ITS and Cycling

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Copenhagen, Denmark, has long been known as one of the world's leading cities for cycling. In some areas of the city, the modal share of bikes has reached a level of as much as 50 %. And on some of the most frequently used bike paths the average daily number of cyclists is close to 30,000. As these numbers continue to rise, new ways of planning and implementing cycling infrastructure are needed.

Increasingly, Danish traffic planners are turning to technology as a tool for planning cycling infrastructure. In Ramboll Denmark, GIS is today an essential tool for both prioritizing and maintaining networks of bike paths. Using both in-house developed GIS applications that analyze data on traffic-safety related issues, road layouts and traffic measurements, it is possible to perform complex analyses, combined with technologies such as Bluetooth and GPS used for tracking the patterns of Danish cyclists. This enables the development of new and ambitious solutions. But technological progress in this area should not be constrained to planning – new technological advancements have also brought about the possibility of embedding technology directly in the solutions and concepts that are actually build.

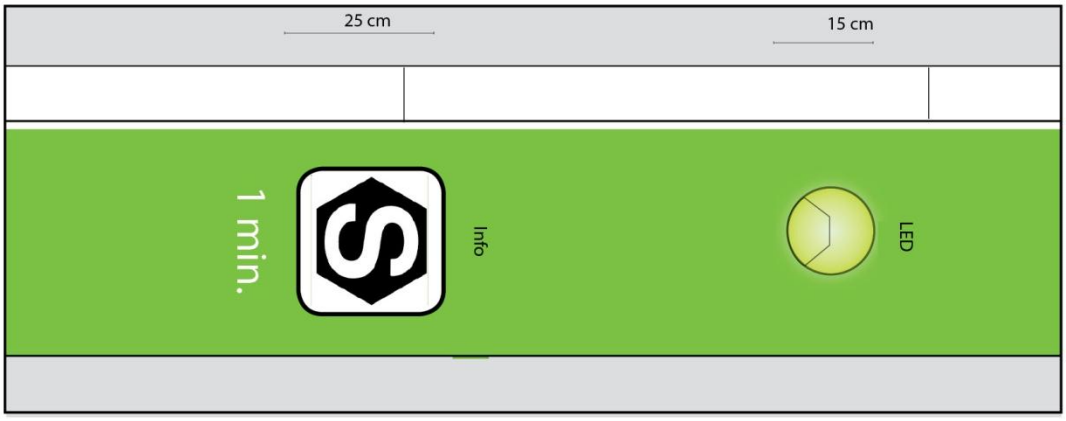
In what follows we will take a closer look at the current developments in this rising field that combines cycling infrastructure and ITS.

1) SUPER BIKE PATHS

Super Bike Paths are modern bike paths for the 21st century that are augmented using ITS to provide information, optimize capacity, enhance service and improve safety. The concept of Super Bike Paths was invented in 2008 by Wulff and Zibrandtsen, in the wake of an ITS competition held by the municipality of Copenhagen. A Super Bike Path can consist of a number of different elements and can gradually be expanded upon, but in its fundamental form, it includes certain defining elements:

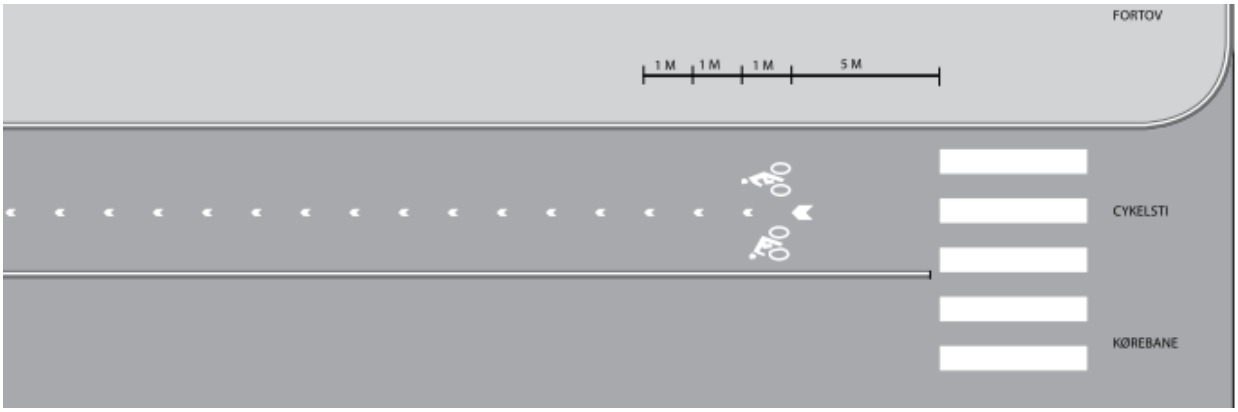
a) Info line

The info line is a 30 cm wide green line along the left edge of the bike path. The line is used for providing cyclists with information about their surroundings (for example the driving time to the nearest metro or train station) through the use of pictograms. But the info line also serves a different purpose; using lane lights it informs cyclists of whether or not they are currently set to make the next green light, allowing them to adjust their pace, so they will not have to stop for red.



b) Fast lane/comfort lane

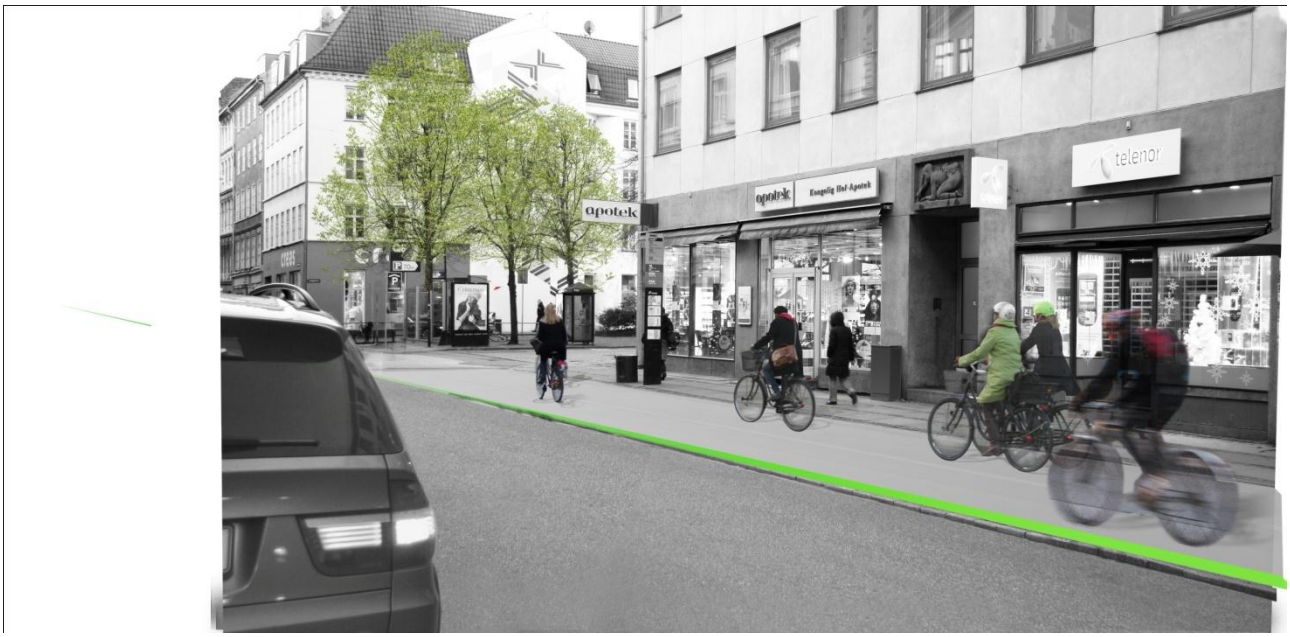
As the amount of cyclist continue to rise, the need to control the flow on the bike paths has become increasingly important. By dividing bike paths into a fast lane and a comfort lane, the Super Bike Path essentially strives to implement highway rules and norms on bike paths. This means that faster cyclists may use the left lane to overtake, while cyclists who are not in a hurry may use the right lane to ride at their own pace.



c) Dynamic bus stops

Traditionally, the way to safely combine a bike path and a bus stop has been to narrow down the bike path in order to make room for a traffic island that bus passengers can safely step out onto. The problem is that a traditional traffic island is static, and takes up space from the bike path, even when there are no busses at the bus stop.

Dynamic bus stops use virtual traffic islands to solve this problem. A virtual traffic island uses dynamic markings that is controlled remotely. As a bus approaches the bus stop, the traffic island is activated, and the bike path is narrowed down to make room for the passengers getting off the bus. As the bus leaves the bus stop, the traffic island is once again removed, thus freeing up the full width bike path again.



d) Service stations (from petrol station to service station)

As a means of creating a higher level of service for cyclists, service stations are placed along the Super Bike Path. These service stations aim to emulate and adapt the relationship between car and gas station by providing some of the same accommodations, but specifically and exclusively for cyclists.

A service station allows cyclists to fix flat tires, provides shelter (or waterproof ponchos) when it rains, and has bike lights, drinking water and interactive screens that provide cyclists with relevant information about traffic, public transportation, weather and the network of bike paths (for example by providing access to the official bike route planner of Copenhagen, http://ibikecph.dk/)

e) Green waves

In order to increase travel speed and reduce number of stops, the Super Bike Path also integrates with signalized junctions along the bike path to create green waves for cyclists.

The first green wave for cyclists

The first green wave for cyclists in Copenhagen was introduced in 2004 along a 2.2 km long section of Nørrebrogade that included 12 signalized junctions. This initial version of the system was set up using a static average speed (20 kph) that was based on the general average speed of cyclists traveling in Copenhagen. As it was not possible to have the green wave running in two directions at the same time, it was decided to apply the green wave toward the city between 6.00 and 12.00 and away from the city between 12.00 and 18.00.

The result of the Green Wave V1.0 was a reduction in travel time of approx. 17 % and a reduction in stops at junctions from an average of six stops before to an average of zero stops after. But despite

these great results, the system also proved to have room for improvement. Evaluations of Green Wave V1.0 showed that the green wave had an inconvenient side effect, increasing travel time for public transportation (busses) with up to 14 %. Furthermore the evaluations showed that using a static average speed to control the system wasted a lot of potential, as it did not take into account any variations in average travel speed that may result from variables such as weather (wind, rain, snow, etc.) or the amount of traffic on the bike paths.

Green Wave V2.0

To alleviate these issues, Ramboll and the municipality of Copenhagen are currently working on an improved system, Green Wave V2.0. The goal is to build a more intelligent green wave that dynamically adapts to the cyclists' current average travel speed, in order to ensure that more cyclists can benefit from the system, while at the same time ensuring that the public transportation runs as close to normal as possible.

The real time measurement of travel speed is carried by using Bluetooth collection points along the bike path. These perform both local speed measurement at certain points along the path (used for signal input and green wave settings), as well as travel time measurements for the entire journey along the green wave stretch.

With Green Wave V1.0 the direction of the green wave was static, going towards the city in the morning and from the city in the afternoon. By using the Bluetooth data it will be possible to alter the direction of the green wave depending on the actual number of cyclist in each direction. The Bluetooth data also provides valid input for decisions on whether cyclists should be prioritized over public transportation or vice versa. This may prove very useful, for example on rainy days, when there might be fewer cyclists and it therefore makes sense to improve the travel speed for the public transportation instead.

The implementation of Green Wave V2.0 will be concluded in the summer of 2013, and it will then be evaluated whether or not the dynamic adoption of the green wave speed has further reduced the travel for the cyclists.

2) PREVENTION OF RIGHT TURN ACCIDENTS

Concepts and initiatives such as the Super Bike Path seek to greatly increase the number of cyclists in the cities. But with a larger amount of cycling traffic follows consequently a larger risk of right turn accidents – especially in situations involving large vehicles such as trucks or vans. Factors such as limited visibility and blind spots mean that even with perfectly-adjusted mirrors, there is still a large risk that a truck driver happens to overlook a cyclist.

In 2009 – in an attempt to alleviate this problem – the City of Copenhagen turned to ITS in an experimental initiative involving four intersections. To heighten awareness and lower the effects of blind spots, the municipality placed lane lights along the edge of the bike path just before and in the intersections. The lane lights function as visual indicators that flash as cyclists enter this potentially dangerous zone, and thus provide truck drivers (even those with poor visibility) with a clear visual signal.

The system is quite simple in its structure, but has proved quite effective in reducing accidents. Two loops are installed in the bike path on the approach to the intersection (one approx. 25 m. from the intersection and another at the stop line) to detect cyclists, both when the signal is red, and when cyclists are approaching a green signal. Whenever the lights are green, the lane lights flash when bikes are detected in either of the loops.

Results from the initiative are clear: in 3 of 4 intersections the number of near conflicts resulting from right turns has been halved, and no accidents have been recorded. This just based on measurements

made during daylight. As an additional benefit the system also makes it easier for drivers to spot cyclists after dark; even cyclists not wearing bike lights.

3) FUTURE PROJECTS

a) Cyclist tax deduction

Among the future concepts currently under development to help increase cycling traffic is the concept of a cyclist tax deduction. The concept revolves around the idea of giving cyclists going to or from work or school a tax deduction/subsidy for each kilometre travelled by bike. Studies have shown that providing travellers with a monetary incentive such as this will greatly heighten their desire to choose the bike over the car, train or bus.

The concept relies heavily on ITS as a means of measuring the distance covered by a cyclist. The system works by embedding a GPS in the cyclist's bike helmet, which has the added benefit of promoting the usage of bike helmets. The GPS continuously tracks distance that the cyclist travels, and every so often this data is uploaded to the City of Copenhagen, where it is validated using metrics such as localization, speed or wheel rotation.

b) BikeCraft: Gamifying cycling

Another concept that aims to put an incentive spin on cycling is BikeCraft. BikeCraft is a cross-media game based on cycling that seeks to combine the real and the virtual world in an innovative and alternative way. The end goal is to get more people up on their bikes, but BikeCraft adds a layer of "gamification", meaning that it seeks to turn the activity into a game by using various game mechanisms; for example giving players rewards for completing certain tasks.

The basic idea behind the game is to blend the real cityscape with a web-based parallel universe. The game relies on GPS tracking, location-based services (LBS), augmented reality (AR) and existing social media technologies to enable the full experience.