Understanding the Efficiency of deCarta's Routing Engine

Technology Tutorial

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deCarta's Routing Engine

Routes Are Not All Created Equally

There are routes, and there are routes. By the simplest measure, the directions served up from all routing engines will get you from Point A to Point B. But clearly, there are increasing degrees of route efficiency among the myriad of potential routes that can be generated between origin and destination points.

Calculating and providing the user with the most optimal route of their choice (fastest, shortest, high-ways, local roads, etc.), in the shortest amount of time is where routing engine technology can either enhance or detract from the end-user's use of and satisfaction with the routing application.

Why is deCarta's Routing Engine Better?

deCarta's customers in the Internet and mobile markets recognize the routing engine in the Drill Down Server as the market leader for both quality and speed of routes generated. The reasons for that leadership are embedded in deCarta's core technology and give customers a competitive advantage in two areas:

1. An outstanding user experience resulting from fast, accurate and flexible routes
2. A cost advantage as customers scale their applications resulting from lower costs for server hardware and support

This paper will contrast deCarta's approach to routing versus a typical routing engine and explain the benefits of our approach. It will also explore the format of our data files and how that leads to increased functionality and additional performance gains.

An Overview of Routing

Routing engines try to emulate human logic when performing a route calculation. When trying to determine the best route from an address in City A to an address in City B, one first considers how to get from the local street to a major arterial, then to a highway and ultimately to a freeway. As one gets close to the destination, the directions would step down the same road hierarchy leaving the freeway. Local roads would never be used for traveling a long distance if higher priority roads were available. Routing algorithms do the same thing.

In order to make the routing algorithm efficient, it never considers the many local roads between an origin and destination. The algorithm searches the road network looking for a path that has the lowest impedance or cost. Local road have a higher cost associated with them; therefore the algorithms try to spend as little time as possible using them.

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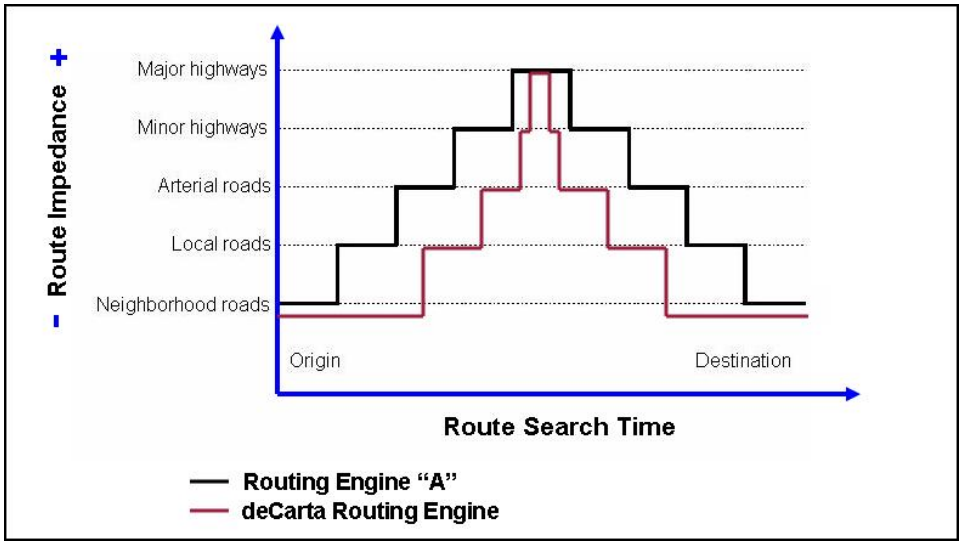
Algorithms typically step up the hierarchy of roads from the origin and destination simultaneously so that the route calculation is fast and efficient. A typical route request would be approached as illustrated in the figure below:



deCarta's Approach to Routing

While all algorithms perform the task in a similar fashion, deCarta is more aggressive in finding the highest quality and most "human like" route. The inherent speed of the routing engine allows it to calculate routes more quickly and to explore alternative routes efficiently to give the optimal result for complex routing challenges.

For example, a typical routing engine may ask the traveler to travel one mile to get onto a freeway. deCarta's routing engine may ask the user to travel two miles in the wrong direction to a better free-way that will take you to your destination more quickly.
deCarta can do this because:

- The deCarta map data indexing and routing scheme is very efficient, which translates into a faster route calculation
- Because of this efficiency, deCarta's engine can spend more time looking for a route along local streets, which will in turn route the user to the optimum freeway

deCarta's algorithm parameters will be more aggressive at exploring local roads which can lead to better routes, yet our underlying exploration speed overcomes the time needed to explore additional alternative routes.

deCarta's Map Data Format Delivers Additional Speed

deCarta is also unique in the approach to the architecture of the underlying map data. Most map data formats utilize a form of network files containing connectivity information (such as turn restrictions or overpasses) in addition to the map data file. This network file contains the turn restrictions analyzed in advance. The valid turns at an intersection or node are precompiled and embedded into the network file.

However, deCarta does not build the connections in advance, but rather determines the connections at runtime (when a route request is generated).

By storing the geometry and building the connectivity at runtime, it takes more computation, but less read time since there is only one file to read. This results in an increase in performance. Significantly, this also allows deCarta to add rules for interpreting connectivity at runtime, which enables one to optimize for specialized map data or dynamic content.

Examples include:

- Traffic-based routing
- Weather-based routing
- Truck restrictions
- Vehicle Classes
- Pedestrian routing

Because the cost computation is done at runtime, deCarta can factor in traffic flow or other cost impedances to a route.

For applications where map data file size is an issue, deCarta's technique of building the connectivity on the fly has another benefit which is reduced file size. Pre-building the network file results in a larger file size since both the map data file and the connectivity files must be built. In addition, there is less flexibility at the application level since the interpretation of connectivity is fixed. For example, there is no ability to ignore turn restrictions or to ignore one-ways (as for pedestrians) if the connectivity has been pre-compiled into the file.

Market-proven Performance

deCarta's routing engine has been proven with billions of routes generated by users of the leading Internet, mobile and turn-by-turn navigation applications including such brands as Google, Yahoo!, Ask, Networks in Motion, and TeleNav. The deCarta routing engine has benefited from this real-world experience in the most demanding and dynamic high-volume applications, and as a result, has real world user experience and validation factored into the routing algorithm.

deCarta's Routing Engine in Use

deCarta's routing engine is available to customers for use via a C library in the Rich Map Engine (RME), as a part of deCarta's geospatial platform Drill Down Server (DDS), and for embedded applications such as Personal Navigation Devices through the Navigation SDK.

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