Alternate Dumbarton Bridge Plan

The reason for this note is to suggest an alternative plan to capture the benefit of the old Dumbarton Railroad Bridge. My suggestion is to use the bridge as a roadway for electric cars under computer control. In what follows I will endeavor to explain how this approach would provide more capacity, more convenience, and be cheaper than rail transit. Rail is very twentieth century. A computer controlled electric car system would be very twenty-first century. Facebook and Silicon Valley would be embracing the future and leading the way. With nominal tolls the system could even make money.

Let’s start with some simple math. A stream of autonomous cars following each other closely at say 20 feet center to center would contain 5280/20=264 cars per mile. If the cars are going 60 miles per hour, one mile per minute, then 264 cars would pass each minute. That’s 15,840 cars an hour.

A lane of freeway, under good conditions, is generally reckoned to carry 2,500 cars per hour. So, a single lane of computer controlled cars can be equivalent to 6 lanes of freeway. In a traffic choked world we must think about it. Of course, that continuous stream must be separated from normal traffic. The old Dumbarton Bridge naturally provides such separation. Beyond the Bridge, for high speed streams through suburbia we must think tunnels. This is our starting point.

We all know the world must get off fossil fuels. Tunnels mandate it - electric cars only. A tunneled road system that is only for computer controlled electric cars could precipitate the switchover to electric cars. Silicon Valley would seem the place to pioneer such a system. And the Dumbarton Bridge is a perfect starting point. Once perfected, selling such a system around the world would be profitable. But most importantly, it would help save the planet’s atmosphere. Build it and the electric cars will come.

Coordinating the movement of 15,000 electric cars an hour through a single lane seems formidable. Controlling an extended system of many such lanes more-so. But, it’s a Silicon Valley type problem. The control program needs to start here. Maintaining it, updating it, and customizing it to cities everywhere would be a business - Windows for our daily movements.

Here is just one possible scenario: The bridge would be for several parallel lanes of small light autonomous electric cars. On the East side the road would disappear into a tunnel with branches to, say, Oakland, Walnut Creek, Brentwood, and Livermore. On the Peninsula side traffic would briefly stay on the surface and then divide into two tunnels, one along the bayfront to Google and Cisco and the other south to Stanford and Apple. Two short tunnels would go into Facebook.

Tunneling alleviates many concerns, but what about the cost? The answer is: tunneling can be much cheaper than commonly believed – just ask Elon Musk! Also, tunneling is environmentally benign and provides less foothold for nimby lawsuits. Our tunneling would become economically feasible by tunneling as much as possible in the hills and as little as possible beneath low-lying built up areas (see attached Google Earth kmz file). Much more about tunneling cost to follow.

There are many advantages to an electric car based system:

1. Convenience. We love our cars. Cars solve the first and last mile problem. Your trip starts at your house and ends at your destination.
2. Rapid transit. You drive to a tunnel system entrance. From there on its autonomous. Because it would be totally computer controlled it would be fast and efficient. Entrance to the bridge and underground roads would be regulated to maintain a nominal speed, say 60 miles per hour. BART averages 28 mph.
3. Passenger capacity. A single lane of single occupancy cars platooning closely together could move 15,000 people an hour. Two people per car would provide the capacity of a transit system. As the car moving capacity of the system becomes filled carpools would be given priority. Central to this concept is on-line real-time ridesharing. Consider the math for two lanes of cars with 3 passengers per car closely following at 60 miles per hour. The throughput is more than any heavy rail transit line. At twice the speed and nobody standing jam packed.
4. Bridge capacity. The railroad bridge was built for railroad loads. Four parallel lanes of closely packed electric cars would be only a fraction of railroad loading. The largest cost to the bridge’s rehabilitation would be a submerged tube at the swing bridge portion. Or, one could close the road and swing the bridge only between 3 and 4 a.m., on demand, and for a fee.
5. Cost. For many reasons an underground road system for autonomous electric cars would cost very much less than a rail system.
6. Tunneling minimizes noise, surface disruption, and environmental and community impact. Fewer nimby lawsuits. Still, enabling legislation would be required.
7. No stations. Stations are for waiting. A major component of the cost of conventional rail systems is the cost of stations, often monumental in scale. Cars would enter and leave our electric car system autonomously, on ramps, by driving. An electric car based system would have no stations. To facilitate carpooling there could be passenger loading areas in no-longer-needed parking lots.
8. Small tunnels. Two parallel lanes of small cars would require tunnels half the size of conventional rail transit tunnels.
9. No rolling stock and associated maintenance facilities. Individuals, rideshare, and carpooling companies would own and maintain the vehicles, as on the roads today. The overseeing operating system would constantly monitor every detail of every vehicles condition.

Learned people everywhere agree that pumping CO2 into the atmosphere is a problem, and that switching to electric cars will be helpful. Here we have a chance to speed up the transition to electric cars by making them mandatory. If your ticket to the bridge requires an electric car, chances are you’ll use it the rest of the time too.

Similarly, during rush hour we may want to give priority to on-line real-time carpools. That is people near you who are going close to where you are going. Travelers would be computer arranged in the instance into a shared car. This would markedly reduce the tons of iron rolling around and could also produce beneficial socialization side effects.

Tolls: Analysis shows that moderate tolls could pay for the bridge, and could also bring in lucrative profits. Such tolling could be structured to social objectives. For example, tiered tolls: Top price 1a, single occupancy; tier 2a, two occupants; tier 3a, three occupants, etc.; tier 1b…4b same but for cars recharged with renewable energy, etc.

The Dumbarton Railroad Bridge could be a catalyst for a 21st century transportation that is more convenient, faster, and cheaper than 20th century rail technology. The world needs the environmental benefits. As we have seen, if Silicon Valley pioneers and proves a new technology, the world follows.

Phasing (for phase maps see Google Earth kmz file attached)

1. Bridge Rehab. Dumbarton Bridge from Newark to Facebook two lanes for autonomous electric cars only. East to west in the a.m. West to east in the p.m. Feeder lanes and distribution lanes will be required at each end. This will be proof of concept.

2a. Eastbay Outreach. Tunnel under Newark into the hills and then divide into branches north to Oakland and Walnut Creek and east to Brentwood and Livermore.

2b. Silicon Valley. The Phase 2a Eastbay Outreach tunnels would feed greatly increased traffic across the new Dumbarton Bridge, so simultaneously we would need to build distribution tunnels to Silicon Valley employment centers. A Bayfront line could bring commuters to Google and Cisco. A Westside line could circle under Stanford, Sand Hill, and then south under the hills to Apple.

3a. Extensions East. Extending the Oakland tunnel to Richmond, the Walnut Creek tunnel to Concord, and the Livermore tunnel to Tracy would further promote electric car adoption.

3b. Extensions West. With Phase 3 extensions east, increased traffic might then require double decking the bridge to four lanes. Distribution of rush hour traffic simultaneously could be extended on the Google/Cisco line to the airport and downtown San Jose. The Stanford/Apple line could be extended to Diridon Station and to the airport to complete the loop (see Phase 3 map). The Tesla line could be extended south to Fremont and East San Jose.

4. Hwy 17 Supplement. The Santa Cruz coast is a desirable living area. But the highway from Santa Cruz is overcrowded and accident prone. An electric car tunnel from the Santa Cruz Coast to Silicon Valley would save lives and be beneficial environmentally.

5. San Francisco. Eventually, starting at Facebook, two parallel tunnels, one for each direction, could be extended under the peninsula ridgeline to San Francisco with many on and off ramps along the way.

Tunneling. A system based on electric cars in tunnels around congested metropolitan areas has a compelling logic. It offers convenience, flexibility, speed, high capacity, and, compared to any other transportation improvement, would be cheap to build. This system should be developed here. Silicon Valley is designing autonomous cars. The first widespread underground road autonomous car coordinating system should also be pioneered here (instead of in China). As Windows is for our desktop, the overseeing control system will be for our worldly movements.

The key advance to make all this possible is much cheaper tunneling. And that is within reach. Several factors combine:

1. Rail systems require large stations with platforms for waiting. These stations are usually monumental. They are built in monumental excavations at monumental cost. An autonomous electric car system would have no such stations. Nearby no-longer-needed parking lots could serve as carpool meeting sites as needed.
2. Modern rail transit systems are built downtown and along main thoroughfares, often through soft waterlogged ground with buildings above. That is the most expensive tunneling. In contrast, as much as possible, we would mine our tunnels in the surrounding soft rock hills.
3. Tunnels in soft rock are easy to mine, and are basically self-supporting. A thin coating of sprayed concrete can be totally sufficient. Subsidence of overlying structures becomes a nonexistent worry.
4. In self-supporting ground much of the over-design common today could be eliminated. Our tunnels need not be 100% waterproof, just not too leaky. The large quantity of required tunnels would lower the unit cost due to the mass-production effect. And improved contractual provisions could incentivize contractor competition, further lowering costs.
5. Generally, in the morning people head down from the hills and crowd onto the freeways. The electric car crowd would head the other way, to a tunnel into the hillside. The control system would guide them into the queue. Each tunnel would have two lanes, one at speed, and the other for merging in and out.
6. Maintenance would be easy. The system could be closed at off hours. Everyone could still get around because we have the road system. The tunneled electric car system would be supplemental. Of course, as time progresses, autonomously traveling under computer control may well prove preferential.

Finance: Today crossing the bay is tolled. It’s slow and you must drive. Let’s suppose a beginning toll of $.25 per mile is viable. Then, at 60 miles per hour, if we use 30’ headway center to center we have 5280/30 = 176 cars traversing each mile each minute. At $.25/mile then each mile of tunnel is making $44.00/minute = $2,640/hour. Times 8 rush-hours/day, times 5 days/week, times 50 weeks/year = $5,280,000/year revenue per mile. And, we are not counting non-rush hours, or weekends, or closer headways, four lanes on the bridge, or even perhaps, dear friends, faster speeds and higher tolls. Construction costs could be returned very soon, and after that profits that could be used to build additional systems elsewhere.

The system would serve todays frazzled caught-in-congestion motoring public. By streamlining traffic, the system’s extended underground road system would reduce surface road congestion. This would help keep Silicon Valley desirable. But the major benefit would be taking a step, and leading the way to others, to transition to electric cars and the CO2 reductions that that would bring.

Developing a system that can control and coordinate the simultaneous movement of many thousands of cars throughout an entire underground road system would seem to be a Silicon Valley capability. As autonomous car systems spread around the world, selling, customizing, and maintaining such a system could be a business.

*Notes on the Phases.* If you have read this far, my thanks to you. Please note that in what follows nothing is intended as definitive, only provocative. The political process and detail engineering would make something perhaps very different. The intention is to spur imagination. My direct interest is cheaper tunneling (see my website “CheaperTunnels.com”).

Per any unit of length, four electric Tesla Model X SUVs abreast weigh no more than an equivalent length of railroad train. Bridge re-engineering for cars or trains would be comparable. Four lanes of cars, with 4 passengers in each car, at 60 miles per hour, with 20 foot headways, would be carrying 253,440 people per hour. No rail transit line comes remotely close to that capacity. And, it would be twice as fast, and more comfortable.

Phase 1 would be to restore the bridge and original right-of-way across the bay. Instead of railway with all its limitations we would start off with just two narrow traffic lanes abreast. Only electric cars under complete computer control would be allowed. The innate capacity of this system is so great that the predominant boundary limitation will always be the capacity of the existing road system to accept the discharge without backing up. Many, many on-and-off ramps will be required.

In the morning on the east side we would need feeder roads. The Phase 1 East Side Connections map shows a minimal arrangement of just four feeder connections. Paseo Padre Parkway will bring cars from Hwy. 84. and then merge with an extension of Jarvis Ave. Two onramps off Willow will bring traffic from Thornton and Central.

On the west side there are homes adjoining the track alignment. One of our basic design principles would be to avoid, as much as possible, subjecting the public to the noise and hazard of more traffic, so the main line would go underground shortly after landfall and swing wide around that housing tract. Branching tunnels would distribute traffic onto University and Willow, north onto Bayfront Blvd. and into direct tunneled ramps into the two Facebook facilities. We must note, those few on-ramps and off-ramps could, in no way, tax the capacity of one computer controlled lane, but it’s a start.

In the morning, it’s east to west. After noon, its west to east. For simplicity, we are thinking that generally these tunneled ramps daylight in the middle of the street. Exiting traffic merges right into the fast lane. After noon, the barriers automatically rearrange so the ramp now opens for entering traffic. Traffic in the other direction then merges left into the center-of-the-road tunnel access lane. To perfect the overall operational system we will need healthy traffic flows. The existence of the New Dumbarton Bridge shortcut will encourage electric cars, and more electric cars will necessitate more on and off ramps.

Phase 2a would extend the eastside catchment area. From Willow Avenue east it’s all tunnel. For illustrative purposes, we tunnel east under Decoto Road into the foothills. Staying in the hills, we branch out to Oakland, Walnut Creek, Brentwood, and Livermore. Each branch would have multiple ramps. Also, east of the bridge, one might provide a tunneled distribution road to Tesla (see Phase 2a map).

Phase 2b would divide traffic beyond Facebook into two streams: the Westside tunnel would go to Stanford and Apple, the Bayside tunnel to Google and Cisco. Each would have ramps at points along the way. At the completion of Phase 2 a greatly expanded residential area would have a reasonable commute to Silicon Valley. Phase 2 is demonstration to the world.

Once agreed upon, and given enabling legislation, all this could conceivably be built in a few years. The unspoken precondition here is permission. Enabling legislation would be required. Generally, that would be the hardest part. But in liberal California, if it was framed as a pressing environmental boon, and Silicon Valley’s leaders got behind it, perhaps we could be building it soon.

Caveats

1. Cost. The Laerdal Tunnel in Norway is the longest road tunnel in the world. It is 15.2 miles long (there are several interesting YouTube videos). It is sized for two lanes of trucks and has regular extra wide pullover areas. It is much larger than we would need for two lanes of autonomous electric cars. It was blasted through rock much harder than the easily mined Bay Area hills. Total cost was 113 million dollars, about 7.5 million dollars per mile. Any American organization contemplating construction of underground roads for autonomous electric cars should study the Norwegian Method. We should then structure our contracting arrangements with their example in mind.
2. Push and Be Pushed. Every vehicle must be able to push and to be pushed. To be most economical the tunnels must be small, just large enough for two lanes, one for cars at speed and one for merging in and out. If any car breaks down, we can’t have all the others swerving around it. The car behind simply pushes it out of the way to the next pullover area or exit. Obviously, there will be occasions when this is untenable. The system will need some sort of scooper trucks for such rare occasions. In assessing this caveat we should keep in mind that these are all computer controlled cars. Each cars’ battery charge and all operating parameters are constantly monitored. No vehicle enters without plenty of charge and all system parameters on go.
3. Enabling Legislation. The only way a system of underground roads for autonomous electric cars could ever be built is with enabling legislation.
4. Eminent Domain. As the railroads once had and road departments and utilities have today, the builders must have a way to build it where engineering dictates.
5. Corollary to this is *no delay*. As part of the enabling legislation judges would be enjoined to not allow any delays. Lawsuits could be heard and settlements made but only *after the fact*. We all want fairness, but delaying lawsuits have become extortionate. It is ironic that environmental laws can be used to stall or defer projects with important environmental benefits. The State Legislatures and the Congress must act to expedite any and all electric car programs that could reduce traffic congestion and, more importantly, help abate the global climate change crisis.

This whole plan, to reduce Silicon Valley traffic congestion and incentivize the switch to electric cars, would be just a beginning. The technology must be worked out here; there is no better place to do it. But soon thereafter it must be multiplied around the world. Traffic is, or will be, even worse in burgeoning third world cities. We must be ready to rapidly proliferate the electric car and tunneling technologies that we pioneer here. It’s an opportunity.