Appendix F

Wireless Streetcar Options

DC Government

Wireless Streetcar Vehicle Options

Proprietary vs. Open Technology

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INTRODUCTION

As the DC Department of Transportation (DDOT) moves closer to re-introducing streetcars to the District of Columbia, one major challenge is the prohibition of overhead wires within the boundaries of the original L'Enfant city. Since the late 19th century, operation of streetcars in Washington has been defined by this prohibition and led to early propulsion experiments with various technologies such as storage batteries, contact pads and compressed air.

Currently, a number of vehicle manufacturers are designing the next generation of streetcar vehicles that can operate primarily or in part without the use of an overhead contact system. This document gives a brief overview of the leading manufacturers, a description of the vehicle technology along with potential advantages and disadvantages of each type of system.

PROPRIETARY vs. OPEN TECHNOLOGY

Currently there are a number of manufacturers conducting research on wireless technology. These range from proprietary systems that provide both vehicles and infrastructure to open systems that allow for interoperability between vehicles and other sub-systems.

I. PROPRIETARY TECHNOLOGY

Firm: Alstom

Vehicle: CITADIS Tram Vehicle

Description of Technology:

The Bordeaux tramway system utilizes the Alimentation par Sol or (APS) system as the power collection method for its CITADIS tram vehicles on approximately 12 kilometers of the network that operate in historic sections of the city.

Similar in appearance to the conduit system used in Washington, The APS system APS uses a third rail placed between the running rails, divided electrically into segments. Each tram has two power collection skates, next to which are antennas that send radio signals to energize the power rail segments as the tram passes over them. At any one time no more than two consecutive segments under the tram should actually be live.

Advantages:

- Ability to operate for limited distance without use of overhead wires
- 100% low-floor vehicle
- Manufacturing facilities located in the U.S. (Newcastle, DE; Hornell, NY; Mare Island, CA)

Disadvantages:

- Proprietary wireless hardware and equipment
- Wireless operation not as reliable as overhead wire
- Considerable infrastructure costs for both vehicles and track installation

Locations in Service:

- Bordeaux, France (wireless operation)

Firm: Bombardier

Vehicle: PRIMOVE

Description of Technology:

The PRIMOVE system uses cables laid beneath the ground and connected to the power conditioning and supply network. They are only energized when fully covered by the vehicle, which ensures safe operation. A pick-up coil underneath the vehicle turns the magnetic field created by the cables in the ground into an electric current that feeds the vehicle traction system.

Advantages:

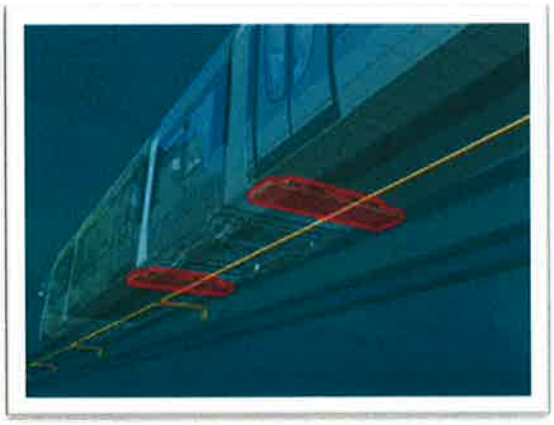
- 100% Low-floor design
- Ability to operate for limited distance without use of overhead wires

Disadvantages:

- Technology can only be used only with the Bombardier Flexity Tram
- Additional track infrastructure required

Locations in Service:

- None are currently in operation



II. OPEN TECHNOLOGY

Firm: Kinkysharyo

Vehicle: LFX-300 Streetcar

Description of Technology:

The LFX-300 is designed specifically for the North American streetcar market and is set to debut in 2010. The vehicle utilizes wireless battery power propulsion designed for operation within areas where overhead wire is prohibited.

Advantages:

- 100% low-floor vehicle design
- Turnkey options
- Meets Buy America and ADA requirements
- Ability to operate for limited distance without use of overhead wires
- Minimal additional infrastructure required

Disadvantages:

- No vehicles have been produced and tested
- No information on whether technology is proprietary

Locations in Service:

- None are currently in service

Firm: Kawasaki

Vehicle: SWIMO

Description of Technology:

The SWIMO uses the Gigacell, Kawasaki's proprietary nickel metal-hydride battery, which allows the vehicle to operate without overhead wires. The battery installed under the seats has been downsized for railway car applications and upgraded for larger output.

When operating in non-electrified sections, the SWIMO runs on the battery and returns regenerative power to the battery when braking. The vehicle is also equipped with a pantograph, which charges the battery while running on overhead wires.

Advantages:

- Ability to operate for limited distance without use of overhead wires
- Uses Nickel/metal Gigacell™ battery for off-wire operation
- 100% low-floor design
- Minimal additional infrastructure required

Disadvantages:

- Proprietary battery technology
- Possible environmental/battery storage issues
- Currently not in revenue service

Locations in Service:

- Tested in Sapporo, Japan

Firm: Siemens

Vehicle: Avenio,

Description of Technology:

The Avenio can be equipped with an energy store for recovering braking energy. This enables their operation without an overhead contact wire, which in turn saves infrastructure costs and reduces the visual impact on the cityscape.

Advantages:

- Low-floor design
- Manufacturing facility in U.S. (Sacramento, CA)
- Ability to operate for limited distance without use of overhead wires

Disadvantages:

- Avenio tram still in development
- Not fully wireless

Locations in Service:

- None are currently in operation

Firm: United Streetcar, LLC

Description of Technology:

The City of Portland has conducted an evaluation of the feasibility of upgrading the battery capability for the prototype. The study conducted by LTK Engineering concludes that considerable design changes are needed in the vehicle to allow for the inclusion of sufficient batteries and capacitors to support revenue operations for the vehicles without overhead wires.

Advantages:

- Produced in the United States
- Similar to Inekon-Skoda design
- Meets ADA requirements
- 70% low-floor design

Disadvantages:

- Not capable of fully wireless operation
- No vehicles currently in production

Locations in Service:

- Portland, Oregon

Firm: CAF/Trainelec

Description of Technology:

The ACR project developed by CAF in conjunction with Trainelec (a CAF group company), is an on-board energy storage system based on the use of ultracapacitors which enables trams to run between stops without catenaries, as well as save energy through the full regeneration of braking energy. This system is compatible with other technologies and suitable for use on rolling stock of any type and manufacturer, and on new or existing facilities and infrastructure.

Advantages:

- Energy saving (brake regeneration) .
- Ability to operate for limited distance without use of overhead wires
- Up to ¾ mile of catenary-free running range depending on route characteristics between stops
- Modular vehicle design .
- Suitable for use on existing systems
- 20 second charge times, compatible with stopping times at stations .

Disadvantages:

- This is CAF's first experiment with wireless trams

Locations in Service:

- Zargoza, Spain (2010)
- Seville, Spain (Expected date: 2011)

CONCLUSION

The selection of a new technology must meet criteria that allows for expansion of the system with minimal cost. While the conduit system from the previous streetcar network served the city well for over seventy years, its labor intensive operation and high construction and maintenance costs prevented the system from expanding to meet the demands of its users. If the District is going to select a new technology it must be selected with consideration of construction and maintenance costs, labor required to maintain the system and the ability to meet future transit demands.

The introduction of new technology allows the selected vendor to use the proposed streetcar network as a showcase for their product and earn Washington the distinction of being a leader in streetcar innovation.

RECOMMENDATION

It is recommended that DDOT pursue the open technology option for both vehicles and infrastructure. Open technology allows for more flexibility in the selection of vehicle manufacturers, minimizes costs and accelerates delivery of equipment and parts.

Since Washington is the nation's capital, any system that is selected will serve as a model for other cities to emulate. Companies wishing to demonstrate their technology here are aware of this and we should be willing and ready to take advantage of any funding opportunities from both public and private entities that will offset the cost to the District.

About the Author

Mr. Madison is a Transportation Planner with the District Department of Transportation and currently working on the DC Streetcar Project. He has a background in rail safety oversight and recently completed his term as chair of the Tri-State Oversight Committee, which oversees safety for the Washington Metrorail system.

He has received extensive training in rail safety, operations and design from such organizations as the University of Wisconsin, University of Tennessee and the Transportation Safety Institute,

Since 1998, Mr. Madison has also been a member of the National Capital Trolley Museum located in Colesville, MD. He has served on the Board of Trustees since 2000 and among his other duties at the museum he serves as car operator/motorman, track inspector and vehicle maintainer.