CHAPTER 17

The "Minibus" Contribution

Andreas Neumann and Johan W. Joubert

17.1 Basic Information

Entry point to documentation:

`http://matsim.org/extensions` → minibus

Invoking the module:

`http://matsim.org/javadoc` → minibus → `RunMinibus` class

Selected publications:

Neumann (2014)

17.2 Paratransit

Paratransit is an informal, market-oriented, self-organizing public transport system. Despite the significance of this transport mode, it is mainly unsubsidized, relying on collected fares. Paratransit systems can be categorized by route pattern and function, by driver organization, type of stops and fare type. Most case studies covered by the Neumann (2014) thesis indicate that paratransit services are mainly organized as route associations operating 8-15 seater vans on fixed routes. Most of the services run in direct competition to a public transport system belonging to a public transit authority. Such a service—minibuses with fixed routes, but without fixed schedule—is often called a jitney service. The minibus module of MATSim is based on the most common characteristics, with the understanding that the jitney/minibus service is only one of many possible paratransit services.

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The minibus model is integrated in the multimodal multi-agent simulation of MATSim. In the model, competing minibus operators begin to explore the public transport market, offering their services. With more successful operators expanding and less successful operators going bankrupt, a sustainable network of minibus services evolves. In Neumann (2014), the model is verified through multiple illustrative scenarios, analyzing the model's sensitivity to different demand patterns, transfers, and interactions of minibuses and a formal operator's fixed train line.

The minibus model can be applied to two different transport planning fields. First: in the simulation of real paratransit targeting the inner workings of different paratransit stakeholders' relationships, the model can create "close-to-reality" minibus networks in a South African context. Neumann et al. (2015) gives an in-depth presentation of the module application and South African paratransit in general. Given the informal and emergent nature of minibus paratransit in developing countries, routes, schedules and fares are usually not published; they can only be captured in the tacit knowledge of operators and frequent users. Applying the minibus model has proven valuable in gaining a better understanding of how routes evolve. Instead of imposing routes and schedules *on* the MATSim model, as is usually the case for formal transit, the modeler observes and gets the paratransit routes as an output *from* the model. As each operator aims to maximize their profit, the resulting network often favors the operators' business objectives, instead of the connectivity and mobility of the mode's users. This model feature accurately captures route-forming behavior in the South African case, where commuters are often required to take multiple, longer trips instead of direct trips.

Second, the same model provides a demand-driven approach to solving a formal transit authority's network design problem; it can be used as a planning tool for the optimization of single transit lines or networks. For more details on the second form of application, see Section 17.3.

For further reading: Neumann (2014) provides an understanding of the underlying principles of paratransit services, namely minibus services, its stakeholders, fares, route functions, and patterns. Furthermore, it contains an in-depth description of the minibus model, its theoretical background, and its application to illustrative scenarios, as well as real world examples. The website of MATSim also hosts latest implementation documentation at `http://matsim.org/doxygen`.

17.3 Network Planning or Solving the Transit Network Design Problem with MATSim

A public transport system's success depends primarily on its network design. When transport companies try to optimize a line using running costs as the main criteria, they quickly find that demand must be taken into consideration. The best cost structure is unsustainable if potential customers leave the system and opt for alternatives, like private cars. The basic problem to solve: find sustainable transit lines offering the best possible service for the customer.

More specifically,

- the customer's demand side asks for direct, uncomplicated connections, and
- the operator's supply side asks for profitable lines to operate.

Informal public transit systems around the world, often referred to as paratransit, are examples of market-oriented, self-organizing public transport systems. For an in-depth coverage of paratransit, see Section 17.2, with references. Despite the significant and increasing importance of this transport mode, it is mainly unsubsidized and relies only on collected fares. Thus, the knowledge of paratransit—and its ability to identify and fill market niches with self-supporting transit services—provides an interesting approach to solving a formal public transit company's network design problem.

The minibus module of MATSim provides a demand-driven approach to solving a formal transit authority’s network design problem; it can be used as a planning tool for the optimization of single transit lines or networks. In the Neumann (2014) thesis, the model was applied to two different planning problems of the Berlin public transit authority BVG (Berliner Verkehrsbetriebe). In the first scenario, the model constructed a transit system, from scratch, for the district of Steglitz-Zehlendorf. The second scenario analyzed the Tegel airport closure impact on BVG’s bus network. Apart from Tegel itself, the rest of the bus network was unaffected by the airport closure. The resulting minibus model transit system resembled the changes BVG had scheduled for Tegel’s closure.

In conclusion, the minibus model developed in the thesis automatically adapted supply to demand. The model not only grew networks from scratch, but also tested an existing transit line’s sustainability and further optimized the line’s frequency, time of operation, length, and route. Again, the optimization process was fully integrated into the behavior-rich, multi-agent simulation of MATSim, reflecting passenger reactions, as well as those from competing transit services and other road users. Thus, the minibus model can be used, along with more complex scenarios, like city-wide tolls or pollution analyses.