# Route Choice Strategy in Traffic Network and Routing Strategy in Communication Network

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### Abstract

Both traffic networks and communication networks play increasingly significant roles in our daily life. They have similar function of transportation, thus are associated in the study of route strategies. In this paper, we first introduce the similarities and differences between traffic network and communication network, and then review briefly the study of route choice strategies in traffic networks and routing strategies in communication networks as well as their algorithms. Finally, we conclude that those route choice strategies and corresponding algorithms based on the global traffic information are more valid for traffic networks, while for communication networks, those routing strategies and algorithms based on the local information are more efficient.

**Keywords:** Route choice strategy; Traffic network; Intelligent transportation systems; Routing strategy; Communication network

## Introduction

Traffic networks and communication networks, the two integral parts of urban infrastructure, have many common characteristics. For example, they both are carriers for transporting agents, as traffic network is a carrier for running vehicles and communication network for transmitting the information packages. Besides, in both networks, the transportation efficiency and congestion problems are crucial issues. In traffic network, the running efficiency of vehicles in city road and traffic jam have attracted heavy research interests from scientists, and in communication network, scientists also focus on the efficiency of transmitted information package and its congestion. In addition, the agents carried by these two networks run with some strategy. In intelligent transportation systems, vehicles move along the path from origin to destination according to rout guidance information, which is produced by the route choice strategy, and information packages in communication are trans- mitted based on a routing strategy.

In recent decades, amount of routing strategies have been proposed by scientists and applied in our real life, both for traffic networks [1-10] and for communication networks [11-16]. In this paper, we firstly introduce the differences between the properties of traffic networks and communication networks, and then review the routing strategies in traffic networks and communication networks and their algorithms, respectively. Finally, we draw conclusions in the last section.

## Differences Between Traffic Networks and Communication Networks

Despite of similar function of traffic and communication networks, there are three major distinctions between them (Table 1). Firstly, the natures are different. The traffic network is a static network, whose structure could not change over an extended time. Communication network, on the other hand, is a dynamic network, whose topology keeps on changing all the time, because new nodes joining. Secondly, there are significant quantitative differences be- tween their sizes. The number of intersections is usually less than 10 thousand in an urban traffic network, while in a communication network, the number of nodes is more than one hundred million in general, and growing exponentially with time. Thirdly, when set up a route strategy of the

two networks, different factors are need to be considered, which should cover vehicles, road and human beings in traffic networks, while in communication network only involves the information of the node, such as degree, delivering capability, and the number of packets on a node. Due to these differences, the according routing strategies should be considered variously. Next, we will first review the route choice strategy in traffic network in the following section.

## Route Choice Strategy in Traffic Networks

There are dozens of route choice strategies for traffic systems, including travel time route choice strategy [1], mean velocity route choice strategy [2], congestion coefficient route choice strategy [3], piecewise function route choice strategy [4], vacancy length route choice strategy [5], flux information route choice strategy [6], exponential function route choice strategy [7], beltway route choice strategy [8] and so on. However, these strategies are proposed on the basis of one-dimensional traffic network, which differs greatly from urban traffic system. In 2011, Li et al. proposed a local algorithm using local traffic information, and applied it to the mean velocity route choice strategy in a two-dimensional traffic network. In their model, vehicles move along the shortest path, and if there are more than one shortest paths, vehicles will choose a road with the largest average speed to next intersection. Li et al. verified that this algorithm is more efficient than the shortest path strategy. Further in 2016, Chen et al. applied this algorithm to the congestion coefficient route choice strategy as well as the exponential function route choice strategy, and carried out simulations on Manhattan-like urban traffic network with traffic lights [10]. The effects of different traffic light rules under a variety of route choice strategies were also investigated. Recently, we proposed

| | **Traffic networks** | **Communication networks** |
|---|---|---|
| Nature | Static Network | Dynamic Network |
| Size | Intersections are less than 10 thousand | Nodes are more than one hundred million |
| Strategy | 1. Vehicle: Size, Speed, location<br>2. Road: One-lane, multi-lane, beltway<br>3. Human | 1. Degree of node<br>2. Delivering capability of node<br>3. Number of packets on a node |

**Table 1:** The differences between traffic networks and communication networks.

a global route algorithm based on the global traffic data. The results indicate that compared to local algorithms, the global algorithm can not only increase the critical density and the average flow, but also bring in more homogeneous distribution of vehicles. There- fore, global algorithm based route choice strategies with the global traffic data have dominant advantages in practical applications, as the static and modest size of traffic network leading to finite size of traffic data.

## Routing Strategy in Communication Networks

Routing strategies in communication networks can be classified into two types according to whether the information they used is local or global. The former called local routing strategy, consisting of local static routing strategy [11], local dynamic routing strategy [12], and pheromone routing strategy [13]. The routing strategy based on the global information is called the global routing strategy, including the shortest path strategy, the efficient routing strategy [14] and the global dynamic routing strategy [15]. Although results have shown that compared to the local routing strategies, the global routing strategies can significantly enhance the critical generation rate of information packets and reduce the average transmission time, they are beyond practical application considering the high searching cost for global information due to the huge size of communication networks whose nodes are growing exponentially with time. Thus the research of this field is mainly focus on local routing strategies.

Lin et al. recently proposed three algorithms for local routing strategies, i.e., the node duplication avoidance algorithm, the next-nearest-neighbor algorithm, and the restrictive queue length algorithm [16]. Each of them is an improved version based on the previous one. These algorithms all can increase the critical generation rate of information packets and decrease the average trans- mission time, especially the last one. After applying the restrictive queue length algorithm to the local routing strategies, the critical generation rate of information packets $R_c$ increases by over 10 times and the average transmission time h$T$i decreases by 70-90 percent.

## Conclusion

The routing strategies in traffic network and communication network are discussed in this paper. The connections and differences between them are discussed, and route strategies and algorithms for the two networks are reviewed respectively. The global strategies behave better than the local strategies in both networks. However, due to the huge size of communication network, the local routing strategy is more practical. On the other hand, the size of the traffic network is not as prohibitively large as that of communication network, and its

structure does not change in a long period, which could enable the possible application of global route choice strategy.

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