Solar-Powered Automated Transportation Networks
the future of sustainable urban transportation

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T3e Webinar
November 17, 2016
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San Jose State University

• Research interests
  – Automated transit
  – Automation and control
  – Sensors and measurements

• Recent publications
Overview of the webinar

• What is ATN? (Buff)
• Why ATN? (Ron)
• What are solar ATN’s unique advantages? (Buff)
• How can ATN integrate into urban environments? (Shannon)
• What are the challenges facing implementation? (Buff)
• How can universities and students make a difference in ATN development and implementation? (Eric H. & Eric R.)
• What action might you take to make solar ATN a reality? (ALL)
• Q & A
What is ATN?
The solar-powered automated transit network is the next ‘big thing’ in sustainable urban transportation

Source: Jpods.com
ATN vehicles function more like automated taxis rather than buses, trains, light rail, or other transit vehicles

Non-stop origin-to-destination

Source: http://tinyurl.com/jgwdknx
ATNs use offline stations, so vehicles only stop and start at origins and destinations.
ATN vehicles are relatively small (4-6 people)
ATN service is on-demand, rather than on fixed schedules
ATN vehicles are fully automated (no driver)
ATN vehicles are captive to a guideway that is reserved for their exclusive use.
ATN guideways can be relatively slim, are usually elevated, but can also be at or near ground level or underground.
ATN vehicles are able to use all guideways and stations on a fully connected network, for example in San Jose.
There are five systems in the world that demonstrate ATN-like features

Morgantown (c. 1975)

photo courtesy of Trans.21
There are five systems in the world that demonstrate ATN-like features

Parkshuttle Rivum (c. 1999)

https://c1.staticflickr.com/1/507/18700664619_96ff4383c7_b.jpg
There are five systems in the world that demonstrate ATN-like features

Masdar City (c. 2010)

There are five systems in the world that demonstrate ATN-like features

Heathrow Terminal 5 (c. 2011)

There are five systems in the world that demonstrate ATN-like features

Suncheon Bay (c. 2014)

http://tinyurl.com/jsajxa5
Ron Swenson
International Institute of Sustainable Transportation

• Research interests
  – Solar-Powered Transportation
  – Bioclimatic Design

• Recent publications
  • The Solarevolution: Much More with Way Less, Right Now—The Disruptive Shift to Renewables, Energies, August 2016
  • Mitigating Climate Change with Solar-Powered Transit, Podcar City 10, Antwerp, September 2016
  • More at www.swenson.com/ron/library
Why ATN?
Congestion
Congestion is overwhelming our cities and widening isn’t working
This is the same “freeway” with electric vehicles
This is the same “freeway” with automated cars

Electric?

Automated?
ATN reduces congestion and achieves the same throughput as ordinary rail

3 seconds headway @ 50km/h
- 1,200 pods per hour
- 42 meters

1.5 seconds headway @ 50km/h
- 2,400 pods per hour
- 21 meters

5 meter spacing in 5 unit virtual trains with 1.5 seconds headway between trains @ 50km/h
- 3,600 pods per hour
- 21 meters
- 50 meters

5 meter spacing in 8 unit virtual trains with 1.5 seconds headway between trains @ 50km/h
- 4,100 pods per hour
- 80 meters
- 21 meters

8 seats × 4,100 ≈ 33,000… (~20,000/hr practical limit)
Climate Change
Climate change is real—it’s getting late for incremental solutions to do any good.

Ron Swenson
Solar ATN eliminates fossil fuel use and cuts pollution to zero
As shown in Paris, there is political will to replace fossil fuels with renewable energy ... to eliminate CO2 emissions.
Energy Independence
The future of oil in the U.S.A. was looking good a year ago

“The next Saudi Arabia!” ??

Source: U.S. Energy Information Administration
Yet when you take a good hard look at the data, you now can see that oil production is down

9.187 mbd →
Yet when you take a good hard look at the data, you now can see that oil production is down… production has dropped more than 1.1 mbd in just 1 year.
It takes drilling rigs to fill the pipeline

Monthly Lower 48 crude oil production (2012-17)

production from wells drilled in 2014 or before

U.S. onshore rig count

quarterly production from new wells drilled in years

2015

2016

2017

forecast

Ron Swenson
Renewable capacity is growing rapidly worldwide.
Solar PV on the guideway allows the system to collect the energy needed within the ‘footprint’ of the system.
Livable Cities
Car cities are almost unlivable

Ron Swenson
In the past, cities streets were lively places

Ron Swenson
Podcar networks can restore city streets for people

Ron Swenson

Spartan Superway
Safety
Can at-grade transit possibly be a solution?
For 100 years the automobile has dominated city streets, with dire consequences.

MOTHERS!
Autos will kill 220 children and injure 5854 in Massachusetts this year unless you help prevent it.

Don't let your children play in the street!

UNSAFE AT ANY SPEED
The Designed-In Dangers of the American Automobile
Ralph Nader

Pedestrian Survival Rate by Vehicle Speed

DANGEROUS BY DESIGN 2011
TRANSPORTATION FOR AMERICA

- 95% at 20 Mph
- 55% at 30 Mph
- 15% at 40 Mph
What are solar ATN’s unique advantages over other forms of transit?
Transportation machinery is physically separated from everything else (especially people!)
ATNs use a tiny fraction of the land required for cars, buses, and trains — without needing new rights-of-way.

**Land Occupation Comparison**

- **TTS**: 0.20%
- **Car/road (residential area)**: 30%
- **Lower limit for car/road (downtown area)**: 50%
- **Upper limit for car/road (downtown area)**: 70%
ATNs can be located on or near existing rights-of-way and can be 100% solar powered.
Shannon Sanders McDonald, AIA
Assistant Professor at the School of Architecture at Southern Illinois University, Carbondale, IL

- **Research interests**
  Automated transit and its impact on sustainable architecture and urban design

- **Recent publications**
  “Road Vehicle Automation 2” edited by Sven Beiker and Gereon Meyer
  paper titled: *Envisioning Automated Vehicles Within the Built Environment: 2020, 2035, and 2050* is available online at http://www.springer.com/gp/book/9783319190778
How can ATN integrate into existing and new urban environments?
Small compact design allows for multiple opportunities to integrate into the existing urban fabric.
Small compact design allows for multiple opportunities to integrate into the existing urban fabric even with watertaxi.

SIU Architecture Comprehensive Masters Urban Design Student Team, 2015
ATN networks can change and/or work with existing streets

Major Street (K St)

Existing

- Trees
- Buses

Transit Priority

- Lanes
- Buses

Exclusive Guideway Options

- Lanes
- Buses

Study from ATRA Transit Workshop, TRB 2016
ATN can be integrated into existing campus settings.
ATN can be integrated into new research campus settings, Drive Lab, Arlanda Airport, Sweden.

SIU Architecture On-Line Comprehensive Masters Urban Design Team, 2014
ATN can be integrated into new building designs for a campus.

5th year Southern Polytechnic Architecture Student, 2008

Shannon Mc Donald
ATN can be integrated into new building designs for a research Drive Lab, Arlanda Airport campus.
ATN can be integrated into new building designs for a research Drive Lab, Arlanda Airport campus.
ATN can be integrated into the landscape/town/University creating a green interconnected ring for the SIU community.

ATN can be integrated with existing buildings and downtowns – Santa Cruz, CA

Master SIU Architecture Student, Don Olsen, 2015
ATN can be integrated into new building design

4th year SIU Architecture Student, Ruba Bdair, 2015
Small compact design allows for multiple opportunities to integrate multimodal designs.

4th year SIU Architecture Student, Esmeralso Camona, 2015
ATN can be integrated into new building design and part of a multi-modal connection.

4th year SIU Architecture Student, Ruba Bdair, 2015
ATN can be integrated into new building design providing interior connection/lobby spaces.

4th SIU On-Line Masters Architecture Student, 2014
ATN can be integrated as a part of the interior and structure of a new design.

4th year SIU Architecture Student, Aaron Neal, 2015
On demand access and networked system provides stations within walking distance, no cars needed - Annapolis MD

Study from ATRA Transit Workshop, TRB 2016
Mobility-challenged have accessibility

SIU On-Line Comprehensive Masters Architecture Urban Design Team, 2014

Shannon Mc Donald
Topological challenges can be addressed

SIU On-Line Comprehensive Masters Architecture Urban Design Team, 2014
Integrated Urban Design for New Mobility can be achieved with podcars
New mobility ideas can be explored

SIU On-Line Comprehensive Masters Architecture, Adnan Omeragic, 2014
New Parking Options can be used to store on demand mobility

3,548 meters squared

- Classic Car Museum
- Car share program parking structure
- Pod car parking structure
- Lobby
- Shipping / Receiving Area
- Car Drop-off lane
- Car Pick-up lane
- Elevator lobby

4th SIU On-Line Comprehensive Masters Architecture, Adnan Omeragic, 2014

Shannon Mc Donald
Mobility-challenged have accessibility with solar ATN

SIU Architecture On-Line Comprehensive Masters, Rob S. Andersen, Jr. 2014
New internal connections offer greater accessibility

SIU Architecture On-Line Comprehensive Masters, Rob S. Andersen, Jr. 2014
New internal connections offer greater accessibility

SIU Architecture On-Line Comprehensive Masters, Rob S. Andersen, Jr. 2014
ATN can provide first and last mile connections, Drive Lab, Arlanda Airport
A new town in the 1970’s was designed with ATN networks that created greenspace and sustainability.

CONCEPT GUIDEWAY - PRIMARY SYSTEM IN RESIDENTIAL AREA

A new town in the 1970’s was designed with ATN networks that created greenspace and sustainability.
What are the challenges facing implementation of ATN?
A compelling design case is beginning to emerge - think of the rotary telephone, before the...
Cities, planners, and ATN developers face a ‘Catch-22’ situation
Validation must be done to prove the safety and business cases

http://tinyurl.com/pjfjxyc
Validation has been done for other systems in the past
Validation has been done for other systems in the past

http://tinyurl.com/q9qx5g9
Eric Hagstrom
Lecturer, Mechanical Engineering
San Jose State University

• **Research Interests**
  – Mechanical design
  – Control systems

• **Recent Projects**
  – Spartan Superway International Summer Research Intern Program
How can universities and students make a difference in ATN development and implementation?
Research and development has been primarily completed by San José State University students.

2012 / 2013
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2015 / 2016

Eric Hagstrom
Research and development has been primarily completed by San José State University students.

2015 / 2016
The Spartan Superway International Research Internship Program allows for interns to continue R&D during the summer.

Summer 2015
The Spartan Superway International Research Internship Program allows for interns to continue R&D during the summer.

Summer 2016

Eric Hagstrom
The Spartan Superway International Research Internship Program allows for interns to continue R&D during the summer.

Summer 2016

Eric Hagstrom
Eric Rosenfeld
Student, Mechanical Engineering
San Jose State University

- Research interests
  - Solar Powered Transportation
  - Sustainable Energy Storage

- Recent publications
The Spartan Superway International Research Internship Program offers diverse ideas and innovative collaboration.
The Spartan Superway utilizes groundbreaking ideas and assistance from professionals around the world.
In September, I had the opportunity to present my work at Podcar City 10 in Antwerp, Belgium.
The Spartan Superway improves the technical and professional engineering skills of students.

80 miles per gallon!
What action might you take to make solar ATN a reality?
There are several ways for you to get involved

Spartan Superway Summer Internship Program
There are several ways for you to get involved

URBAN INTERNATIONAL DESIGN CONTEST

The rapid development of autonomous vehicles for private and public transportation creates a completely new playground for urban development.

The UIDC series of workshops will combine the know-how and creativity of academics and students, city planners, transportation specialists, and developers to create and propose new urban designs, incorporating the new possibilities that can be achieved with elevated and road-based autonomous vehicles.
There are several ways for you to get involved

**URBAN INTERNATIONAL DESIGN CONTEST**

- **Local Government**
- **Local University**
- **Local Industry**

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>Winter &amp; Spring 2017</td>
<td>Build your local team</td>
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<tr>
<td>Summer 2017</td>
<td>Design internships in Silicon Valley</td>
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<tr>
<td>September &amp; October 2017</td>
<td>Local design workshops (charrettes)</td>
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<tr>
<td>November 2017</td>
<td>Compete at Podcar City 11</td>
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There are several ways for you to get involved.

Come to Podcar City 11 next November.
There are several ways for you to get involved

Develop a solar podcar network in your city
There are a number of good references on ATN


- INIST Library: [https://www.inist.org/library/](https://www.inist.org/library/)
And a special thanks to all of our collaborators and sponsors.
Questions and Answers

Buff Furman
SJSU Spartan
Superway Overview & Mechatronics

Ron Swenson
INIST
Solar Energy

Shannon McDonald
Southern Illinois Univ
Architecture

Eric Hagstrom
SJSU Spartan Superway
ME Instructor

Eric Rosenfeld
SJSU Spartan Superway
ME Student

References
www.solarskyways.com/events/T3e