Beamways AATN
An update
Bengt Gustafsson, 2015-05-06
Itinerary

Here is where I tell you what I am going to tell you:

• The problem for pure PRT.

• Adaptive ATN simulation.

• Beamways system prototyping.
The problem for pure PRT

Proven PRT capacity is too low to solve the problems traffic planners care about.

Attaining higher capacity by using shorter headways is a pie in the sky.

Even 3 second headway feels impossible to most transit professionals, despite being approved at least once.
AATN line capacity requirements

• ATN must match tram line capacity.
• The infrastructure cost level must be much lower.
• Must not use headways shorter than 10-15 s.

Facts: 40 m trams hold 200 pax. Two can be connected. Min headway 3 minutes. Total capacity: 8000 pax/h.

At 15 s headway we need 33 pax vehicles to match this.
Beamways podtrain concept
Station capacity considerations

A station stop takes about 30 s. For **line haul** operation other vehicles can’t pass. To reach target capacity we need 66 pax vehicles.

With off line stations and skip-stop operation we can get close to line capacity with 33 pax vehicles.

With different size vehicles and **ad hoc** routing we can reach high capacity with good service for dispersed *and* directed travel patterns.
The BeamEd 3D simulator

BeamEd 3D has a very accurate vehicle simulator with multiple vehicle sizes implemented.

The simulator works with speed-dependant headways and has full merge collision avoidance.

Each passenger is assigned to a vehicle when arriving at the station. Cost of wait time, travel time, vehicle operation etc. are taken into account in the choice.

Intermediate stops are allowed. En-route rerouting is allowed.
Vehicle allocation algorithm

• The algorithm runs when a new passenger group arrives at a station. No advance warning is used.

• All vehicles are inspected and for each a cost function is evaluated for passing the origin and destination stations of the passengers between any previous stops.

• The cost function includes passenger wait and ride time cost, cost to split groups and cost to run vehicles, different per size.

• The cheapest option is selected and any new stops are added to the selected vehicle(s) routes.
Work to do in BeamEd 3D

Better algorithms for allocating vehicles to trips:

• Route cost to depend on predicted traffic situation.

• Vehicle allocation based on statistical knowledge of demand.

• Reevaluation of previous choices when new groups arrive.

This is going to be extremely compute power intensive.
Deadlock!
Simulation results so far

For the example network mean speed is about 35 km/h with line speed of 54 km/h.

At normal network loads each passenger gets only around one intermediate stop.

Wait times and ride times increase with load, but not dramatically.

With initial algorithms mixing vehicle sizes does not improve performance.
Simulation results so far

Mean total time

- 244 x 4
- 100x4, 25x12, 10x28
- 40x4, 40x12, 40x28
- 450 x 4
- 190x4, 40x12, 20x28
- 150x12
Simulation results so far

**Intermediate stops**

- 244 x 4
- 100x4, 25x12, 10x28
- 40x4, 40x12, 40x28
- 450 x 4
- 190x4, 40x12, 20x28
- 150x12

**Mean trip time**

- 244 x 4
- 100x4, 25x12, 10x28
- 40x4, 40x12, 40x28
- 450 x 4
- 190x4, 40x12, 20x28
- 150x12

**Mean wait time**

- 244 x 4
- 100x4, 25x12, 10x28
- 40x4, 40x12, 40x28
- 450 x 4
- 190x4, 40x12, 20x28
- 150x12

**Passenger count**

- 244 x 4
- 100x4, 25x12, 10x28
- 40x4, 40x12, 40x28
- 450 x 4
- 190x4, 40x12, 20x28
- 150x12
Beamways system prototyping

Several universities worldwide work on the Beamways system:

**San Jose State University**: Four years of Capstone courses. Models and prototypes. Summer school ‘15.

**Linköping University, Sweden**: Cabin design, 1:4 model of full switch design.

**INSA, Lyon, France**: Alternate switch designs, vehicle dynamics study.

**Uppsala, Delft, Paris, San Francisco, U of S Illinois**.
San Jose models

Two models around 1:10 scale have been made, with the purpose to act as a development platform for control software.

Images of the first year’s model.
Spartan Superway Scale Model – Silicon Valley S.T.E.A.M. Festival 2015

PERSONAL RAPID TRANSIT
San Jose full scale prototype
Linköping Cabin (in San Jose)
Lyon vehicle dynamics project

II  Le Bogie
II.4  Système de switch

2 Solutions proposées:
- Système 4 barres
- Système pignon/crémaillère

Figure 37 - Visualization of forces of contact

Figure 38 - Normal force between drive wheels 1, 4 and rail (N) = f(second)

Figure 39 - Longitudinal force between drive wheels 1, 4 and rail (N) = f(second)
Conclusions

Here is where I tell you what I told you:

• Pure PRT’s capacity is not appealing to customers.

• Getting a capacity boost from multiple vehicle sizes requires better algorithms.

• Mechanical prototyping need serious funding to go much further.