Adaptive Traffic Control Systems

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Effects on traffic flows in a medium-sized city
Agenda

• Background
• Solution
• Evaluation Methods
• Effects
• Main conclusion
Aalborg in Europe
• Population in municipality: 194,000
• Population in Aalborg area: 126,000
• Area: 1,144 km²
• Inlet crossing traffic: ~99,000 ADT
A need for additional solutions

- General increase in traffic
- Change in car taxes – more although cleaner cars
- Traffic growth in the city
- Revitalisation of the harbour front
- To handle the increased and relocated traffic
The ring road, Østre Alle

- Central east-west-going distributor road
- Main entrance from North
- Two-lane carriageway
- Bicycle paths
- ADT >20,000
- Many intersections reduce capacity
- Congestion problems
Solution:

- Adaptive Traffic Control System (ATCS) on the ring road
  - UTOPIA/SPOT
  - Central monitoring and expanded possibilities for operating the traffic signals
  - Included traffic signals are optimized every third second
  - A forecast about the traffic flow the next 2 minutes is generated
  - The traffic signals are optimized to maximize traffic flow within the predefined frames in a traffic model
  - The model is based on traffic counts on all lanes and congestion registrations on the critical approaching lanes
  - Each intersection communicate with traffic signal, the other intersections and a central server
  - Various cost elements are used for each subsection, e.g. the cost for stopping a vehicle; the cost of the vehicle giving way; the cost of tailbacks
  - Also, bus priority is included in the system (not active)
• 8 (9) intersections
• 1,700 m
Evaluation method

- With/without study
- Data collection:
  - GPS-based Floating Car Data (FCD) on the ring road
  - Bus data on crossing roads
- Morning peak, noon, afternoon peak
- Results presented as:
  - Speed profiles
  - Travel times
Data collection 1: Floating Car Data

- Driving on the ring road
- The ‘chasing car method’
- FCD were collected with 1 Hz

<table>
<thead>
<tr>
<th>Included weekdays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, Wednesday, and Thursday</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Without</th>
<th>With</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Morning peak</th>
<th>Noon, off-peak</th>
<th>Afternoon peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.00-8.30</td>
<td>11.00-12.30</td>
<td>15.00-16.30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without</td>
</tr>
<tr>
<td>120</td>
</tr>
</tbody>
</table>
Data collection 2: Bus data

- Transportation time for crossing buses
- Time from bus stop to bus stop
- Part of the standard registration in the bus operating systems
- Timewise displaced (old data were unavailable)
- Similar time and weekday but new with/without periods
  - ACTS was deactivated for one week in late February 2013. The following week the with data were collected.

<table>
<thead>
<tr>
<th>Without</th>
<th>With</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 – 28 Feb 2013</td>
<td>5 – 7 Mar 2013</td>
</tr>
</tbody>
</table>
# Transportation time on the ring road

<table>
<thead>
<tr>
<th>Direction</th>
<th>Morning peak</th>
<th>Midday off peak</th>
<th>Afternoon peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transportation time</td>
<td>Mean speed (km/h)</td>
<td>Transportation time</td>
</tr>
<tr>
<td>East</td>
<td>With ATCS</td>
<td>4:12</td>
<td>31.4</td>
</tr>
<tr>
<td></td>
<td>Without</td>
<td>4:18</td>
<td>30.7</td>
</tr>
<tr>
<td>West</td>
<td>With ATCS</td>
<td>4:09</td>
<td>31.8</td>
</tr>
<tr>
<td></td>
<td>Without</td>
<td>4:02</td>
<td>32.8</td>
</tr>
<tr>
<td>Total</td>
<td>ATCS total</td>
<td>4:11</td>
<td>31.6</td>
</tr>
<tr>
<td></td>
<td>Without</td>
<td>4:10</td>
<td>31.7</td>
</tr>
</tbody>
</table>

*Statistically significant (p<0.05)
## Transportation time across the ring road

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Without</th>
<th>With ATSC</th>
<th>Without</th>
<th>With ATSC</th>
<th>Without</th>
<th>With ATSC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Morning peak</td>
<td>Midday off peak</td>
<td>Afternoon peak</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection D</td>
<td>1.40</td>
<td>1.49</td>
<td>1.26</td>
<td>1.34</td>
<td>1.36</td>
<td>1.53</td>
</tr>
<tr>
<td>Intersection F</td>
<td>1.38</td>
<td>1.34</td>
<td>1.24</td>
<td>1.32</td>
<td>1.25</td>
<td>1.36</td>
</tr>
<tr>
<td>Intersection H</td>
<td>1.41</td>
<td>1.38</td>
<td>1.43</td>
<td>1.27</td>
<td>1.49</td>
<td>1.41</td>
</tr>
<tr>
<td>Intersection H, Turning</td>
<td>0.42</td>
<td>1.12</td>
<td>0.29</td>
<td>0.30</td>
<td>0.53</td>
<td>0.49</td>
</tr>
<tr>
<td>Total (unweighted)</td>
<td>1.25</td>
<td>1.33</td>
<td>1.16</td>
<td>1.15</td>
<td>1.26</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Transportation time (s). >4 s differences are marked

**ITS: Real Solutions for Real Needs**
Main results

• Aalborg Municipality has installed ATCS on the main ring road
• Significant positive effects on the ring road in the most congested time (17%)
• Slightly negative effect on crossing traffic – especially on the western part of the ring road
Thank you

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