# A Cellular Mass Transit (CMT) plan for TNCs

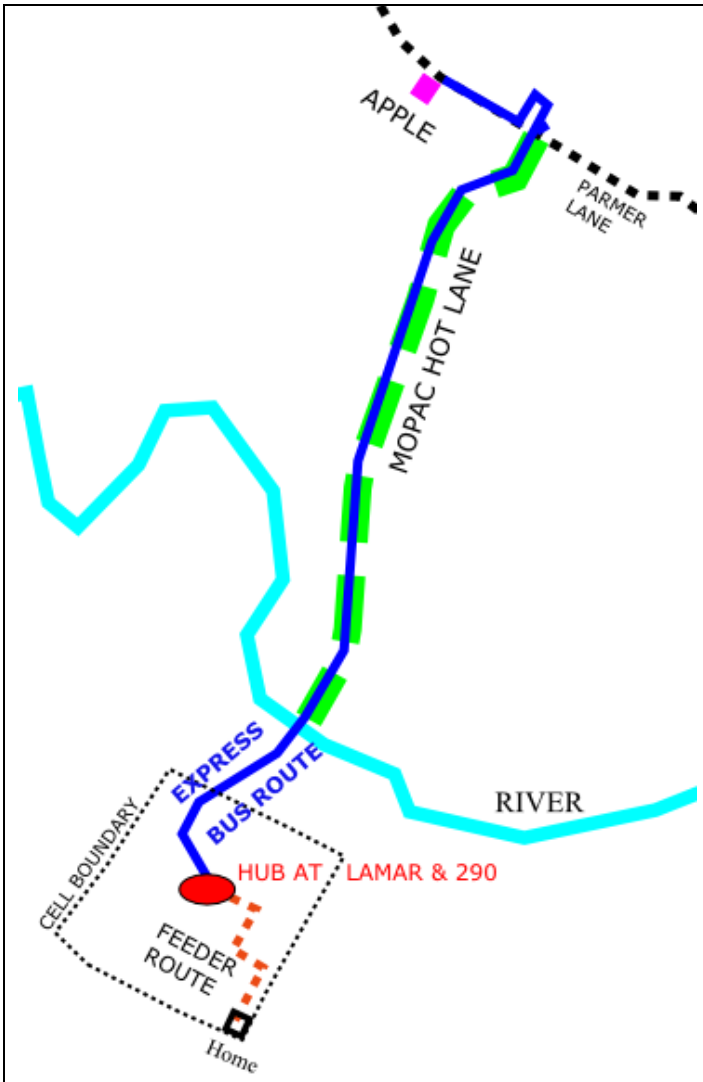
Richard Shultz, March 2021

A TNC, such as Uber or Lyft, could make a profit providing the hubs and mobility services that implement a CMT system for an urban area. The TNC (transportation networking company) would have to provide facilities for hubs. That expense will be offset by the competitive advantage achieved when several mobility services work together. I will explain the profit potential of mobility services later. But first I need to explain CMT.

Cellular Mass Transit, or CMT, is so called because the transit service area is divided into rider collection areas called cells. Each cell has a hub that serves as a collection point for the cell.

A CMT system will reduce mass transit travel time and allow bus riders to relax during stress free commutes. This will appeal to the 28% of Austin commuters who travel 15 or more miles one way from home to work. Low income workers traveling shorter distances will also find the service attractive.

The example trips shown below are from south Austin to Apple's operation in north Austin. Apple's operations on Parmer lane will soon have 20,000 employees.




## Peak Trip from South to North

Peak travel hours are 6 to 9 am and 4 to 7 pm.

A peak trip to a large employer would have two legs: a first by taxi van and a second by express bus.

At lower left an STV (shared taxi van) on a feeder route would bring 8 riders from homes to a south hub at Lamar and 290.

Riders from several feeder routes would collect at a hub and wait for about 5 minutes until an express bus arrives. The hub would have an enclosed, air-conditioned waiting area.

The express bus would then take riders up MOPAC direct to Apple.

The express bus would run 11 miles non-stop on the MOPAC HOT lane (in green) at 45 to 60 mph. HOT stands for high occupancy and toll.

Cars in regular lanes might be doing only 15 mph.

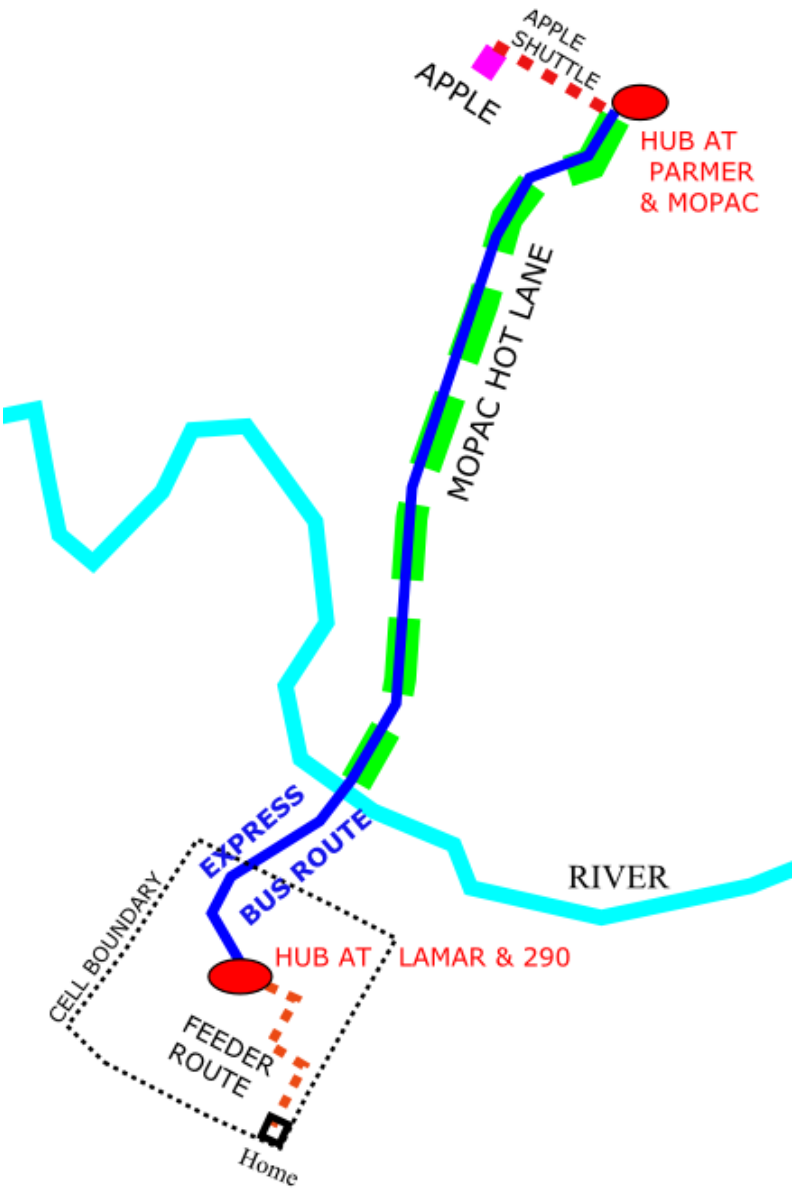
Door to door travel time will be less than a similar trip by car.

Compared to conventional transit, the CMT trip will take half the time.

Travel will be faster because most miles of a long distance (15+ miles) trip will be by express bus running a 20 mile route with only two to four stops. The express bus will only stop at hubs, large employers, or other dense activity sites (DAS). Only a few stops are needed because hubs collect and distribute riders. Each hub is a collection point for a rider collection area called a cell. A cell of 12 square miles will typically have all homes within 2.5 miles of a hub.

Off Peak Trip shown next




## Off–Peak Trip

Off peak hours are from 9 am to 4 pm and 7 pm till midnight.

Off peak trips have fewer riders and hence require a second transfer.

An off-peak trip has three legs: first by taxi van, then by express bus and last leg by company shuttle.

At lower left a taxi van, or TNC pool, on a feeder route brings riders from homes to a south hub at Lamar and 290.

Riders from several feeder routes collect at a hub and wait for about 5 minutes until an express bus arrives.

The express bus then takes riders up the highway to a north hub at Parmer and MOPAC.

A company shuttle, provided by Apple, takes riders the last two miles to Apple.

Other shuttles take riders to nearby destinations like IBM, Domain, North Austin Medical Center, National Instruments, and ACC Northridge

CMT can get workers to large employers but it can also get riders to wherever they want to go. With CMT the number of destinations that can be reached by transit, in under an hour, will more than double. Many off-peak trips will require two transfers. Sheltered transfers, provided at hubs with amenities such as air conditioning, will make two transfers acceptable. Hubs are described in more detail below.

The two-transfer trip requires three legs. The first leg would be from home to nearest hub.

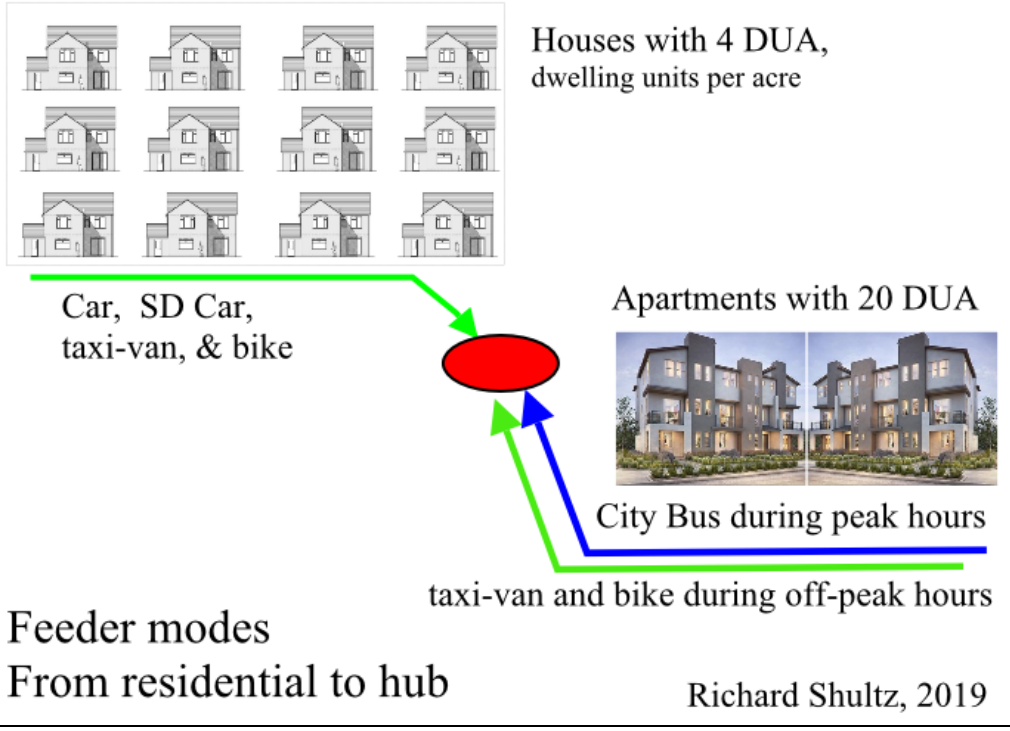
  

## From Home to Hub

There would be many options for getting the first two miles from home to hub. These include city bus, park & ride, kiss & ride, self-drive car, TNC pool, shared taxi-van (STV) and bike. These short-range feeder modes would collect riders from all parts of a 12 square mile cell and bring them to hub.

The most popular modes depend on residential density and time of day. Private modes like SD (self-drive) car, kiss & ride, TNC pool, bike and taxi-van can serve low density areas and off-peak travel times that are not served by city bus.

High density residential areas with many apartment complexes will have high enough rider density, during peak hours, to justify a city bus running a feeder route to hub every seven minutes.




Feeder modes from home to hub, first two miles.

Private modes like car and bike are shown in green.

A public mode, the city bus, is shown in blue.

Self-drive (SD) car might be possible in next 10 years.

Park-and-ride is a popular option for getting to some mass transit pickup points. But expensive parking lots and parking garages might soon be made obsolete by SD car, shared taxi-van and TNC pool.

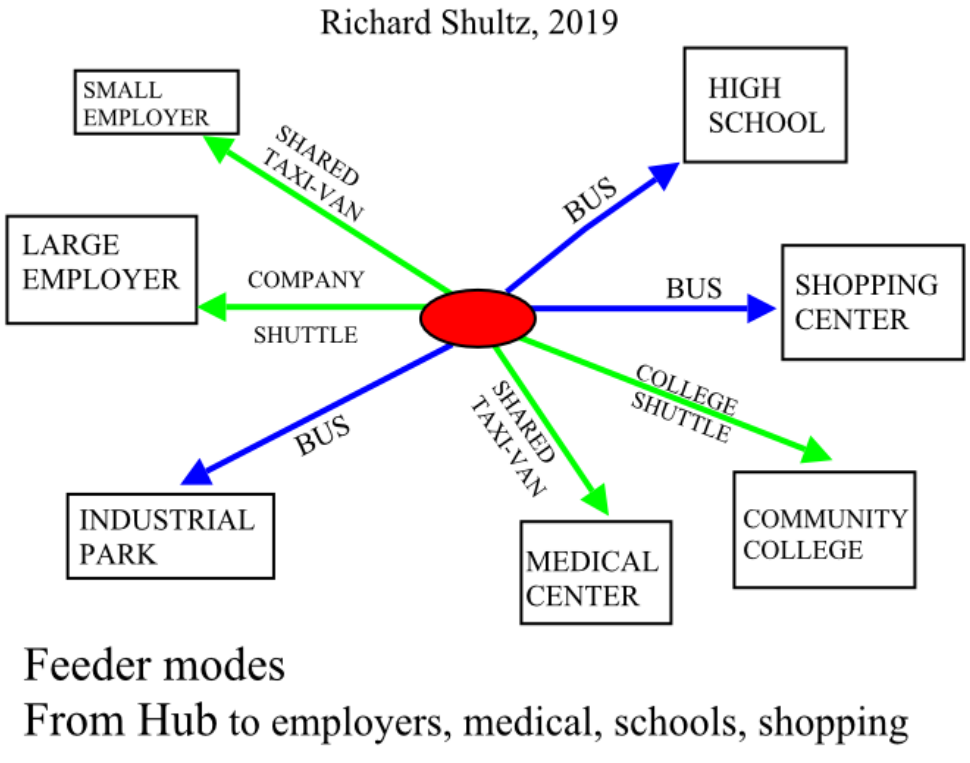
Using parking that is already in place, such as at a large movie theatre complex or mega church, can be an economical way to provide the park and ride option. Theaters and churches have plenty of parking spots not used on weekdays between 6 am and 6 pm.

## From Hub to Final Destination

A mix of public and private modes will also get riders the last one to three miles from hub to jobs, shopping areas, and schools. Many of these trips will be by small cabin private modes like sedan and van, reaching destinations not served by city bus.

Shared taxi van is a popular mode used by millions in developing countries. Most are run by independent owner/operators without government subsidy.




### Feeder modes from hub to final destination

Private modes like company shuttle, taxi-van and bike are shown in green.

Public modes, like city bus and school bus, are shown in blue.

Short range modes fan out from hub to all employers, schools and commercial areas within a cell.

## Express Routes

Express routes will be of two types: Hub to hub and hub to dense activity site (DAS). Examples of DAS in Austin are the airport, central business district, large employers like Apple, UT and Dell, and large mixed-use developments like Domain and Grove,

Hub to hub express routes would keep 20 hubs connected. A CMT system for Austin might have 20 hubs. These 20 hubs would require 190 hub-to-hub connections which could be served by 48 hub-to-hub express routes.

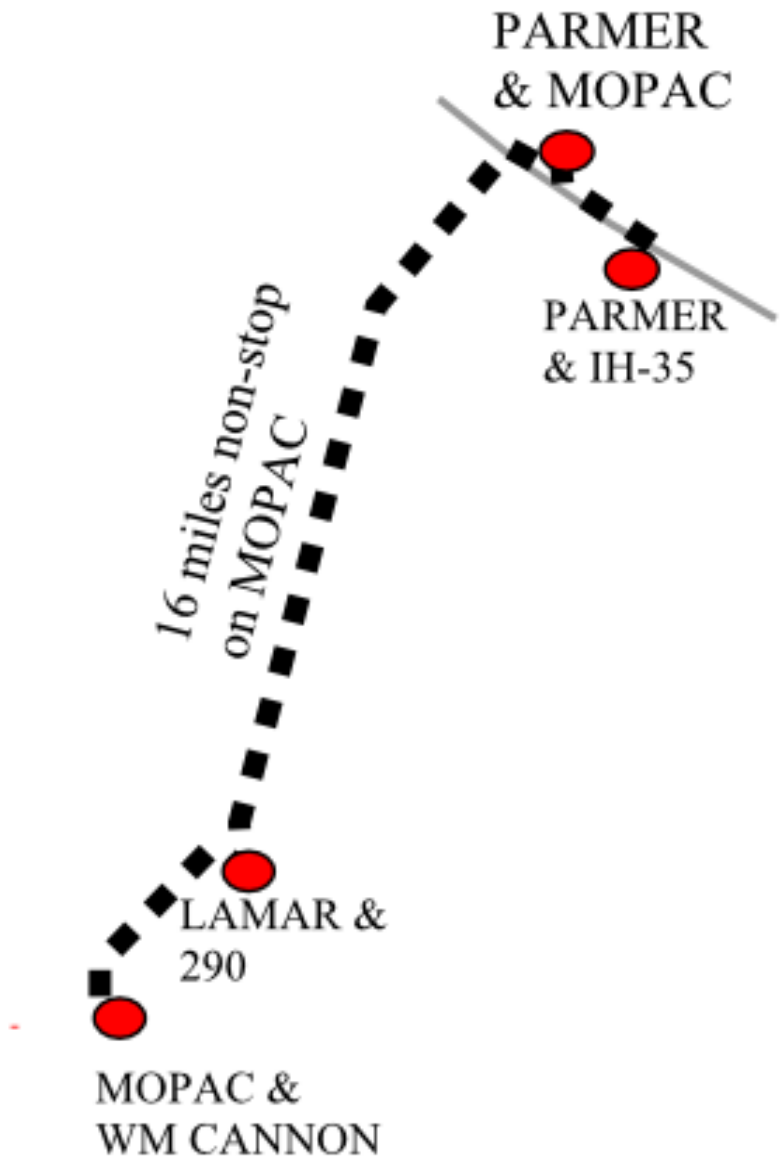
A typical route would have four hub stops and serve four to six connections.

With 48 routes serving an average of four unique connections per route, all 190 connections would be served. That means a rider can start at any home hub and get to any other hub by a route that is direct and has at most two intermediate stops. Buses would run every ten minutes on most routes. Busier routes might have buses running every five minutes.

Examples of hub to hub routes are shown on next three pages.

## Example route from south Austin to north Austin is shown below




A long north -south express route with 4 hub stops and a 16 mile nonstop leg on MOPAC.

The route starts at Mopac and William Cannon in south Austin and ends at Parmer and IH-35 in North Austin.

An Express bus would travel the 16 mile middle leg in **27 minutes.**

Eleven of the 16 miles are along the MOPAC HOT lane.

Times are for 8:30 am on a weekday.

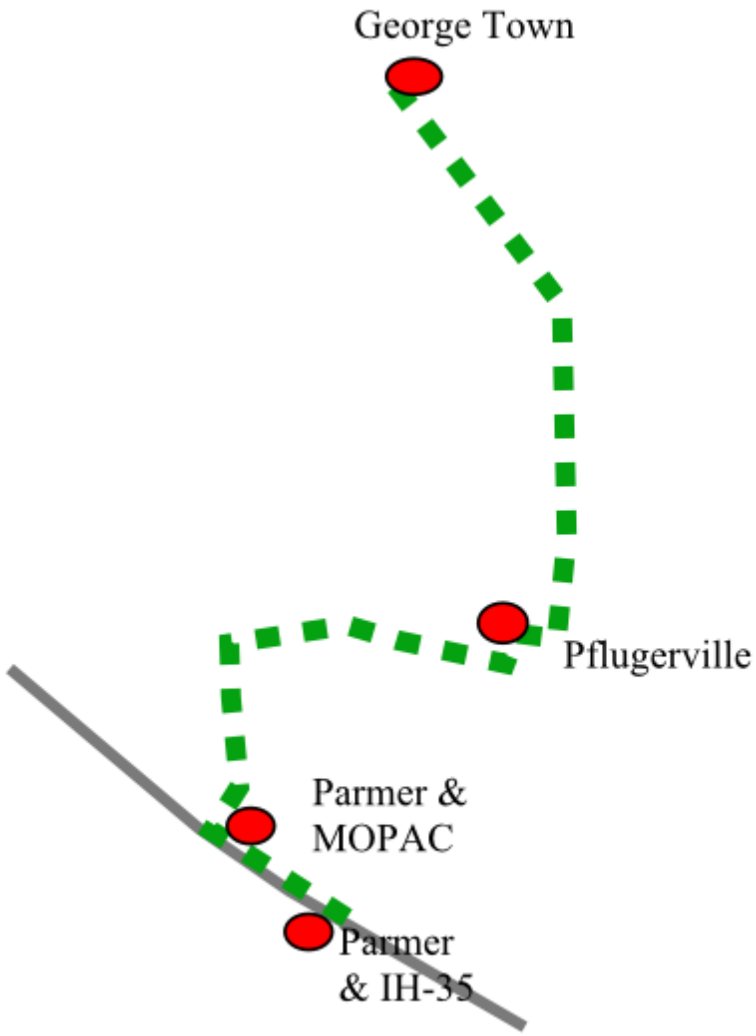
A car driver would pay a $9 toll to use the 11 mile MOPAC HOT lane at 8:30 am.

Average speed, with 4 hub stops would be 26 mph.

In the example above, an Express bus would travel the 16 mile middle leg non-stop, taking only **27 minutes.** Existing public transit would take **one hour and 35 minutes** with two transfers to travel the same 16 miles. Existing transit is slow because most routes are making ten pickup and drop off stops per mile on arterials that have several traffic lights per mile. About 35 minutes of a conventional trip is spent at two unsheltered transfers.

Example route from Georgetown to Parmer & IH-35 is shown below




Shown at left is another 4 stop express route starting at a hub near Georgetown and ending at hub near Parmer and IH-35

A Georgetown hub would be near state road 29 and toll road 130.

An express bus would travel 24.3 miles in 24 minutes
, along toll roads, to get from Georgetown hub to a hub at Parmer and MOPAC.

The stop at Pflugerville hub would add another 4 minutes. Total travel time would be 28 minutes to get from Georgetown to MOPAC and Parmer.

The express bus would continue two miles along Parmer to last hub near IH-35.

**Average speed for whole route would be 42 mph even with hub stops**

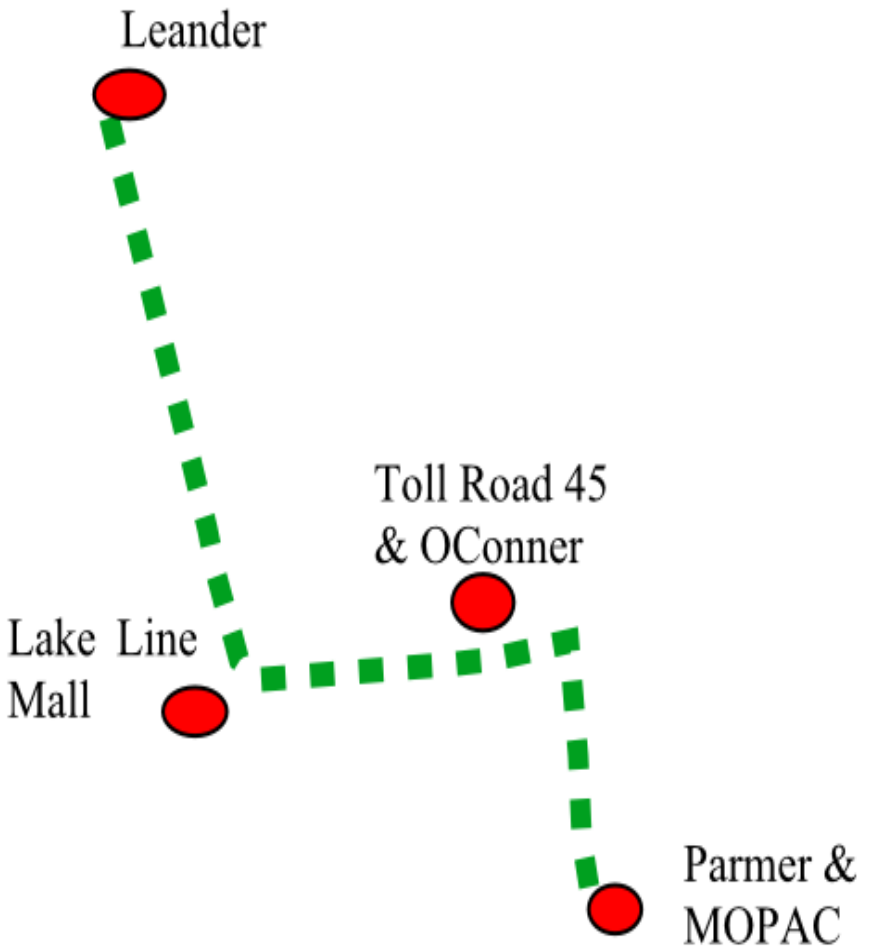
Travel time was estimated on Monday morning at 8:40 am

No public transit option was found by Google Maps.

Georgetown and Pflugerville are not within the Capital Metro Transit Authority service area.

Next example, shown below, is from Leander to Parmer and MOPAC




Shown at left is a four stop express route starting at a hub in Leander and ending at hub at Parmer and Mopac.

The Leander hub would be near 183 and Hero Way.

An express bus would travel 19 miles in 20 minutes, along toll roads, to get from Leander hub to hub at Parmer and MOPAC.

The hub stops at Lakeline and O'Conner might add four minutes each for a total travel time of 28 minutes.

**Average speed, with hub stops, would be 41 mph**

Travel time was estimated on Monday morning at 8:45 am

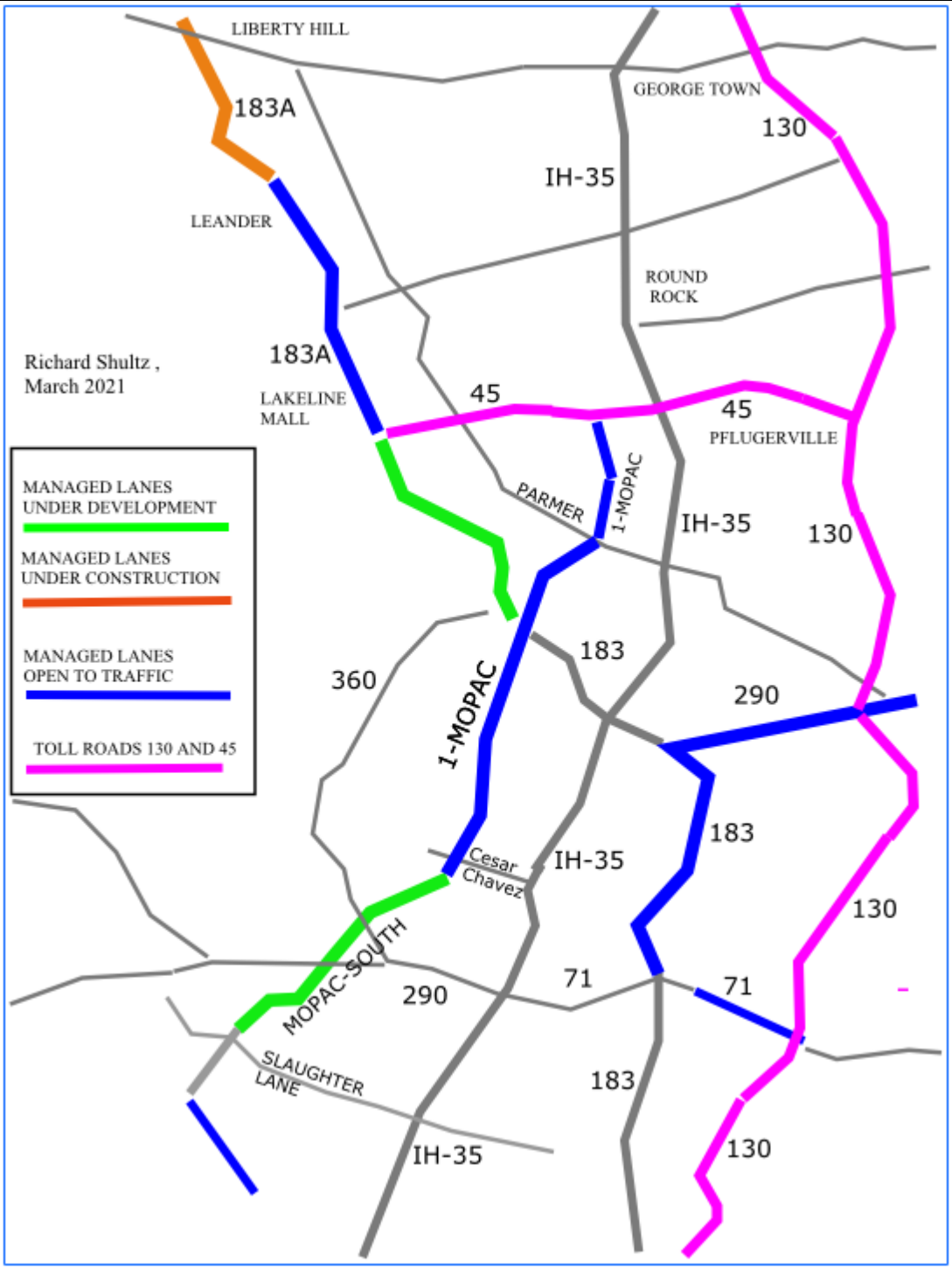
No public transit option was found by Google Maps

A rider could get from their home hub to any other hub by an express route that is direct and has only 4 stops. Most routes will run around the city core, avoiding congestion near city center. Express buses would depart every 10 minutes, 18 hours a day and 7 days per week.

Many routes will run for miles on toll roads or managed lanes. Managed lanes, sometimes known as HOT for High Occupancy and Toll, on MOPAC and 183 will be dynamically tolled to keep the vehicle count low enough that the lane is in a free flow state. A bus could travel at 45 to 60 mph on a managed lane while cars in adjacent regular lanes would shuffle along at 10 to 20 mph. Tolled roads also provide an advantage to an express bus. Bus riders can enjoy faster travel along the tolled road while not having to pay a toll as they would in a private car.

Austin will have 100+ miles of toll roads and/or managed lanes in the near future. See map below.




Existing managed lanes are in blue.

Managed lanes under development are in green

Gold denotes lanes under construction.

Tolled lanes are shown in purple. These include 130 and 45.

TR 130 runs 37 miles from north of Georgetown south to HWY 71

TR 45 runs from 130 west to Lakeline mall for 13 miles

MOPAC north express lanes (blue) run 11 miles on MOPAC from Cesar Chavez north to Parmer.

South MOPAC Express lanes will run from Cesar Chavez to Slaughter Lane, for 8 miles.

From Liberty Hill in the north west, to MOPAC, the 183 toll lanes will run 23 miles.

The blue on 183 East runs another 8 miles.

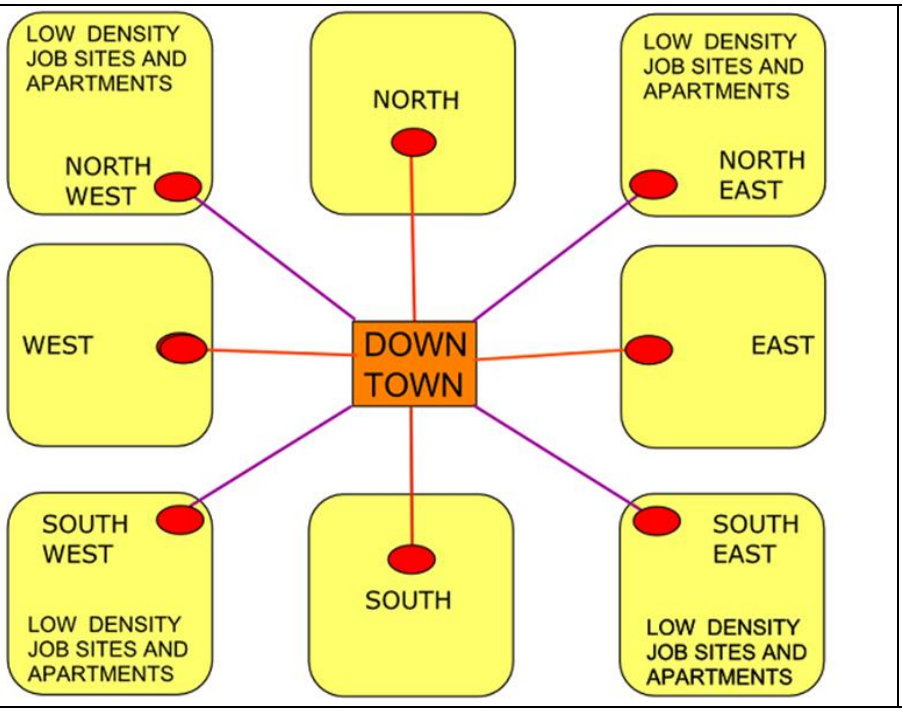
The extent of tolled & managed lane miles will be over 106 miles in the Austin metro area.

Why would riders use a TNC express bus rather than conventional transit? Conventional transit suffers from several serious flaws:

- It is too slow
- Transfers are not sheltered
- There are long waits between bus runs
- Only one commercial area gets service

Conventional transit is based on the obsolete belief that most people work and shop downtown. Transit is set up to connect many residential areas with only one commercial area: the Down Town, or central business district (CBD).




Conventional transit is slow because it serves only one commercial area with express routes and frequent service.

If you want to get from one part of town to any other, by express routes you have to go through the congested city center.

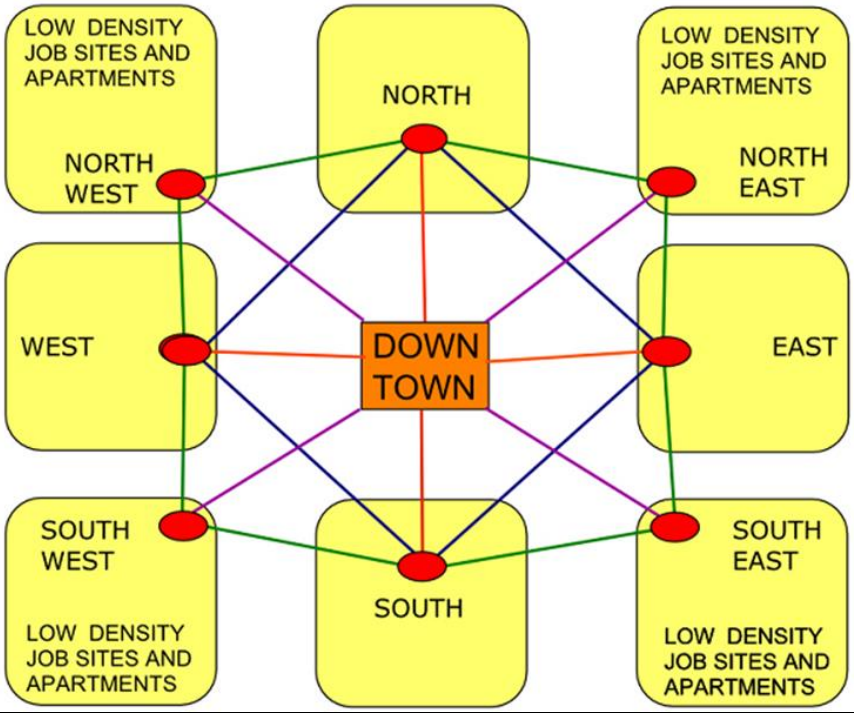
It is a Many to One express network.

Most people now shop and work in dozens of smaller commercial areas that are scattered over several hundred square miles of low-density urban area. And many people are going to work at employers that are well outside the city center. Examples of large employers far removed from city center are Apple, IBM, Samsung and Dell.

Low ridership is the result of conventional public transit's many failings. In Austin, with a population of about a million, only about 30,000 use the city bus. That is just 3%.

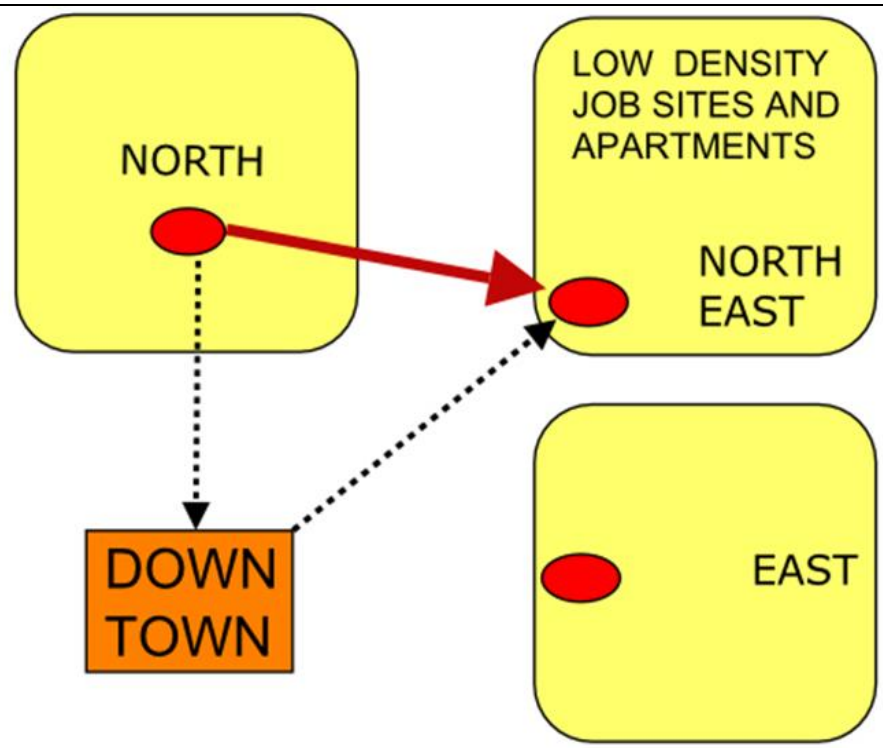
Compare that to the 40% ridership of the BRT in Curitiba Brazil. BRT stands for Bus Rapid Transit. The BRT in Curitiba has 2.3 million boardings per day, in a city with 1.9 million people. If we assume an average of 3 boardings per rider, per day, then the number of regular weekday riders is 767,000 and the fraction of people using BRT is 40%.




What Austin, and any large metro are needs is a many-to-many (M2M) system that connects many neighborhoods to many commercial areas with express routes.

This shows how such an express network would connect outlying low density areas with routes that are more direct.




With more express routes riders could get from North to North East without transferring down town.

Dotted route is the old way.

**Solid red arrow is the new**.

A more direct route would cut travel time from 120 minutes down to 60. There would be fewer miles and faster travel since the route does NOT pass through congestion at the core.

## Hubs will provide sheltered transfers

With a CMT system bus service will be greatly improved when compared with conventional transit. One reason is that hubs will support express bus operations so that travel times are reduced.

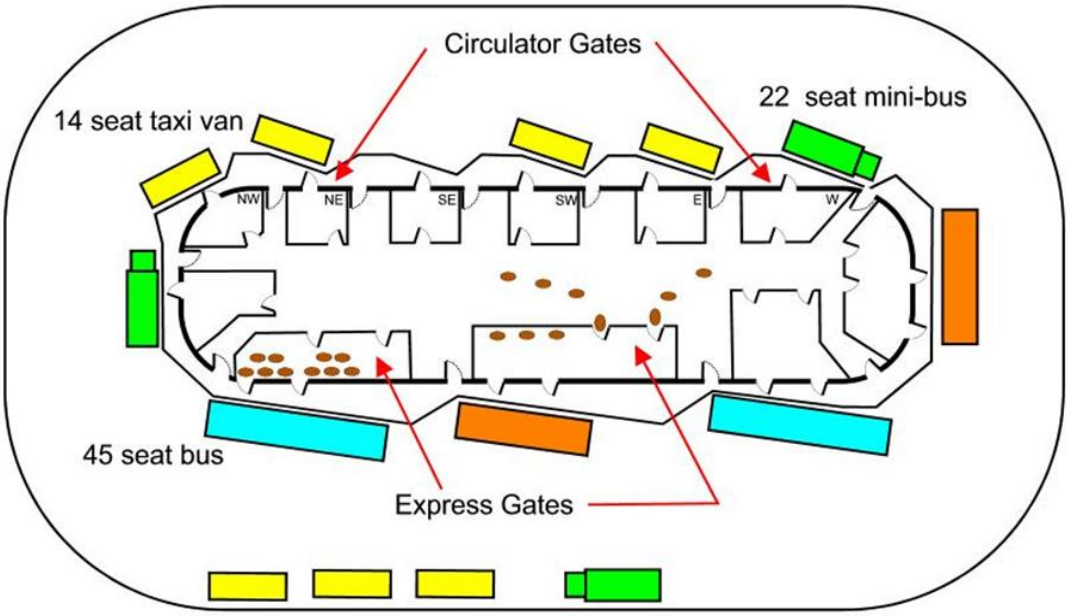
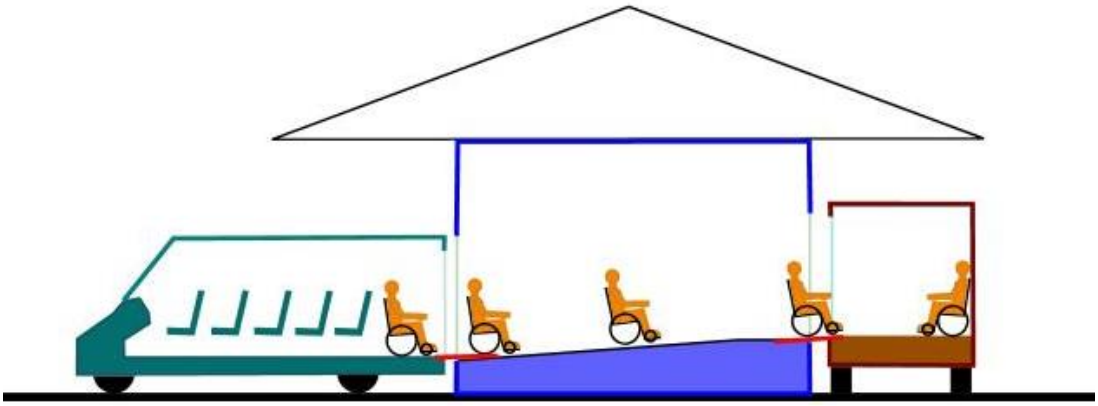
Hubs with climate-controlled shelters and other amenities will improve comfort during transfers. Reducing transfer discomfort is essential to making a two-transfer trip acceptable. Although a large fraction of trips in the peak hours will be single transfer, most trips in the off-peak hours will require two transfers.

A hub will have air conditioning, access control, a security guard, bathrooms, bike lockers, cushioned seating, and displays showing wait time for each route. With express and feeder routes running every ten minutes the average transfer wait will be only five minutes.

The hub will have several fast-board gates for express buses. There will also be several smaller gates for feeder or circulator routes. These will have bays big enough for vans and minibuses. Gates will have seating. Riders will enter a gate by paying fare with a smart pass at a turnstile. Up to 60 riders will collect at a gate within three minutes. They will then board a bus, without paying fare, in under a minute, as you would on a subway.

The BRT (bus rapid transit) in Curitiba Brazil uses subway style fast boarding gates for buses. The fast boarding gates are level with the bus deck. An automatic bridge connects the two. Riders in wheelchairs can cross this bridge without assistance. All riders in the gate can board quickly since they have already paid fares to enter the gate.

The central hall will also have seats along with ride request terminals and destination and gate displays.

<table>
<tr>
<td> 
</td>
<td>Each hub will have an enclosed climate-controlled waiting area.<br><br>There will be amenities like bathrooms, water fountain, and security guard.<br><br>There will be large bays with gates for buses and smaller bays for vans.</td>
</tr>
<tr>
<td>  </td>
<td>A rider in a wheel chair is shown leaving a van on the left, then rolling across the transfer platform and rolling onto a bus on the right.</td>
</tr>
</table>

Sheltered transfers will reduce transfer penalty. Transfer penalty is a metric which includes transfer time and conditions. As conditions are improved with airport like amenities, such as AC, the penalty goes down. A sheltered transfer will have a lower penalty than an exposed transfer. Transfer penalty is deduced, by transit researchers, as they observe how riders use a system with multiple route options.

While an unsheltered transfer with infrequent bus service can have a high penalty of 45 minutes, a sheltered transfer with frequent service has a low penalty of only five minutes. Transfer penalty in the London subway is estimated to be only five minutes. Riders will be willing to make two transfers when the penalty is only five minutes.

On express routes the bus will make a profit by collecting more fares. In the cost comparison shown below both buses are operating at peak hours. The conventional service route, with ten stops per mile, loses $58.75 per hour. The CMT express will make a profit. The CMT express will travel faster with more riders and hence provide more passenger miles per hour. A CMT express bus will travel faster because it has at most 4 stops on a 20 mile route. It will carry more riders because it will take on 20 to 40 riders at a single hub stop.

| Conventional Service route | |
|---|---|
| 15 | mph |
| 3.5 | boardings per mile |
| 50 | cents per boarding |
| $ 26.25 | fares per hour |
| $ 85.00 | cost per hour |
| **$ 58.75** | **loss / hr** |

| CMT Express route | |
|---|---|
| 30 | mph |
| 20 | riders |
| 20 | cents per passenger mile |
| $ 120.00 | fares per hour |
| $ 80.00 | cost per hour |
| **$ 40.00** | **profit / hr** |

First and last mile trips would be served by a mix of modes, as described earlier. Both private and public entities could contribute to providing this service. STV and sedan-pool, provided by a TNC, would make a profit. Feeder buses operated by the local transit authority would operate more productively resulting in little or no subsidy per rider.

The feeder buses operated by the transit agency would require little or no subsidy because they would only be used on routes and at times when ridership is high.

Feeder bus trips would run every seven to ten minutes. Compare that to most existing bus routes like the 392 along Braker Lane that make riders wait up to 45 minutes for the next bus.

You might ask: Are there any precedents for a transit system like CMT?

As far as I can tell CMT has never been tried. There are, however, precedents for some of its components.

Express Route Precedent

BRTs in Curitiba and Bogota have fast board gates and dedicated bus lanes. The result is high performance, low subsidy and high ridership. BRT stands for Bus Rapid Transit. Wikipedia has a long article on "bus rapid transit". The BRT in Curitiba has 2.3 million boardings per day, in a city with 1.9 million people. If we assume an average of 3 boardings per rider, per day, then the number of regular weekday riders is 767,000 and the fraction of people using BRT is 40%.

Flatiron Flyer from Denver to Boulder, has express buses running on managed lanes serving stations with parking lots and pedestrian bridges.

Company Shuttle Precedent

Eleven tech companies in San Francisco bay area run shuttle buses that are free to their employees. Apple runs a bus from San Francisco 31 miles south to the corporate campus in Cupertino. Search with "google bus" to see related articles.

Shared Taxi-Van Precedents

Shared taxi Vans are a big part of public transit in many developing countries. Search on the string "shared taxi" to see a lengthy Wikipedia article.

The dollar vans of Brooklyn NY operate with no taxpayer provided subsidy. These vans provide 45 trips per hour while the city bus provides only four. 830 vans have 100 to 120,000 boardings per day. Van drivers charge each rider $2, the same fare as the city bus.

In Cape Town, South Africa over 60% of South African commuters use shared minibus taxis (16 seater commuter buses). These are not subsidized by the taxpayer.

In Atlantic City New Jersey, Jitneys have been in service since 1915. These are not subsidized by the taxpayer.

Mexico City, with a population of 22 million, has an estimated 28,000 Peseros (mini-buses). These Peseros are not subsidized. Because drivers are motivated by fare collection they rapidly respond to shifting demand. There are an estimated 1500 routes. Many of these routes start at subway stations. Each station provides a steady stream of travelers trying to get the last three miles. Fares are as low as 26 cents for a three mile trip.

Other examples are jeepneys in the Philippines, the Dolmus in Turkey, marshrutka in eastern Europe. Hong Kong has the public light bus. These small vehicles are not subsidized.

The pages above explain how CMT would be an improvement compared to conventional transit. But how does it compare to the personal car? Let's compare the cost of a trip by car with the same trip by CMT.

## Compare full cost of a car ride with a CMT trip in 2020

Consider the case of an Apple employee traveling 20 miles from home to work. If they drive a car the full cost is $22.00. A trip by CMT would cost $5.10. Since Apple provides a $100 a month mass transit allowance, the cost after allowance would be only $2.60.

The CMT trip cost includes a first leg by TNC STV (shared taxi-van) costing $1.50 and second leg of 18 miles by bus at 20 cent per mile for $3.60. The total is $5.10 one way.

The car trip cost has two parts: car cost, $11.60, and driving labor, $10.40.

The IRS car use rate is 58 cents per mile. For 20 miles that car cost is $11.60.

If we assume the driver should be paid $13.00 an hour [1] for driving labor, then for a 48 minute drive the labor cost is $10.40. This $10.40 reflects the difference between riding and driving. As a rider one is free to work or relax. A rider can text and send emails, or even write computer code. In contrast, driving labor is boring, unproductive and stressful. Long term exposure to stress degrades quality of life.

Fast forward ten years to when we have self-driving buses, vans and cars:

## Compare cost of a ride in a self-driving car with a CMT trip in 2030

Consider the case of an Apple employee traveling 20 miles from home to work. If they ride in a personally owned, self-drive car the cost is **$11.60 one way or $23.20 round trip.**

A trip by CMT would cost $2.80. Since Apple provides a $100 a month mass transit allowance, the cost after allowance would be only **60 cents** for the round trip.

The CMT trip cost includes a first leg by TNC STV costing $1.00 and second leg of 18 miles by bus at 10 cent per mile for $1.80. The total is $2.80 one way. Bus and STV costs are lower with self-drive tech. Driver labor cost is eliminated.

The IRS car use rate is 58 cents per mile. For 20 miles the self-drive car cost is $11.60. That does not include tolls. Many of the faster roads in Austin are tolled.

As explained above, CMT beats conventional public transit because it is faster. And CMT is cheaper than the personal car. Now let's talk about the profit potential.

[1] average wage in Austin is $26 an hour. Half that rate is used because a bus rider is limited in how they can use their time.

## Profit Potential of Hub Connected Mobility Services provided by a TNC

Ridership assumptions: Austin MSA population by 2030 will be 2.3 million. Half, or 50%, will work. Percentage of workers that travel 15 or more miles is now 28%. The percentage that are low income is 34%. Low income people are below twice the FPL (Federal Poverty Level)

R1) Long distance working commuter potential = 2.3M x 0.5 x 28% = 322,000 riders

R2) Short distance, low income worker = 2.3M x 0.5 x (1-.28) x .34 = 281,000 riders

R3) Non-working & low income = 2.3M x 0.5 x .34 = 391,000 riders

Total ridership potential = (R1 + R2 + R3) = 994,000 riders

The ridership potential of 994,000 is reduced to 300,000, since many will choose to continue to use a car. Three hundred thousand would be about a third the ridership per capita that BRT has in Curitiba Brazil. This ridership estimate is used in a later calculation of income.

Total annual income projection, $240 million, is explained in more detail below:

First let's explain sources of revenue and profit per person trip:

### TNC (transportation networking company) naming

The TNC that owns hubs will be called TNC-H. TNCs that do not own hubs are called TNC-K. The assumption is that TNC-H dominates the market by owning hubs. TNC-H uses hubs to enhance the productivity of its services while taxing the services from TNC-K.

### Hub access fees

The TNC-H would own and operate hubs. Riders arriving by park-n-ride, bike, kiss-n-ride or TNC-K services would pay a 50 cent access fee to walk into the hub. Hub access will be restricted to paying riders so that it does not become a camping area for the homeless.

### TNC pool

Estimated TNC pool fare per rider would be $2.50. Estimated profit per rider: 50 cents for pools collecting 3 riders over a 3 mile route. TNC-H pool riders would walk into the hub for free. TNC-K pool riders would have to pay a 50 cent access fee, for entry to hub, every trip.

### Shared Taxi-Van (STV)

Riders will pay about $1.50 to ride an STV for the two miles from home to hub. If the take rate is 20% then TNC-H makes 30 cents per rider. Shared taxi vans (STV) provided by TNC-H would provide riders the benefit of getting into a hub free. Any other first mile mode such as bike or Kiss-n-ride would have to pay a 50 cent fee to enter hub.

## Express Bus

The typical Express bus would average 30 mph with an average of 20 riders on board thereby providing 600 passenger miles per hour. If TNC-H charges 20 cents per passenger-mile this would generate 120 $/hr. The cost to operate a bus would be about $80 per hour. Profit per hour would be $40. Riders served per hour would be 30. Profit per rider would be $1.33. As owner of the hub and its fast board gates, TNC-H can prevent any competitive express bus provider, such as another TNC, from docking at hub gates.

## Hub Gate Fees

Transit Authority feeder buses wishing to dock at a hub's fast board gate would pay a $10 gate fee per docking. The local transit authority will be motivated to use the fast board gates because it will increase their ridership. Transit authorities want to increase ridership to justify their existence to the public. Without public support they could lose their subsidy provided by taxpayers. Corporate shuttle vans would also pay a few bucks for each docking at a fast board gate.

## Real Estate Value Capture

TNC-H could buy or lease properties near the hub. Thousands of person trips per day through a hub will increase the market value of nearby properties.

## Service Synergy

The TNC-H's mobility services, which include pool, shared taxi van (STV) and express bus, will complement each other and result in more customers for the combination of services. The STV becomes a profitable service because the hub provides a place to drop off 14 riders at one stop. Express bus becomes a profitable service because the bus can pick up 20 to 40 riders at one hub stop. TNC pools can also operate more productively by dropping off a full load of three riders at one hub stop.

## Summary of profit by income source:

The full ridership potential of 994,000 is reduced to get 300,000. This would be about a third the ridership per capita that BRT has in Curitiba Brazil. In the express bus calculation shown below, there would be 300,000 riders, each making 2 bus trips per day for 250 days per year.

Profit by service type is shown below:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | weekday riders | |
| | | | | | | 300000 | |
| service | express trip per day | work days per year | profit per rider | fraction for mode | users per day | annual profit | |
| Express Bus | 2 | 250 | $ 1.00 | 1 | 300,000 | $ | 150,000,000 |
| | feeder trip per day | | profit per rider | | users per day | | |
| Shared Taxi-Van | 4 | 250 | $ 0.30 | 0.5 | 150,000 | $ | 45,000,000 |
| | trips per day | | | | | | |
| Sedan-Pools | 4 | 250 | $ 0.50 | 0.1 | 30,000 | $ | 15,000,000 |
| | trips per day | | profit per walker | | | | |
| Walk ins | 2 | 250 | $ 0.50 | 0.4 | 120,000 | $ | 30,000,000 |
| | | | | | | profit per year | |
| | | | | | | **$** | **240,000,000** |

Capital costs for 20 hubs can be financed for about $2.3 million a year. This is based on 20 hubs costing $1.8 million each and loans at 4% over 30 years. A hub lot would be 450 feet long and 200 wide and cost about one million. The hub building would be 300 feet long and 60 feet wide. Construction cost would be about $720,000.

## Environmental Impact

Buses powered by battery are now technically and economically feasible. Riders that give up the gas burning car and start riding an electric bus will have a much smaller carbon footprint. Even if the bus were a hybrid the CO2 per rider-mile would be reduced by a factor of four. A TNC will be motivated to use electric buses as they have a lower per mile fuel charge. They also create a cleaner and quieter environment in the vicinity of the hub. While diesel buses are loud, smelly and emit black smoke, an electric or hybrid would be clean and quiet. A TNC that uses electric buses will enjoy more "value-capture" from properties near the hub.

# Conclusions:

- CMT will allow riders to relax during stress free commutes that have door to door travel times comparable to travel by car.

- CMT Express routes running long distances on tolled or managed lanes, and with only two to four stops, will be much faster than conventional bus routes.
- Rides on CMT will be cheaper than driving alone in a car.

- Hubs will support express bus operations by collecting and distributing riders.

- Hubs with airport like amenities will reduce transfer penalty to a level that makes two transfer trips popular.

- All privately operated mobility services that support a CMT (Express bus, shared taxi van, and TNC pool) will be much more productive as they pick up and drop off full loads at hubs.

- The TNC that has hubs will make a profit while serving most of the mass transit riders within the metro area.

Please send comments and questions to

Richard Shultz at rempshultz@sbcglobal.net or 512-203-5397