

## Round-Based Public Transit Routing (Extended Abstract)

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### Abstract

We study the problem of computing best connections in public transit networks. A common approach models the network as a graph (Pyrga et al. 2008) on which it runs a shortest path algorithm (Dijkstra 1959). To enable interactive queries, a variety of *speedup techniques* exist that use a pre-processing stage to accelerate queries (Delling et al. 2009; Bast et al. 2010). Unfortunately, developed with road networks in mind, they fall short on public transit networks due to their different combinatorial structure (Bast 2009). Also, unlike in road networks, one is usually interested in reporting *Pareto sets* of journeys for several criteria, such as travel time and the number of transfers. While Dijkstra’s algorithm can be augmented (Pyrga et al. 2008), this increases running time even further (Berger et al. 2009; Disser, Müller-Hannemann, and Schnee 2008; Müller-Hannemann and Schnee 2007; Müller-Hannemann, Schnee, and Frede 2008). One can achieve interactive queries by settling for approximate results and using heavy preprocessing (Bast et al. 2010), but this fails to account for the dynamic nature of public transit systems, which are subject to frequent delays and cancellations.

We introduce RAPTOR, our novel Round-based Public Transit Optimized Router. It computes all Pareto-optimal journeys between two stops, minimizing arrival time and the number of transfers. It is, unlike previous algorithms, not Dijkstra-based. Instead, it operates in rounds (one per transfer), and computes arrival times by traversing each *route* (such as a bus line) at most once per round. In fact, it boils down to a dynamic programming approach with simple data structures and excellent memory locality. Also, routes can be distributed to different CPU cores, enabling easy parallelization. To incorporate more criteria, we extend RAPTOR to McRAPTOR. As an example we use fare zones, a common pricing model. Another extension, called rRAPTOR, outputs Pareto sets of journeys for *all* departures within a given time range. Because our algorithms do not rely on preprocessing, they are directly suited for dynamic scenarios. Finally, our experiments on the large metropolitan network of London show that RAPTOR is indeed practical and fast enough for interactive applications.

\*During his time at Microsoft Research Silicon Valley.  
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This is an extended abstract of the paper (Delling, Pajor, and Werneck 2012) published at ALENEX 2012.

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