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CargoFish: A Network Utility for Parcel Exchange

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Executive Summary

An installed utility infrastructure affording instant dispatch of small parcels to specified destinations would alleviate the need to use automobiles for these purposes. Because the use of automobiles for transportation of any small payload is an extremely low capacity utilization, a gain in energy efficiency of about two orders of magnitude can easily be achieved. Additionally, the areas most suited to such an installation, by virtue of their high population density, are precisely the same areas that are least able to expand road capacity and most likely to be experiencing traffic congestion. Analysis of expected installation and operational costs verses reasonable user fee revenue streams indicates that the enterprise will provide a profitable return on investment.

Introduction: An installed utility infrastructure affording instant dispatch of small parcels to specified destinations would alleviate the need to use automobiles for these purposes. Because the use of automobiles for transportation of any small payload is an extremely low capacity utilization, a gain in energy efficiency of about two orders of magnitude can easily be achieved. Additionally, the areas most suited to such an installation, by virtue of their high population density, are precisely the same areas that are least able to expand road capacity and most likely to be experiencing traffic congestion. Capital and operational costs verses expected revenue streams indicate that the enterprise will provide a profitable return on investment.

Background: Modern society operates more than ever on specialization and trade. This level of interdependence between us is itself dependent on effective transportation. Before the age of oil, transportation methods and infrastructure primarily exploited techniques which reduced energy consumption to improve throughput. Examples of this include the use of watercraft, invention of the wheel, construction of canals, and development of railroads. From about the beginning of the twentieth century though, the internal combustion engine began to offer much greater flexibility in the application of transportation to economic enterprise, leading to the dominance of today's systems not tuned primarily for high efficiency. While these changes have impacted both passenger and freight transportation, it is the confluence of these... the everyday use of passenger vehicles, light trucks and cars, for household provisioning that demonstrates the largest change in terms sacrificing economy for convenience. While several other specific areas of today's transportation methods offer opportunities for improvement, none afford it at so great a magnitude or so low a cost.

Analysis: Freight energy consumption is typically measured in BTU's per ton mile, and industrial modes of transport acheive efficiencies ranging from a few hundred BTU per ton mile for ships, railroads, and pipelines, to two or three thousand BTU per ton mile by truck, or a few tens of thousands of BTU per ton mile by air. These are state of the art efficiencies. Let us consider a typical consumer errand, such as "running" to the store for a gallon of milk, using an automobile. A Toyota Prius driven by a "hyper-miler" will be our assumed vehicle. Assuming 57.5 mpg, and using the typical 115,000 BTU per gallon energy content of gasoline, this car is consuming 2,000 BTU per mile driven, regardless of payload. Further, since the payload is only 0.004 tons, the energy intensity is therefore 500,000 BTU per ton mile. This should come as no surprise though, since the Prius is rated to haul in excess of 800 lbs, but a gallon of mild weighs only 8 lbs, so the "capacity utilization factor" for the loaded portion of the trip is only one percent, and averaged over the round trip for just this purpose, it is one half percent. That then brings the energy intensity for this delivery to a full million BTU per ton mile. Even if the car considered were a Nissan Leaf, getting three miles per kWhr, that still comes to over 83 kWhr per ton mile one way, and almost 167 kWhr per ton mile total round trip. Electric freight trains such as are used for ore in parts of Sweden, acheive about 0.4 kWhr per ton mile overall.

Analogies: Water provisioning for households, before municpal water systems and indoor plumbing, used to be more labor and energy intensive. Today, we simply open the tap. And though installation and operation of community water systems entails capital costs in the millions, indeed billions overall, and yet the water bill for a typical household is very low. This would not be the case if it were attempted to extend water systems into sparsely populated areas, but for any area of sufficient population density it would be far more expensive to provide water by any means other than a network of pipes. Similar findings result from consideration of sewer for waste removal, as well as electric and natural gas distribution for energy supply.

Compariative Analysis: Underground water distribution main installation costs are as low as $250,000 per mile, and do range up to $1,000,000 or more. Gas distribution mains installed in easy conditions using cut and cover methods run about $53,000 per mile. Using horizontal directional drilling, the same installation costs about $132,000 per mile. Each of these utilities are buried to considerable depth. The former to avoid freezing, and the later to minimize the dangers of accidents. The installation, in the same trench, of a pair of twin 8" diameter physical internet lines requiring only 12" of cover, would cost only about $75,000 per mile. Conditions more difficult than ideal would cost more, but this is no different than so many other successful utilities.

Conclusion: Developing and implementing a physical internet utility for operation in areas of high population density would be of great value to the population, offering greater convenience and lower cost than presently employed means of transportation for small parcels.

Author: Robert DeDomenico grew up on a rural farm and learned to operate and maintain equipment as a child. Most of his pastimes, from an early age, have been transportation related, including: model railroading, bicycling, human powered vehicles, sailing, wind surfing, and hang gliding. He was an electronics technician and submarine reactor operator in the US Navy for six years. He has over twenty years experience in commercial nuclear power operations, and holds a BS in Computer Science from Rowan University. He has conducted extensive research and development on the CargoFish Physical Internet concept, totaling more than 4,000 in just over 4 years, including elements of prototype design, fabrication, and testing.