ANPR vs. Bluetooth

This case describes how data from ANPR cameras match corresponding Bluetooth sensor data.

The map shows an arterial road in the city of Aalborg with a total of 4 lanes, 2 in each direction. The measured road segment has 6 sets of traffic signals. 2 Bluetooth sensors and 4 ANPR cameras was mounted on the same poles at each end of the measured road segment.

Journey Time Quality

Measurements showed that in weather conditions with good visibility, ANPR cameras have a greater detection rate compared to Bluetooth, but as the dashboard to the right shows, the quality of journey time data is almost identical. BlipTrack supports ANPR camera as a data source and is able to provide journey time measurements based on these data. The same filtering engine was used to remove the outliers from the ANPR and Bluetooth data.

(The dashboard shows that the median travel time based on Bluetooth (blue line) and ANPR (green line) are almost identical. The blue bars represent Bluetooth detections and the green represent ANPR detections.)
ANPR vs. Bluetooth - “Snowfall”

Early morning on Friday, January 17th, 2014 the city of Aalborg, Denmark experienced heavy snowfall, which lasted throughout most of the weekend.

The dashboard below shows how the cameras, on the same road segment as mention on the previous page, almost completely stopped collecting traffic data from midnight on January 17th to late night on January 18th. The dashboard also shows that the cameras were not fully operational again until the morning on the 19th, indicating that snow was either blocking the camera lenses and/or the number plates on the cars.

Note that the snow had no effect on the Bluetooth sensors in the same period.
Filtering Engine

This case describes how BlipTrack is able to provide clean traffic data, in an urban environment, by filtering out outliers such as stopped vehicles, bicycles or pedestrians. The filtering is based on calculating a normal journey time per device, based on data from the immediate past, to see if the journey time of the specific device deviates from the current journey time.

BlipTrack eliminates data from devices, carried by cyclists and pedestrians (displayed below as red dots), if these have journey times deviating from those of the vehicles.

*Journey time was calculated from Bluetooth devices found in vehicles ONLY.*

Accuracy

BlipTrack is able to detect even small changes in traffic light duty-cycles.

The dashboard below shows how the median journey time, provided by BlipTrack sensors, is affected by a change in the duty cycle of the traffic signal controller, handling the traffic at the busy Randersbro junction in the city of Randers, Denmark.

The duty cycle is decreased from 80 sec to 60 sec at 9:00 pm.
Queue Information “Highway merge”

This case describes how BlipTrack is able to deliver detailed queue information from both segment and point perspectives. BlipTrack’ segment-based incident detection provides detailed real-time journey times, both in the sensors coverage, due to the directional antenna design (Time@Sensor), and between the sensors. This allows road operators to monitor the entire road segment, unlike traditional point-based solutions with limited coverage.

The illustration below shows a highway merge (E39 and E45) near Aalborg, Denmark. The sensors detects an increase in journey time between the two sensors, while there is no increase in journey time at the sensors.

This suggests a connection in speed and the potential for a queue to be building, probably due to the merge of highway E39 and E45.
Queue Information “Tunnel incident”

This case shows the effect of an incident in the Limfjord tunnel on highway E45. The sensors detected a queue build-up (south-bound traffic) both in and between the sensors. The collected data was compared to an incident report from the Danish Road Directory and the results showed that the Bliptrack solution can be used to detect incidents.

Report from the Danish Road Directory:

07:31 Reports of a car accident, south-bound direction in the Limfjordstunnel, leaving only one lane available.
07:43 Police and roadside assistance is on the site of the accident.
07:54 Wrecked car is removed.

The following data was collected from BlipTrack Bluetooth sensors mounted along highway E45:

07:28 An increase in journey times at sensor 3 is detected, indicating queue build-up.
07:29 Queue standstill between sensors 2 and 3.
07:34 An increase in journey times at sensor 2 is detected, indicating queue.
07:38 Queue standstill between sensors 1 and 2.
07:50 An increase in journey times at sensor 1 is detected, indicating queue.

The flow at sensors 4 and 5 was not affected, indicating that the accident happened between sensors 3 and 4.

BlipTrack dashboard displaying journey times at the time of the incident
Combined WiFi and Bluetooth “Seattle”

This case shows the results from a combined Bluetooth and Wi-Fi measurement. Four combined Bluetooth and WiFi sensors was roadside placed on route 522 in downtown Seattle, USA.

The dashboard below, shows the journey time from the southernmost road segment, in the southbound direction. The median journey time, based on Bluetooth, is the blue line, WiFi is the green line. Notice that the two lines are almost identical.

The dashboard below shows the total count of matched Bluetooth and Wi-Fi devices on a daily basis. Notice that there is approximately 20% more Wi-Fi detections compared to Bluetooth.

The detected Wi-Fi data comes primarily from smart phones. These devices are NOT detected by the Bluetooth sensors, due to the Bluetooth implementation in these phones. The Wi-Fi detections complements the Bluetooth data, increasing the sample rate significantly, providing much more precise measurements.
Detection Rate

More than 135 BlipTrack sensors are installed in the city of Aarhus, Denmark. The sensors provide journey times for all major road segments in and around the city.

The sensors in Aarhus shows that BlipTrack has a high detection rate of collected Bluetooth devices, which is important to provide accurate and reliable traffic data.

Our definition of a detection rate is as follows: A BlipTrack sensor would have a detection rate of 100% if all Bluetooth devices, which pass the sensor, are detected.

A high detection rate is important because:

1. It improves the number of matched devices between sensors. If two sensors each have a detection rate of 50%, they will only be able to provide travel time for 25% of the devices.

2. A high and consistent detection rate is also important for Origin and Destination analysis.

The BlipTrack sensors has a detection rate close to 100%. The detection rate was analysed using the sensors in the figure below.

Test methodology:
For each Bluetooth device detected at sensor 1, it was checked whether the device was also detected, within 10 minutes, at sensor 3. For each Bluetooth device detected at sensors 1 and 3, it was checked whether the device had been detected at sensor 2, between detections at sensor 1 and 3. The average detection rate in the tested period was: **96.6%**
Intersection Analysis

This case shows how journey times can be measured for all 12 possible directions in a four-way intersection. Sensors were placed before and after the intersection in order to obtain a detailed picture of turning movements.

There can obviously be large deviations between journey times for both straight through and left-right turning traffic. Sensor location and filtering logic should be considered carefully when measuring in intersections.

Some may only be interested in the journey times for straight through traffic, but these may be contaminated by data from turning traffic, if the sensor location and filtering logic is not considered carefully.