Relationship between application scale and maximum time latency in Intelligent Transport Solutions

Abstract
This paper investigates the relationship between the spatial scope of a traffic control measure and the maximum time latency of data used for this control measure. This means how old the data can be when the control action is determined, and includes data collection time, aggregation, communication and processing times. For a wide variety of measures it holds that larger areas allow for larger time latencies. If generalized, this can be used to determine the time latency for a desired control action, or it can be used to determine the smallest spatial scope given the latency of the current ITS systems.

Spatial scales
1. Vehicle
2. Local
   a) Node
   b) Segment / Link
3. String - multiple local elements combined, one main direction
4. Network - more than one string:
   a) Two or more parallel main roads
   b) Two or more crossing main roads

Application
1. For a desired spatial scale of control, the maximum latency can be determined
2. For current systems, the latency determines the minimum spatial size of the control area

Temporal scales
1. Latency
   How old can the information be before it is outdated?
   implications for measuring, processing, aggregation and communication
2. Duration of a control action
   How long is the control action
   (not considered here)

Other dimensions: expectations
- Availability: what fraction of the data is available
- Accuracy: how large are the errors in the available data

Conclusions
The maximum latency that an ITS system can have is related to the spatial scale of the control. The larger the spatial scale, the larger the allowed latency. Road authorities can use this relationship when specifying the (hardware) system requirements for an intended ITS system. Alternatively, given the available hardware, the road authority can determine what is the smallest spatial scale at which they can control. Similar relationships are expected for accuracy and availability.