aligns fares more closely than Option C1 with the user pay principle – *the more transit you use, the more you pay* – because bus fares are based on distance travelled instead of flat bus fares in Option C1.

Fares aligned with the quality of service: Rapid transit is generally faster, more direct, and more reliable than bus travel. Fares in Option C1 are more aligned with the quality of service for the mode travelled (since bus always costs the same or less than rapid transit) than Option C2 (in which the price is the same for a given distance regardless of which mode is used). Although Option C1 is more aligned with quality of service, it is a rough approximation as the fares for short trips are the same price for bus and rail, and only longer trips have a price differential. Some other transit systems such as Sydney and Singapore have fares that vary based on both distance travelled and the quality and speed of service offered, with slower and less direct services priced at a lower rate per kilometre. This type of system would represent a compromise between Options C1 and C2. TransLink may consider exploring this variation of Option C2 in the future based on the results of the Phase 3 evaluation and consultations.

3.3 Keep it affordable and minimize the impacts of fare changes

A new fare structure that aligns fares more closely with the amount of transit people use means that fares for many trips will change. The magnitude and scale of this change needs to be balanced with the objective of minimizing negative impacts to customers who may experience an increase in fares for some of their trips. The fare changes provided here are ranges based on preliminary estimates of new Adult Stored Value fares only. In Phase 4, as the fare products, customer discounts, and time of day components are incorporated, more analysis will be performed and shared on the overall impacts of fares. These additional fare structure components are expected to mitigate some of the impacts of the fare changes significantly.

Table 5: Summary of impacts of fares relative to current fare structure

	Option C1 Measured distance by km on rapid transit and flat bus	Option C2 Measured distance by km system-wide
% of trips with a fare decrease of more than 20%	Less than 10%	10-20%
% of trips with a fare decrease of 5% to 20%	Less than 10%	20-30%
% trips paying about the same (-5% to +5% difference in fares)	60-70%	20-30%
% of trips with a fare increase of 5% to 20%	Less than 10%	Less than 10%
% of trips with a fare increase of 20% to 40%	Less than 10%	Less than 10%
% of trips with a fare increase of than 40%	Less than 10%	10-20%

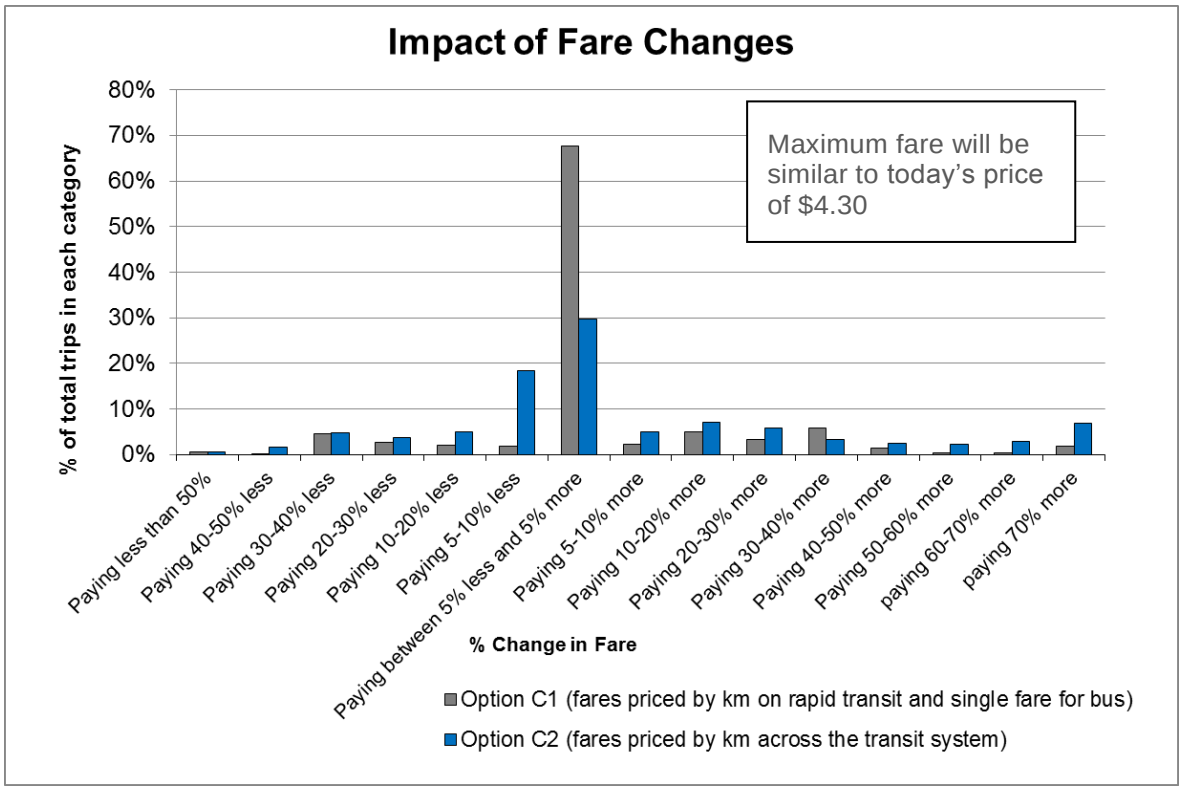


Figure 3 – Change in Adult Stored Value trip fares (source: ridership and revenue model)

Option C1

Option C1 involves fewer changes to customers' fares than Option C2 since only trips on rapid transit will see any changes (see Table 5 and Figure 2). In Option C1, about 60-70% of trip fares would be roughly the same as today (including all bus-only trips). About 10-20% of trip fares would cost at least 5% less than today. The trips that cost less are primarily the shorter rapid transit trips that cross a zone

boundary. Approximately 10-20% of trips would involve an increase in fares of 5% to 40%. Less than 10% of trips would have an increase of 40% or more in fares - these are primarily long trips on SkyTrain that are currently occurring within a single zone under the current zone system – for example trips entirely within Zone 1 or entirely within Zone 2.

Option C2

Option C2 involves more change than Option C1 in terms of both fare increases and decreases. Under Option C2, about 20-30% of fares stay about the same as today. Fares for about a third of trips would decrease between 5% and 40%. This is due to the lower base fare for shorter trips, as well as a decrease in fares for shorter trips across what is now a zone boundary. About 20-30% of trips would cost between 5% and 40% more than they do today, largely bus trips longer than about 6km and long trips on SkyTrain within a single current zone. About 10-20% of trip fares would cost at least 40% more than today. Most of the trips facing a significant increase in fares under Option C2 are long distance buses.

Bus trips

The temporary removal of zoned travel on buses caused long distance bus travel to become relatively inexpensive under the current system. As a result of these temporary low fares for long distance bus trips, implementing distance based fares on buses would result in relatively large increases for some long distance bus customers. However, if the new fare by distance on bus concept was compared to the former fare structure (when zones applied to buses prior to the implementation of the Compass system), the number of trips that cost more under the shortlisted fare by distance options would decline considerably. For Option C1, there are no changes to the fares for bus-only customers.

Rapid Transit trips

Under both options, long trips on the SkyTrain that occur within one zone and long trips within two zones will see an increase in price over the current system. These trips are paying the least per km under the current zone system. The trips that will see the biggest decrease are shorter trips that cross a zone boundary on both SkyTrain and SeaBus. These trips are currently paying the highest price per km (though, recognizing in the case of the SeaBus, the crossing replaces a much longer bus trip alternative).

Potential mitigation of the impacts of fare changes

As noted in previous sections, the preliminary modelling undertaken thus far for the Transit Fare Review is based only on Adult Stored Value fares, and more work is needed to understand the impacts of other components of the fare structure including products, discounts and pricing by time of travel. Although there will be fare changes for many trips regardless of the fare structure chosen, there are several mechanisms through which the impact of fare increases could be mitigated. Some measures that may be considered in Phase 4 include:

- Continuing to have a maximum fare around the same price as today
- Capping fares for long bus trips at less than the maximum SkyTrain fare, thus

reducing the increase in fares for long bus trips in Option 2
- Always pricing trips according to the shortest transit (or road network) distance, not necessarily the actual path travelled on transit
- Fine-tuning the station to station distances on rapid transit to alleviate unfairness

3.4 Impact on low-income customers

The focus of the fares by distance component of the fare review outlined in this document is to propose a fair system that maximizes the benefits and alleviates fairness concerns for as many people as possible, and it is not intended to address the needs of any one group. The fare by distance structure is an imprecise and ineffective tool with which to target affordability for low income passengers. Nonetheless, as part of the evaluation, the impacts on low income customers were assessed to ensure that the proposed fare by distance structure does not have undue impacts on low income passengers.

Low-income residents often rely heavily on transit and are generally the most price-sensitive to any change in fares as they pay a proportionally higher share of their income on transit. They also tend to make more short trips and make a higher proportion of trips during the mid-day period. TransLink assessed the impacts of fare changes on individuals from households with incomes of less than $25,000 per year and $25,000-$50,000 per year, as these were the income ranges that were included in TransLink's 2011 Trip Diary Survey.

In spite of different trip patterns, modelling and assessment of the proposed fare structures suggested that the magnitude of impacts of the fare changes on low-income customers were almost indistinguishable from other customers, and low-income customers are not subject to greater absolute changes in fares than the average customer. As was indicated in the impact of fares section above, Option C2 has a greater overall impact of fare changes than Option C1 largely due to fares priced by distance on bus.

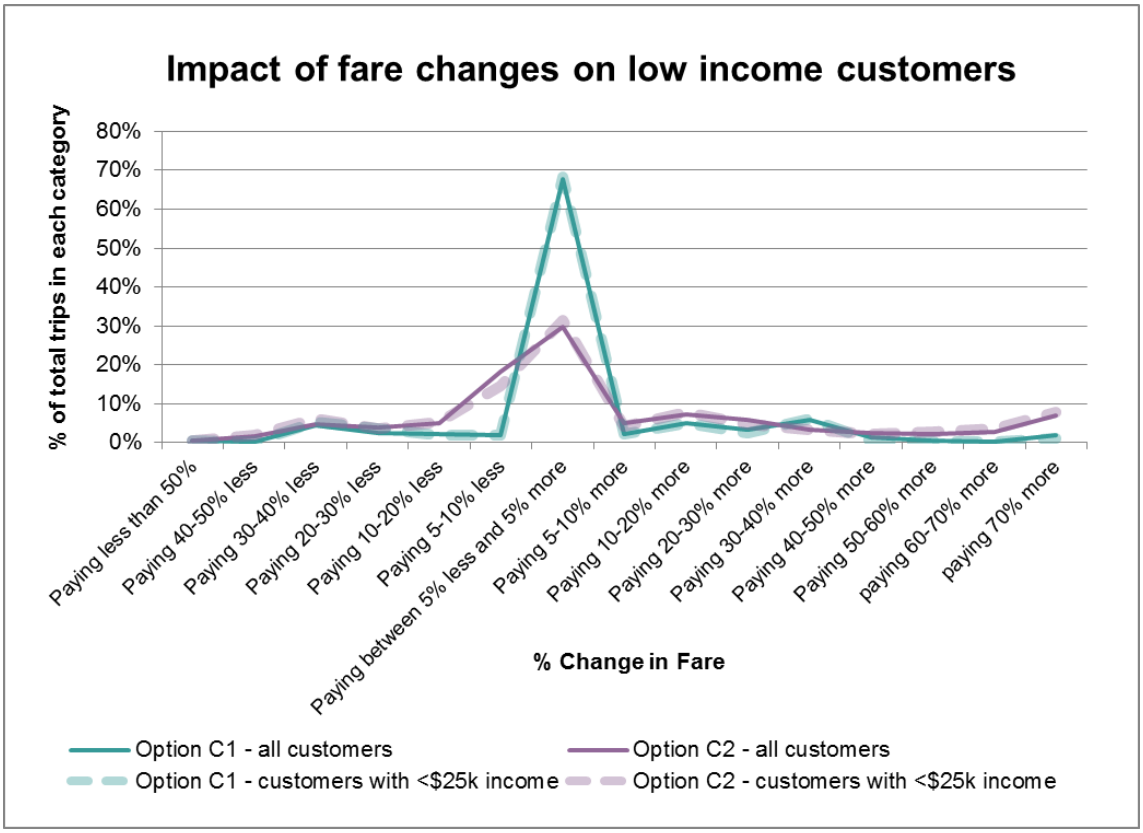


Figure 4 - Impact of fare changes on low income customers

Although the magnitude of the fare changes was very similar in percentage terms, the same dollar value change is likely to have a greater impact for low-income customers as this group often spends a greater proportion of its income on transit. Affordability will be a key consideration in the customer discounts section of the fare review.

Affordability for low-income customers is being specifically addressed in Phase 3 consultations through a review of opportunities to expand customer discounts. Additional work will be completed in Phase 4 to determine the impacts of various fare products and pricing by time of travel, which have the potential to mitigate impacts on low income customers. Time of travel discounts are particularly important for low income customers as they tend to have a higher propensity to travel at off-peak times.

3.5 Public acceptability to date

For this evaluation, public acceptability refers to public attitudes and opinions towards a given fare structure based on surveys conducted to date. Phases 1 and 2 of the Transit Fare Review indicated strong public support for varying fares by measured distance on rapid transit (56-61% of respondents agree vs. 30-34% of respondents disagree).

In the Phase 2 survey, respondents had a preference for flat fares by distance on bus (53-61% of respondents agreed with flat fares on bus vs. 30-34% disagreed) vs. fares by measured distance on bus (37-42% agreed with measured distance on bus vs. 46-52% disagreed).

Now in Phase 3, a public survey on the two options will be used to inform our understanding of the level of public acceptability for these two options now that more is detail available on how these options would work. In addition, stakeholder forums with key organizations as well as elected officials forums will further help better understand the public acceptability of the options and customer implementation considerations.

3.6 Grow transit ridership and use

Ridership modelling was undertaken for each of the options. This modelling is preliminary and further work is needed to refine the results. Other components of the fare structure including time of day pricing, fare products, and user discounts will be incorporated in the next phase and will impact the modelling results.

The options were priced at a conceptual level using Adult Stored Value fares to ensure they were revenue neutral – meaning the total fare revenue collected in each option is the same as the current and projected fare revenue. The model produces conservative estimates for ridership impact that may evolve over time as customers adapt to the new fare structure.

Ridership: Both options have a negligible (<1% less than the base) impact on ridership under a revenue neutral scenario. This degree of change is comparable to daily fluctuations in ridership due to weather and special events. Overall, the change is small compared to other factors, including service expansion, population growth, and broader changes in the regional economy.

Passenger kilometres travelled on transit (PKT): Passenger kilometres travelled (PKT) measures the total number of kilometres travelled by all passengers on public transit. It captures both the number of passengers and how far they are travelling, and higher numbers are generally better. Increasing PKT results in societal benefits such as reduced congestion, fewer accidents, and lower greenhouse gas and other air emissions. Kilometres travelled by active transportation modes can affect PKT, though most of the increase in PKT is replacing a corollary decrease in vehicle kilometres travelled in private vehicles (VKT). Option C1 has a decrease of 1% to 1.5% in PKT compared to the current system while Option C2 has a slightly worse decrease of 2% to 3% in PKT.

The decrease in PKT in Option C2 is driven in large part by the increase in long distance bus fares. As discussed previously, there are several mechanisms through which the impacts on these fares can be mitigated that will be further explored in the Phase 4, which may have significant effects on the PKT values. These results will be updated in Phase 4 upon completion of further modeling work that considers fare products and user discounts.

Table 6: Impact on weekday transit ridership and passenger kilometres travelled

Criteria	Option C1) Fares priced by km on rapid transit and flat fare on bus	Option C2) Fares priced by km across the system
Change in ridership	No significant change	No significant change
Change in transit Passenger Kilometres Travelled (PKT)	-2% to -1%	-3% to -2%

3.7 Implementation considerations

Ease of transition for customers: Both options would require significant communication, marketing and change management to ensure a smooth transition for customers. Option C1 involves changing the rapid transit fares only, while the flat bus fare stays the about the same. This results in an easier transition for customers than Option C2.

Fares by kilometre on bus: Charging fares priced by kilometres on buses in Option 2 requires new systems or protocols to determine the distance passengers are travelling on the bus. The common approach used today on other systems is for customers to tap in as well as tap out when exiting the bus. This way the smart card fare system can automatically calculate the distance travelled and deduct the appropriate fare. Tap out on buses has been successfully employed in other cities around the world. Thanks to on-going improvements since Compass launched in 2015, the Compass system is ready to support tap-out on bus today if we were to revert back to a system-wide three-zone fare structure. Additional improvements and updates will be needed to support tap-out on bus under a system that prices bus travel by kilometre (like Option C2).

A review of transit systems around the world requiring customers to tap out on bus reported no technological impediments, safety concerns, dwell time delays to transit vehicles or other adverse impacts due to tap out on buses, even on busy systems with high volumes of passengers (e.g. Singapore, Sydney, Brisbane, Melbourne, and Amsterdam). The review found that, after a system was introduced, customers quickly got used to tapping out on bus. There is a risk of negative customer satisfaction impacts when passengers are charged the maximum fare for forgetting to tap out on bus, as well as impacts on call centre volumes. Central to the success of these peer regions was intensive public awareness campaigns. Customer education is a core component of change management that must be considered equally with the technical requirements of the structure.

In Phase 2 respondents indicated that they would prefer not to have to tap out when exiting the bus. In response to this feedback, TransLink is exploring ways to eliminate the need to tap out (at least for most trips), and to mitigate the impacts for those customers who do choose to tap out on bus. Technology exists and is now being tested on other transit systems called ‘be-in-be-out’ that can sense when passengers leave the bus (currently via a Bluetooth connection to their card or

smartphone), allowing participating users to exit without needing to tap out. This technology is expected to be more widely deployed in the next few years. The amount of change to customers for Option C2 could also be mitigated by a phased implementation approach. The first step could be to implement fares by distance on rapid transit similar to Option C1, followed by implementing fares by measured distance on bus when 'be-in-be-out' technology is more widely available.

Time, cost and technological challenges and risks:

The Compass system was designed to be a robust and future-oriented system that can be adapted to meet the needs of new fare structures and ways to pay – like Options C1 and C2 that are being considered here. There will be some costs associated with changing the fare structure, including re-programming the system, updating the Compass Vending Machines, testing the new system, and customer education to ensure a smooth transition. These costs will depend in part on which structure is chosen. Nonetheless, the vast majority of the hardware including Compass Card readers, vending machines, and fare gates are ready for a new fare structure.

Option C1 could be easily adapted to the existing system and implemented relatively quickly within about a year after the details of the new fare structure are finalized, at low cost, with low risk of technological complications and passenger disruption. Option C2 would require relatively more time and involves more substantive upgrades to the Compass system to enable per-kilometre distance based pricing on the bus system and support future 'be-in-be-out' technology. This will result in Option C2 having higher implementation costs than C1. The higher levels of change in Option C2 also brings higher technological risks that would need to be managed through testing and piloting systems in a similar way to what was done with the implementation of the Compass Card.

There are several examples of fare structures like Option C1 and C2 being used in other cities around the world. Washington DC, Hong Kong and San Francisco's BART have fare structures similar to Option 1. The fare structures in Amsterdam, Singapore and Sydney are similar to Option C2.

3.8 Key trade-offs

Options C1 and C2 both help to address many of the key issues with the current fare structure by eliminating arbitrary zone boundaries and minimizing steep jumps in fares between zones. However, there are a number of key differences between the options that are important to consider.

Compared to Option C2, Option C1 (fares priced by kilometre on rapid transit and flat fare on bus) would:

- be simpler to learn and use since bus fares are flat;
- have a lower adverse impact on fare increases;
- be an easier transition for customers;
- be cheaper and faster to implement on account of low technological changes

and risks.

Compared to Option C1, Option C2 would (fares priced by kilometre across the system):

- be fairer with respect to better alignment with the principle of the more service you use, the more you pay, but less fair with respect to the principle that fare prices should reflect the quality of service experienced;
- have lower base fares (by about 10 cents) for shorter trips (less than about 5 km trips).

The evaluation reveals a complex set of trade-offs between the objectives, and no one option maximizes the outcomes across all evaluation criteria. This means that the preferred option for individual people will depend on the importance that they place on each criterion and how they think about the trade-offs. For some people, fairness may be the overriding concern; for others simplicity may be the prevailing factor, resulting in a different preferred solution for different people.

A few key trade-offs have been highlighted below:

How important is the user pay principle of "paying closer to what you use", and what is the relative importance between this principle and other objectives such as simplicity, predictability and impact of fare changes in order to achieve the user pay principle?

- *Trade-off between user pays principle and understandability for customers*: Option C2 aligns more closely with the user pay principle of the more transit you use, the more you pay but bus fares are more complicated. C1 has simpler bus fares, but it is less aligned with the user pays principle.

- *Trade-off between user pays principle and impact of change in fares*: Option C2 aligns more closely with the user pays principle and, as a result, impacts more transit fares (both increases and decreases in fares). It offers a lower base fare for all short trips and charges a higher fare for longer bus trips. By keeping flat bus fares, Option C1 does not align fares as closely with the distance travelled and, as a result, has less impactful fare changes (both increases and decreases in fares).

- *Trade-off between user pays principle and ease of transition*: Option C1 does not achieve as high a rating on the user pays principle, but is easier, less costly and faster to implement than Option C2. Option C2 involves a significant revamp of the fare structure, changes to the Compass system, and a generally more complex transition but more closely adheres to the user pay principle.

Should bus trips pay the same distance-based fares as rapid transit, aligning more closely with the distance travelled, or should bus trips pay a lower flat fare, aligning more closely with the quality of service provided?

- Option C1 aligns fares more closely with quality of service because long SkyTrain trips cost more than the same trip made by bus. Option C2 aligns more closely with distance travelled because a long bus trip costs less than a short bus trip.

4 Conclusions and next steps

Based on detailed evaluation, two measured distance options were selected for further investigation and consultation because they performed the most favourably in the evaluation. Both of these options were found to be fairer than the current system, simpler than the alternatives, and better addressed the concerns identified with the current system.

The public and stakeholders are invited to provide their preference on Options C1 and C2 as well as on other considerations for the new transit fare system during Phase 3 consultations. In 2018, TransLink will consider input received and the technical analysis to make an informed decision on how to move forward. Additional work will then be undertaken to optimize the fare structure and to investigate off-peak fares, products, user discount options, and determine the optimal implementation pathway for the new fare structure.

5 Detailed evaluation of all fare options

5.1 Comparison of what would change under each fare by distance option

Impact	A) System-wide flat fare	B1) Refined zones - 3 overlapping zones	B2) Refined zones - 22 zones with 2-zone base fare	C1) Fares priced by km on rapid transit and flat fare on bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
What would stay the same?	- Flat bus fare **- Tapping** – Tap in only on bus; tap in and out on rapid transit/ SeaBus - **Transfers**: no additional fee to transfer between modes	**- Zone structure** – modified version of current 3 zones with addition of overlapping zones **- SkyTrain trips –** priced according to number of zones travelled - **Transfers**: no additional fee to transfer between modes	**- SkyTrain trips –** priced according to number of zones travelled, though with a greater number of zones being included - **Transfers**: no additional fee to transfer between modes	**- Tapping** – Tap in on bus; tap in and out on rapid transit - **Bus only fares**: about the same as today - Rapid Transit fare includes unlimited bus fare - **Transfers**: no additional fee to transfer between modes	- **Transfers**: no additional fee to transfer between modes
What would be different?	**- SkyTrain/SeaBus fares** – change from a zone based structure to a flat fare for unlimited travel	- **Tapping on bus**: Tap in on bus with new technology allowing customers to either tap out on bus or detect their exit from vehicle automatically without tapping out - Overlapping zones - Bus Fares are zoned (but similar to former fare structure)	- **Tapping on bus**: Tap in on bus with new technology allowing customers to either tap out on bus or detect exit automatically without tapping out **- Zone structure** – approximately 22 zones **- Two zone base fare –** initial fare covers your first zone crossing - Lower fare	**- Rapid transit fares:** are based on the number of kilometres you travel instead of how many zones you travel through	- **Tapping on bus**: Tap in on bus with new technology allowing customers to either tap out on bus or detect their exit from the vehicle automatically without tapping out **- Fares for all modes,** including bus, are calculated based on the number of kilometres you travel, instead of how many zones you

Impact	A) System-wide flat fare	B1) Refined zones - 3 overlapping zones	B2) Refined zones - 22 zones with 2-zone base fare	C1) Fares priced by km on rapid transit and flat fare on bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
			increments between zones - Bus fares are zoned		travel through - **Fares for short trips**: starts about 10 cents lower than today
Which trips would pay more?	- All one-zone and bus-only trips	- Bus trips that cross a zone boundary	- Long trips that were one zone in the old system and cross 3 or more zones in the new system - Bus trips	- Long trips on SkyTrain within a single zone in the current system	- Bus trips longer than about 5km - Long trips on SkyTrain within a single zone in the current system
Which trips would pay less?	- All two and three zone trips	- Short trips across a zone boundary that are within the proposed common zones - Multi-zone trips that start or end in a common zone	- Short trips on SkyTrain that cross a (current) fare zone boundary	- Short trips on SkyTrain across a fare zone boundary - SeaBus crossings - Shorter 2 and 3-zone SkyTrain trips	- All short transit trips under 5km - shorter SkyTrain trips across a current fare zone boundary - SeaBus trips - Shorter 2- and 3-zone SkyTrain trips

5.2 Detailed evaluation of fare by distance options

Scale (evaluated relative to the current system)

Much Worse	Worse	Neutral	Better	Much Better

Objective	Evaluation Criteria	A) System-wide flat fare	B1) 3 overlapping zones	B2) New 22 zones	C1) Measured distance by km on rapid transit, flat bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
Make it simple to learn and use	Logical and intuitive to understand	Much Better - Simple to understand and describe	Worse - Overlapping zones concept is closest to today's fare structure but is more complicated to understand and describe - zone boundaries are arbitrary and unintuitive	Worse - 2-zone base fare concept is complicated to understand and describe - zone boundaries are arbitrary and unintuitive	Better - Pay by how far you travel on rapid transit is easy to understand and describe - Discrepancy exists between bus and rapid transit	Much Better - Pay by how far you travel is intuitive and easy to understand
	Ease of Use and Predictability:	Much Better - One fare system-wide	Worse - Most similar to today's fare structure, but learning required to become familiar with new common zone areas - Bus fares and zone boundaries hard to communicate and remember for common zone areas	Worse - Customers would need to consult a zone map to determine fares ahead of time - New zone map difficult to communicate and remember, requiring detailed information or an interactive trip planner for bus fares	Worse - Significantly more fare levels, though flat bus fare aids in predictability of bus only trips - Passengers will need to consult trip planner for unfamiliar trips - System wide fare information can be displayed at each Rapid Transit station	Much Worse - Bus fares are variable and more difficult to predict - Customers will need web-based interactive trip planner to determine bus fares prior to travel

Objective	Evaluation Criteria	A) System-wide flat fare	B1) 3 overlapping zones	B2) New 22 zones	C1) Measured distance by km on rapid transit, flat bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
Make it fair	Alignment with user pay principle according to distance travelled	Much Worse	Better	Better	Better	Much Better
		- No relationship between distance travelled and fare paid - Increases costs for short trips that currently pay the highest $/km fare	- Bus fares are subject to zones - Some short trips align more closely with distance travelled, some longer trips move farther from principle	- More zones allows closer alignment with distance travelled	- Rapid transit fares align with distance travelled - Bus fares are flat and not reflective of distance travelled	- Both rapid transit and bus fares are priced by distance
	Addresses customer concerns over the boundary penalty, arbitrary boundaries and steep jump in fares	Better	Better	Better	Much Better	Much Better
		- Addresses zone boundary issue by avoiding boundaries altogether - No jumps in fares	- Short trips across a zone boundary are addressed - Still have large jump in fares at arbitrary zone boundaries	- Finer-grained zone structure reduces zone boundary penalty and fare increments - Establishes new zone boundaries that recreate similar though less pronounced fairness issues	- Key fairness issues are addressed including pricing of short and long trips within a zone now priced by km, and short trips across a zone boundary -no boundary issue for bus trips	- Key fairness issues are addressed including pricing of short and long trips within a zone now priced by km, and short trips across a zone boundary
	Fares aligned with the quality of service of a mode travelled	Neutral	Neutral	Neutral	Better	Neutral
		- Bus and SkyTrain Fares are the same (not aligned by service quality)	- Bus and SkyTrain Fares are the same (not aligned by service quality)	- Bus and SkyTrain Fares are the same (not aligned by service quality), though zones can be configured to approximate distance travelled on rapid transit	- Average per km SkyTrain fares higher than flat bus fare	- Bus and SkyTrain Fares are the same (not aligned by service quality)

Objective	Evaluation Criteria	A) System-wide flat fare	B1) 3 overlapping zones	B2) New 22 zones	C1) Measured distance by km on rapid transit, flat bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
Keep it Affordable	Minimize negative impact of fare changes	Much Worse - Fares increase more than 20% for two thirds of trips	Neutral - Most fares stay about the same, some short trips decrease - Multi-zone bus fares increase	Worse - Moderate SkyTrain fare changes - Long distance bus fares increase	Neutral - Bus only fares stay the same - Moderate changes in SkyTrain fares	Worse - Large number of short trips will experience a small decrease in price - Small number of trips will experience large increase – opportunities for mitigation to be explored in Phase 4
Grow transit ridership and use	Grow Ridership (% change)	2-3% decrease	No significant change	No significant change	No significant change	No significant change
	Transit Use PKT (% change)	No significant change	1% to 2% decrease	No significant change	1% to 2% decrease	2% to 3% decrease
Public support to date	Level of public support to date	Much Worse - Contrary to strong support in Phase 1 for lower fares for shorter distance trips and higher fares for longer distance trips (67-70% agreed vs 17-19% disagreed)	Worse - Moderate support for pricing rail by zones (45-50% agreed vs 37-39% disagreed) - Very low support for varying fares by distance with refined zones on bus (29-37% agreed vs 48-54% disagreed)	Worse - Moderate support for pricing rail by zones (45-50% agreed vs 37-39% disagreed) - Very low support for varying fares by distance with refined zones on bus (29-37% agreed vs 48-54% disagreed)	Much Better - Strong support for measured distance on rapid transit (56-61% agree vs 30-34% disagree) - Strong support for flat by distance on bus (53-61% agree vs. 30-34% disagree)	Better - Strong support for measured distance on rapid transit (56-61% agree vs 30-34% disagree) - Moderate to low support for fares by distance on bus (37-42% agree. 46-52% disagree)

Objective	Evaluation Criteria	A) System-wide flat fare	B1) 3 overlapping zones	B2) New 22 zones	C1) Measured distance by km on rapid transit, flat bus (Option 1 in Discussion Guide)	C2) Fares priced by km across the system (Option 2 in Discussion Guide)
The implementation considerations below are evaluated on an absolute scale						
Impact of implementation	Near term ease of transition for customers and amount of change	Low - Change is easily managed from a customer perspective	Moderate - Zoned buses requires new customer behaviour and/or technology - Represents incremental change of fare structure for customers - moderate customer education required	Moderate - Zoned buses requires new customer behaviour and/or technology - significant customer education required	Low - Bus fares remain flat resulting in familiar Compass interactions - Completely new fare structures for rapid transit - significant customer education required	Moderate - Fares priced by kilometre on bus requires new customer behaviour and/or technology - significant customer education required
	Technical cost, risk, and complexity	Low - No major barriers from a technological, complexity or risk perspective	Moderate - Zoned buses requires new processes and technology	Moderate - Zoned buses requires new processes and technology - New zone structure would take significant planning, implementation effort and cooperation	Low - System requires new fare tables and minor reprogramming	Moderate-high - Distance pricing on bus requires new processes and technology - Requires significant upgrade to Compass Card system