San José Urban Hyperloop

RFI Response

Prepared By:

Hyperloop Transportation Technologies, Inc.

Los Angeles, California

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A. Respondent Profile

a. Legal name of the company

Hyperloop Transportation Technologies Inc.

b. Address

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c. Legal status

Corporation

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f. High-level description of the concept (do not exceed one paragraph)

Full-speed Hyperloop moves people and goods at airplane speeds safely, efficiently, and sustainably. Passenger and cargo capsules levitate just above a track and travel through a network of vacuum tubes. Proprietary passive magnetic levitation and a linear electric motor, combined with a tube environment, allow the capsules to move at high speeds with minimal friction. Hyperloop travel allows people to live further from their jobs, changing travel time from hours to minutes and creates economic opportunities throughout the connected region. With Hyperloop features and advantages, Urban Hyperloop is a fully autonomous guideway system that provides passengers a seamless transit experience. It travels in a lower-speed profile on wheels inside an upgradeable vacuum-ready tube system. The infrastructure with a relatively small tube enclosure, is designed to fit well in urban environments - it can be implemented above, at, or under the ground level. The system is engineered to be community-friendly with a low environmental impact. Leveraging the enclosed tube structure and its autonomous self-driving system, it lowers maintenance, operational costs, and initial investment, while providing a high level of safety and efficiency. Urban Hyperloop leverages many proven technology systems and their subsystems applied in Full-speed Hyperloop, and is built to be easily upgraded into a full-speed HyperloopTT system. Connecting with first/last mile options, the Urban Hyperloop solution provides passengers a seamless transit experience.

g. High level description of business plan

Through the use of unique patented technology and an advanced business model of lean collaboration, open innovation, and integrated partnership, Hyperloop Transportation Technologies Inc. (HyperloopTT) is developing and licensing mobility technologies. HyperloopTT licenses to infrastructure and transportation operators who could either be public or private entities.

HyperloopTT is an industry mobilizer, facilitating the creation of an emerging mobility system through collaboration. Partnerships with public and private consortia are assembling the Hyperloop industry piece-by-piece through our technology integration framework. As HyperloopTT and others throughout the industry lead the way toward comprehensive regulations and standards, we work with stakeholders throughout the industry landscape to rethink the future of mobility.

Urban Hyperloop implements a comprehensive mobility framework that connects linear infrastructure within urban spaces to make jobs and homes more accessible with the ability to upgrade into or connect with a full-speed HyperloopTT system. By leveraging enclosed tube structure and autonomous systems, Urban Hyperloop requires low maintenance and operational costs to connect people safer. Urban Hyperloop infrastructure will be tailored to optimize the journey relative to operational speeds with an eye on obtaining higher speeds in the future.

For portions of the Urban Hyperloop corridor that are above grade, the system structures and terminals can be co-located with adjacent separated bicycle/pedestrian pathways providing a seamless experience from point of origin to destination.

B. Proposed Concept

a. Provide a high level description of your concept(s)

The HyperloopTT system is designed around creating the safest mode of transportation possible. During the early phases of designing the HyperloopTT systems, redundant safety measures ensure additional layers of protection for addressing operational issues.

Full-speed Hyperloop I Full-speed Hyperloop moves people and goods at airplane speeds safely, efficiently, and sustainably. Passenger and cargo capsules levitate just above a fixed guideway and travel through a network of reduced pressure tubes.

San José Urban Hyperloop I With Hyperloop features and advantages, Urban Hyperloop is a fully autonomous guideway system that provides passengers a seamless transit experience. It travels on wheels in a lower speed profile inside a vacuum-ready tube system, and its network will be interoperable and compatible with full-speed Hyperloop connections. It is designed to be human-centric with low environmental impact, low investment, high safety level, and high efficiency.

	Full-speed Hyperloop	Urban Hyperloop
Tube	✓	✓
Passive Magnetic Levitation	✓	
Track	✓	✓
Vacuum System	✓	Optional
Renewable Energy Sources	✓	✓
Maximum Speed	760 mph	125 mph
Tube Diameter	4 m/ 13.1 ft	4 m/ 13.1 ft
Capsule Length	32 m/ 105 ft	32 m/ 105 ft

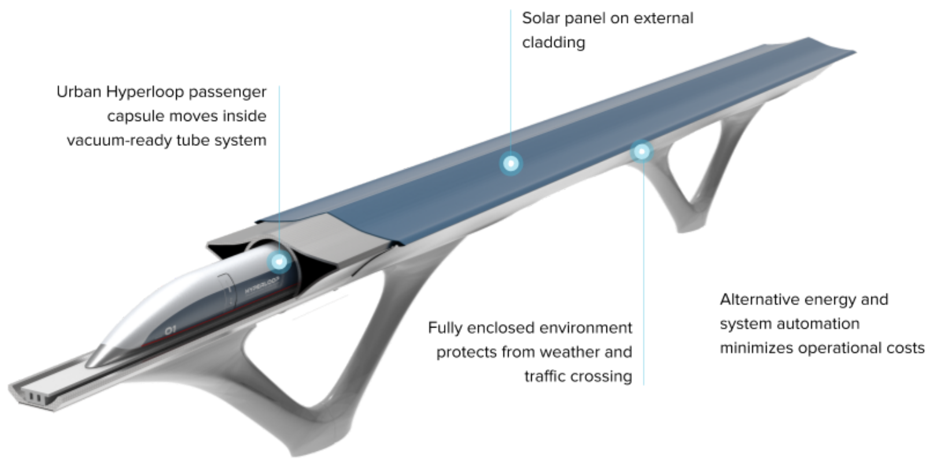
Siting of the Urban Hyperloop system is flexible since the system operates at grade, above grade, or underground and can integrate into existing spaces and areas where cities would like to facilitate economic development.

C. Physical Elements

HyperloopTT's Urban Hyperloop system is a vacuum-ready enclosed corridor includes a guideway, an enclosure, a climate controlled capsule operating on the linear system, a passenger portal between the capsule and the passenger station, ingress and egress points along the corridor, emergency access, and auxiliary maintenance facilities.

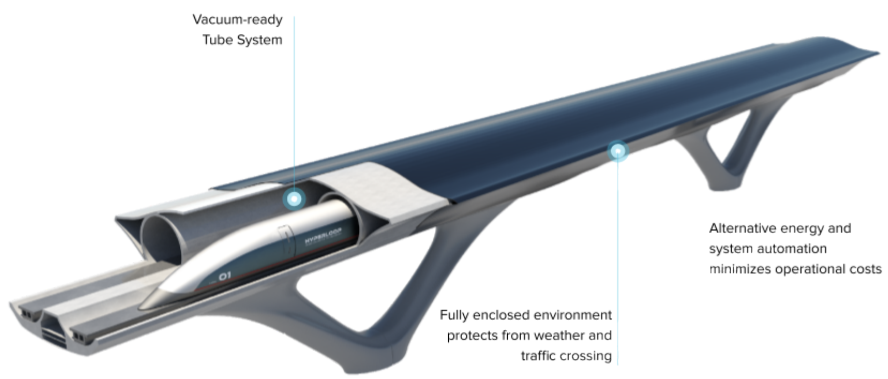
a. Describe the guideway

The linear infrastructure for the HyperloopTT system includes the fixed guideway as a running surface for capsule wheels. The guideway is affixed within the interior of the tube infrastructure.



HyperloopTT Urban Hyperloop System - Bi-directional Single Tube Shuttle System (Rendering)

Where the route corridor is a dual guideway system---as in, one guideway for each directional tube---the guideway is a contiguous looping structure that supports the dead and live loads of the capsules and its components.



HyperloopTT Urban Hyperloop System - Looping Multi-capsule System (Rendering)

i. **What does it look like for a person walking by, and for a person using the system**

Urban Hyperloop enables cities to reclaim some of their surface level from transportation infrastructure. The system can be grade-separated by going completely underground or be elevated on pylons with additional functions (e.g. vertical gardens, e-mobility charging stations, etc.). WhenAlong the subsurface, the most substantial impact the HyperloopTT system would have on the surrounding cityscape would be in the untapped potential along the surface. The underground structure will just be the tube guideway without solar panels and pylons. As the capsule travels through the tube, passengers will not see any part of the structure, the capsule's augmented windows will present a controlled graphic scenery or real-time streaming view of the city.

ii. **How it is grade-separated**

The elevated configuration uses a system of pylons and foundations typically located 30 m/ 98.4 ft apart to allow tubes and solar panels to span across. With different heights of pylons and technology to go below the ground level, the Hyperloop structure would be completely grade-separated except in transition zones between above and below-grade segments..

iii. **What are its right-of-way needs**

The structure can be 100% underground with ventilation/ emergency exit shafts. Tunnel depth below the surface would be approximately 30 ft minimum clear below the surface, designed to minimize infiltration of air or water and to accommodate seismic design requirements. When necessary to provide an elevated structure, easements would be required for pylon placement every 30 m/ 98.4 ft. Subterranean corridors increase the versatility for the deployment of the HyperloopTT system while reducing the ecological barriers for surface level development.

b. **Describe the stations/passenger access points**

i. **What do they look like for a person walking by, and for a person using the system?**

Urban Hyperloop stations and platforms can be similar to the traditional subway and/or light rail stations and decks. There will be some volume allocated for door lockings between the capsule and the platform, in case of upgrading the system to add vacuum operation. While capsule will be connected to the platform gate via a docking system for onboarding. Passengers boarding the capsule will just see the two docking doors to the capsule.

ii. **What are the right-of-way and land needs of a station/access point?**

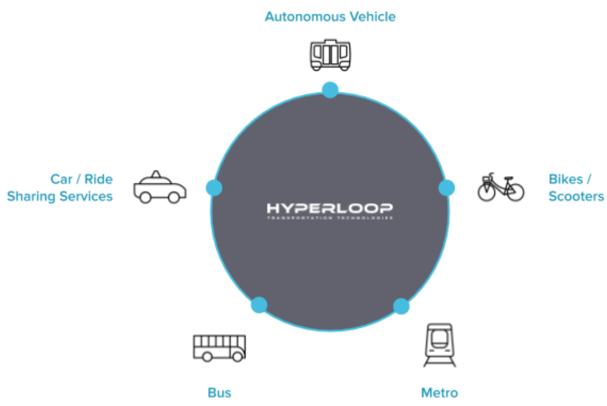
Stations can be above and/or below the ground level. The size of the station can vary due to the expected travel demands, and context of the station site, stations require a similar amount of land needed for a traditional subway or light rail system.

iii. **How will stations/access points integrate with the surrounding urban fabric on the Stevens Creek Line?**

The capacity to locate below and/or above the ground level prevents conflicts with the existing urban environment. The Hyperloop system's design integration focuses on adding a unique and seamless touch to the city.

iv. **How will the system integrate with existing transit systems?**

HyperloopTT aims to integrate as tightly as possible - both physically and digitally. Urban Hyperloop will accommodate current and future mobility solutions within Hyperloop systems and use digital payment tools to ease access for all, including trips that use different modes.



HyperloopTT prefers discussions with public and private stakeholders, and transportation authorities throughout the region, to better understand the needs of the area.

v. How will the proposed system connect with rail platforms (either BART or other heavy rail) at Diridon Station?

The Urban Hyperloop linear infrastructure could interface with the Diridon Station through a subterranean, at grade, or elevated terminal portal. Station integration with other rail platforms is a possible option but requires further study for its feasibility. HyperloopTT currently collaborates with partners on station integration concept options for several locations globally.

vi. How will the proposed system connect with airport facilities and parking at SJC?

The Urban Hyperloop system builds on existing transportation networks and easily integrates into existing spaces like parking lots. Establishing a direct terminal connection to parking facilities along the guideway corridor enables the Urban Hyperloop to synchronize with existing transportation modes and facilities.

The exact points where the Urban Hyperloop station would physically interface with surface-level facilities would require a more detailed study that outlines more substantively some of the alignment objectives for the Parties along the proposed corridor, along with costs to implement a particular embodiment of the system, and potential expansion opportunities for the system in the future.

vii. How do the system's vehicles operate within the network?

HyperloopTT aims to optimize the system's operation by collecting big data, and utilize AI applications to let the maximum number of passengers experience the most convenient trip. HyperloopTT is open to discuss with the local authority and stakeholders to find the needs and customize the system accordingly.

viii. Is there level boarding?

Yes, Urban Hyperloop capsules allow for a flat boarding floor and full ADA accessibility.

ix. How will the system be designed to be compatible with "complete streets" if the system is aerial?

An elevated Urban Hyperloop concept has a minimal footprint on the existing street network, with pylons spaced every 30 m/ 98.4 ft. HyperloopTT is also able to co-locate elevated bicycle and pedestrian facilities on the elevated infrastructure if desired.

x. If the main guideway is aerial or underground, how do passengers get to grade level?

Access to above-ground or underground stations is provided via well-lit elevators, escalators, stairways or ramps.

c. Describe the vehicles

i. What do they look like for a person walking by, and for a person using the system?

The Urban Hyperloop uses a capsule-shaped vehicle inside a 4 m/ 13.1 ft diameter tube. Inside the fuselage, passengers will feel a similar amount of space as in bus, but see the capsule-shaped round interior. The exteriors of capsules are not typically seen by the public unless desired.

ii. How many passengers and how much baggage can fit in a vehicle?

Each capsule carries 28 - 50 passengers and sufficient space for all luggage. Optimization of capsules to trips will allow capsules with more room for luggage to be dedicated to airport trips.

iii. How do passengers board and alight from the vehicle?

On a platform deck, passengers will board and alight through two docking gates on the side of each capsule.

iv. What is the top speed, and how quickly is it achieved?

The top speed of Urban Hyperloop is approximately 125 mph on a straight, flat stretch of corridor. Acceleration/ deceleration is maximum 0.1 G to allow passengers to comfortably stand and move around the capsule.

v. Are vehicles autonomously operated?

Yes.

vi. What vehicles do when they are not operating?

Urban Hyperloop capsules are stored in a maintenance facility inside the station or a separated yard where they are charged and undergo various maintenance tasks.

vii. Do the vehicles require space off the guideway for storage?

Yes, Urban Hyperloop capsules will be stored at terminal stations, or at a maintenance facility.

viii. How are vehicles powered (e.g. number of facilities, connection to the system, size of facility, etc.)?

The capsule carries battery modules. It also uses regenerative braking for energy collection.

ix. Do the vehicles need to move or be moved in order to be redistributed to meet demand on a regular basis? Describe how this is performed (by operator, autonomously, by user, etc.) and how often.

Redistribution will be pre-analyzed in accordance with demand. Such analysis will supply data to the HyperloopTT system to provide distribution autonomously overseen by the operator. This will be aligned to meet operations and maintenance needs. The HyperloopTT system will adjust to unexpected demand promptly utilizing real-time data.

d. Provide pictures or renderings of all physical elements of the system.

Rendering models shown above in Section B and C. Proposed concept in Appendix c.

D. Operational Elements

a. **Describe the operational model**

i. **Can the vehicle travel outside the grade-separated guideway (e.g. provide point-to-point service utilizing city streets?)**

The Urban Hyperloop system resides completely within the HyperloopTT fixed guideway system, utilizing last mile solutions available at the Urban Hyperloop stations.

ii. **What is the potential travel time from SJC to Diridon?**

Urban Hyperloop's potential travel time from SJC to Diridon (5 mi) is approximately 8.5 min.

iii. **What is the potential frequency of the service?**

The potential frequency is based initially on a 2-minute headway. The system can reduce it to 40 seconds during peak demand. A further feasibility study is required to find detailed information.

iv. **What is the potential passenger carrying capacity?**

The Urban Hyperloop capsule has a capacity of 28 - 50 passengers per capsule.

v. **How can capacity scale up if demand exceeds initial supply?**

The system can reduce headway between capsules, and add extra capsules. Far-future expansion of more tunnels/ tubes can be considered as well.

vi. **What is the dwell time of a vehicle at a station?**

HyperloopTT's autonomous system controls the entire process by recognizing real-time travel demand. With sensor technologies to adjust, enough time will be provided for passengers to board and alight.

vii. **What is the reliability of the service?**

Urban Hyperloop is designed to adopt the latest sensing technologies to monitor the structure and use data analytics and predictive maintenance to maximize reliability. Urban Hyperloop's integrated logistic support (ILS) process is designed to maximize availability and reliability.

viii. **Can the service be ticketless? If so, how will fares be collected?**

The main ticket service will be through a digital platform, but there will be additional services to maximize accessibility including physical service points.

E. Current Status of Concept Technology

a. **Provide a description of the current development status of your concept (e.g. conceptual, design, development, pre-production testing, or production).**

The Urban Hyperloop concept combines technologies or individual components that have existed for decades with recent breakthroughs. The Urban Hyperloop system applies HyperloopTT technology to a variety of physical settings with the exact embodiment of the linear infrastructure depending on the nature and length of the connection between the points along a route corridor.

b. **Include a schedule for development of a fully deployable system, if applicable. Identify key assumptions for this schedule.**

The key elements of the technology/ IP package for a full-scale HyperloopTT system is ready for licensing.The world's first full-scale Hyperloop prototype has been built and currently tested in Toulouse, France (320m/ 1050ft track). Within the next year, HyperloopTT will start construction of a commercial line (5km/ 16404ft) in Abu Dhabi, UAE, which aims to be complete and operating by 2022. Urban Hyperloop follows the same product development process and timeline. The Abu Dhabi system can be used to test both Full-speed and Urban systems.

c. **Include examples of successful similar implementations if available.**

World's first full-scale Hyperloop system is currently tested in Toulouse, France (320m/ 1050ft track)

d. **Identify areas of notable risk that would be investigated further.**

An essential goal of conducting a Feasibility Study, including a study of the geotechnical landscape, will be to understand the risk analysis and management for subterranean operations as they are compared to surface-level operations. The risk register created by the Parties will identify potential risks, their probability of occurrence, and their consequences. The proposed Feasibility Study will inform the risk management plan to deal with these risks by eliminating or reducing the consequences by planning, design, or operational provisions (Appendix e).

F. Concept Requirements

a. **Describe key requirements for implementation of the system (e.g., infrastructure, utilities, regulatory and/or policy) and estimated length of time required to implement the system.**

Infrastructure: Integration within the engineering, architecture, design, and planning frameworks for development across urban areas.

Integration: Plan and design interfaces into buildings along the guideway corridor to include infrastructure within individual developments including shared vertical spaces with pedestrian links to other mobility infrastructure.

Utilities: Connect microgrids and macrogrid connectivity to a redundant network for electricity, internet or other utilities requiring physical space.

Regulatory/Policy: Interplay between density requirements for connected buildings, including local comprehensive plans for state and local government bodies, and connective infrastructure to those spaces. Any use of subsurface space will need CEPA review.

Further implementation information requires HyperloopTT feasibility study.

b. Could the system function in either an aerial or underground configuration? Could it transition between aerial and underground? What are the maximum allowable grades for the system to ascend/descend?

The Urban Hyperloop can be constructed as an elevated transit system supported by pylons, or it can be installed underground in tunnels bored, lined and sealed to prevent water and air infiltration. The transition between elevated and underground configurations is via portals as needed based on surface availability and topography. In congested urban areas, an underground system can be constructed with access to the surface via vertical circulation similar to subway systems. The maximum allowable gradient for the system to ascend/descend is approximately 10%.

c. Could the system be extended in the future?

The Urban Hyperloop system is designed to be extended in the future by adding additional tubes and guideways. All systems are modular allowing for extensions as needed. Additional capacity can be provided by adding additional capsules to the fleet, and by reducing headway to not less than 40 seconds. In addition, different cabin configurations can be applied to carry more passengers.

d. Could stations be added to the system in the future?

Stations can be added to an Urban Hyperloop system in the future as warranted. Stations can be elevated, at grade, or subsurface depending on the configuration of the existing Urban Hyperloop system. A further feasibility study is required for the specific corridor.

e. What are the maintenance requirements for the guideway, vehicles, stations, etc. ?

Guideway I One of the biggest advantages of the Urban Hyperloop system is its controlled tube environment. The guideway will be in a fully controlled environment allowing it to be weather-proof and avoid any crossings. The tube requires sensors to monitor the structural health of the guideway, temperature and air pressure.

Vehicle I The capsule will be operated in a controlled environment to minimize stress on the fuselage. It requires interior, battery and system maintenance.

Station I It will be similar to other transportation infrastructure maintenance.

G. Costs

a. What is the cost per mile to deliver the fixed infrastructure needed to operate the system, not including stations and land acquisitions costs?

Feasibility studies are underway in the US and they show on average a lower cost (OPEX and CAPEX) with comparable modes of transportation.

Urban Hyperloop's tube system is relatively small in diameter compared to other tunnel systems. It clearly benefits to reduce its costs by preventing larger boring space, easier implementation, etc. (Appendix f).

b. What is the incremental cost of a station and/or access point?

Detailed information/data can be determined by a HyperloopTT Feasibility Study.

c. **What is the cost of the vehicle fleet needed to begin operations?**

Detailed information/data can be determined by a HyperloopTT Feasibility Study.

d. **Summarize the capital costs for delivering the full system for each potential project, Airport Connector and Stevens Creek Line.**
Assume six stations on the Stevens Creek line and three stations on Airport Connector, plus Diridon station for both routes.

Detailed information/data can be determined by a HyperloopTT Feasibility Study.

e. **Provide a high-level estimate of the ongoing operations and maintenance costs, as well as equipment replacement costs and schedules.**

Detailed information/data can be determined by a HyperloopTT Feasibility Study. The study details the local structural benefits for subsurface Urban Hyperloop systems. These issues include operational factors like consistent temperatures to mitigate thermal expansion, reduced wear and tear, fewer intersections and potential collisions with surface-level transportation, along with reduced labor costs from the maintenance of solar panels and other energy systems along the corridor.

H. Business plan

a. **Describe the business plan to deliver and operate the proposed project.**
The city is looking for innovative ways to fund and operate new transit systems.

HyperloopTT is the licensor of the hyperloop technology to infrastructure operators and transportation operators who can be either public or private entities. HyperloopTT plays also the role of a network orchestrator by providing access to the full supply chain and key stakeholders to allow the project to be implemented. HyperloopTT can support the creation of a consortium of entities in charge of building and operating the system according to the local rules and regulations.

HyperloopTT signed America’s first Hyperloop Public-Private Partnership. So far, the partnership has led to the near completion of the Great Lakes Interstate Hyperloop feasibility study and formed a regional effort comprised of 50+ public and private stakeholders. With its experience generating a regional Hyperloop initiative, HyperloopTT can provide a unique Public-Private Partnership and regional contributing model to minimize cash burn and leverage local talent and resources.

b. **Who will operate the system once constructed (VTA, the builder, PPP, other)?**

HyperloopTT is open to discuss with public and private stakeholders, and is able to facilitate the creation of P3 and consortium to implement the hyperloop project. HyperloopTT license technologies to infrastructure and transportation operators who can either be public or private. The HyperloopTT system provides flexibility in creating the structure for designing, building, and operating a Hyperloop transportation facility.

c. **What is the passenger fares strategy?**

Hyperloop aims to be a profitable public transportation with high-energy efficiency and low required maintenance. The operator will have the flexibility in using fares to address different market needs, ensuring a balance between accessibility and increased revenue.

d. **What are the expected fares for passengers to use the system?**

Hyperloop's high-energy efficiency minimizes the operational costs and allows the fares to be competitive in the market. Detailed information/data can be determined by a HyperloopTT Feasibility Study.

e. What is the strategy to maximize ridership?

The system, once built, can continuously add extra capsules in the future when demand increases. HyperloopTT systems are capable of adding extra capsules into operation and shortening capsule headway time down to 40 seconds. Capsules can adopt different cabin configurations to maximize the number of passengers per capsule.

f. Can capital and operations costs be funded through passenger fares?

Hyperloop consumes less operational cost than other traditional railway systems but is capable of carrying more ridership. It aims to be profitable public transportation by minimizing the costs and finding multiple revenue streams, such as fare collection, advertisement, passenger experience services, and renewable energy generation. The initial objective is to cover capital and operational costs by collecting passenger fare - further feasibility study is required for detailed information.

g. Describe opportunities or strategies to maximize farebox recovery and/or offset operations and maintenance costs.

- Ticket/ fare
- Connecting journeys to last-mile transit system and lodging services
- Advertising revenue
- Entertainment media content and advertisement
- Cargo and freight capacity agreements/fees
- Alternative infrastructure applications

Ticket prices for the HyperloopTT system are flexible, which means that operators can dictate which revenue streams to focus on for maintaining a profitable system. By understanding the system wide costs, risks, and efficiencies, operators can understand the optimal infrastructure to facilitate passenger connection, which will be directly related to the price point for ticketing. The Urban Hyperloop system facilitates additional services throughout the local area, providing a unique mobility experience while tailoring the ticket price to the desired rate of return from the system operator. (Appendix g)

I. Impacts

a. What are potential negative impacts during construction?

Expected negative impacts during construction are similar to traditional infrastructure construction, however, hyperloop advantages minimize chances of those negative impacts:

- Underground boring can prevent some of the environmental impacts and traffic detours
- Elevated structure with pylons will minimize conflicts with ground-level traffic

b. What are potential negative impacts during operations?

Expected negative impacts during operations are comparable to traditional infrastructure operations, however, hyperloop advantages below minimize chances of those negative impacts:

- Enclosed tube environment to prevent crossings and other outdoor engagements

- Fully autonomous system to minimize human factors
- Capability to go below and/or above ground, and operation 100% by electricity
- “Smart materials” with embedded sensors reducing risks and predicting maintenance needs

c. How can negative impacts be mitigated?

The enclosed tube system is completely separated from the area surrounding the tube, which isolates the capsule and guideway from obstacles and outside conditions including weather, traffic, pedestrians, and wildlife. The low-pressure tube environment provides a natural fire-resistive separation that is superior to other forms of transportation. Removing obstacles from the guideway reduces risk factors from collisions at high speed. Likewise, operating in all weather conditions provides reliable and consistent connections during inclement weather and peak traffic conditions.

d. What might the community outreach and engagement strategy look like?

We are connecting people in a more seamless and efficient way to bring new opportunities to the community. Hyperloop will contribute to the community by saving energy, creating zero-emission, bringing new job opportunities, and providing new housing solutions and urban lifestyle to solve congestion. HyperloopTT collaborates with local stakeholders by building a regional consortium and forming a public-private partnership.

J. Appendix

a. MobilityOS

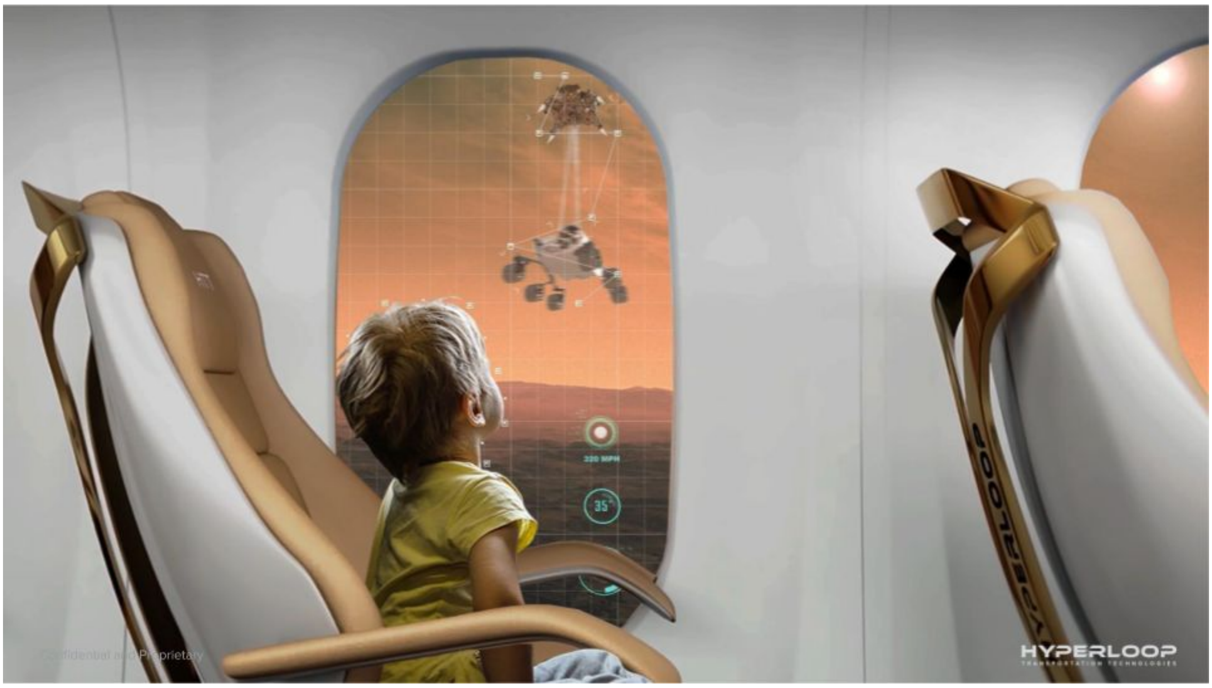
Enhancing the intermodal capabilities of the HyperloopTT system within the connected region is essential for the adoption of Hyperloop systems. HyperloopTT is developing a mobility platform and a set of applications to build a truly connected end-to-end transportation solution. These mobility solutions enable consumers to navigate to their final destination using a variety of modes of transit. For added revenue collection opportunities, the HyperloopTT marketplace will provide monetization opportunities for the various applications along with collecting and exchanging the data itself for added value.

Traveler-centric platform for contextually offered services and selected experiences:

- Marketplace for personalized services with AI-powered trip assistance
- Digital Identity with biometric identification
- Open platform Operating System

MobilityOS is a platform with customer-owned data management through a private blockchain network and a marketplace via API and SDK for developers.

b. Augmented Windows



i. Introduction to Augmented Window

As a hybrid of a screen and a window, Augmented Window uses the passenger's field of vision to create vivid experiences by projecting outside world inside transportation. Displaying a variety of visual content, the Augmented Windows provide useful information overlaid across moving images of landscapes, scenery, and other compelling visual imagery to feel like transparent windows. Moreover, these displays track movement of the passenger to project images that move with a passenger's changing orientation to provide authentic experience that feels like looking at window. The Augmented Window is a medium that allows its operator to learn from and engage with passengers while the visual platform enables content creators to reach individuals in new and compelling ways.

ii. Background

While engineering a windowless transportation solution inside of an evacuated tube, Hyperloop Transportation Technologies (HyperloopTT) faced an issue that Hyperloop passengers cannot physically see an outside scene. To mitigate the psychological issues and stress for passengers while in transit, HyperloopTT is developing Augmented Window to enhance the passenger experience by layering the visual experience of travel with information and entertainment.

iii. Commercial Application

The Augmented Window technology, HyperloopTT is creating a platform for transportation companies and content creators to enhance the overall passenger experience. Application of this visual platform could help content creators along with companies looking to apply new and interesting ways to engage consumers. With its potential to collect user's biometric and behavioral information, the Augmented Window can create a new passenger experience ecosystem.

Applicable Industries		
Travel	Existing modes	Public Transit (Taxi, Bus, Train, and Airplane)
	Emerging modes	Autonomous car, Drone
Housing and Hospitality	Hotel, Condo, Apartment, Restaurant	
Consumer Electronics	Smartphone, TV, Laptop, Tablet	

iv. Current Status

The Augmented Window technology was selected among the top 10 NASA iTech Cycle finalists in 2018. HyperloopTT is now in discussions with leading transportation companies to transform the passenger experience while negotiating with major studios to produce content for the Augmented Windows and grant access to their IP libraries. HyperloopTT and its partners have developed a working prototype that has been tested in terrestrial environments and currently continue testing and improvement. The team anticipates to begin commercial applications as early as 2020.

c. Rendering Image

HyperloopTT System Structure - Ground level

d. Light Rail vs. Urban Hyperloop

	Light Rail	Urban Hyperloop
Tube		✓
System Tracking/Positioning	✓	✓
Track	✓	✓
Vacuum System		Vacuum - ready
Renewable Energy Sources	Optional	✓
Top Speed	60 mph	125 mph
Noise Impact	High	Low
Carbon Emission	Medium	Low
Passengers per Vehicle	90 per compartment	28 - 50
Space for Luggage	✓	✓
Headway Time	Scheduled	Predictive Dynamic Optimization (PDO)

e. Risk

According to the Federal Highway Administration, major risk categories for tunneling operations include construction failures, public impact, schedule delay, environmental commitments, failure of the intended operation and maintenance, technological challenges, unforeseen geotechnical conditions, and cost escalation.

HyperloopTT proposes conducting a Feasibility Study that will assist in updating the integrated risk management plan to identify all risks associated with design, execution, and completion of the above-surface and subsurface Urban Hyperloop system. This Feasibility Study will help identify all reasonable risks associated with design, procurement, and construction of subsurface facilities including risks related to health and safety, the public, and the environment.

HyperloopTT understands that creating regulations could the biggest challenge for a Hyperloop project. Currently, HyperloopTT is actively communicating with governments and local authorities to bring suitable regulatory guidelines for each region. Munich RE, a global reinsurance company has deemed HyperloopTT system safe and insurable as a public transportation, and TUV SUD, a global safety certification company, and HyperloopTT collaborated to complete the world's first certification guideline for Hyperloop system. HyperloopTT has submitted the framework to the European Commission. In the United States, The Department of Transportation announced to form a new council, NETT, for Emerging Transportation Technologies including Hyperloop.

f. Cost

To best understand the differences between a surface-level facility and a subterranean Hyperloop system, the financial viability of each respective embodiment of linear infrastructure will depend on the life cycle cost analysis. Tunnels are traditionally designed for a life of 100 to 125 years, however, recent trends have designed tunnels for 150 years life. These costs will include construction, operation, maintenance, and financing using Net Present Value.

Underground construction has three main cost drivers: physical, economic, and political. The tunnel route study would consider: subsurface, geological, and geo-hydraulic conditions; constructability; long-term environmental impact; seismicity; land use restrictions; potential air right developments; life expectancy; economic benefits and life cycle cost; operation and maintenance; security; and sustainability. For Urban Hyperloop, small tube diameter reduces costs.

These cost-benefits will compare surface-level iterations of the HyperloopTT system while also considering intangible factors like environmental benefits, ecological preservation, aesthetics, noise and vibration, air quality, right of way, real estate, and potential air right developments along the surface-level. In understanding this difference, the financial evaluation should compare the construction and operation risks along the surface and subsurface levels, which would be expressed as financial contingencies or provisional cost items in the published findings.

The Federal Highway Administration recommends at the planning phase that tunneling projects prepare a bottom up construction cost estimate using estimated materials, labor, and equipment. As conceptual level cost analyses are often based upon the unit measurement for sections of tunnel, a Feasibility Study will consider the proper framework for evaluating the financial requirements of subterranean Urban Hyperloop construction operations. Moreover, as the design of the system advances and HyperloopTT and other stakeholders identify project risks, HyperloopTT anticipates that the contingencies will be gradually reduced as system design and details increase.

Understanding the cost drivers will include the advance rate, labor force, geological conditions, suitability of equipment, contractor means and method of tunneling, and experience of the workforce. In understanding the labor costs, the cost analysis will examine linear issues affecting tunneling operations including advance rate, construction schedule, number of shifts, labor union requirements, local regulations (state, local, and federal), and environmental factors such as noise and vibrations.

At the conceptual phase, the level of details for risk and design will solidify the cost models and will progressively become more detailed as the design is advanced. Moreover, the Parties will consider soft costs for the HyperloopTT system, including engineering, program and construction management, insurance, owner cost, third party cost, right of way costs, and the like. The Urban Hyperloop cost analysis framework will include the possibility of multiple tunneling operations conducted concurrently along the route corridor; potential specialty work to mitigate geological features; and understanding the variable labor costs for tunneling as well as concurrent surface and subsurface operations along the development corridor.

g. Revenue Streams

Broadening revenue streams enables a variety of ticketing options with unique services attached to those tickets. Taking advantage of local markets and experiences, operators can create monthly or annual commuter programs or eventually establish a ticketless travel experience where other parts of the system subsidize passenger transportation completely.

Subterranean systems also enable the collocation of utilities and other common elements of infrastructure, which could reduce logistics for other surface-level transportation and infrastructure projects including reducing relocation costs of utility lines and increasing access to connectivity facilities like electricity, water, and internet.

These factors, in addition to those that address implementation for route-specific corridors and design criteria, dictate exactly what services the local system can provide across the region. Thus, studying the regional geology and conducting geotechnical research will enable a variety of options for use of the system space and rights of way and will likewise determine exactly what system costs need to be offset by revenue from ticketing as well as other corollary services.