

The authorities' intention is to develop a working, near real-time traffic emissions forecast model. The model chosen for this work is the Nowcaster traffic model from OPSIS Ltd of Sweden. Specific enhancements to the model are being developed by OPSIS to meet this authorities requirements. The model will compute pollution loadings along the primary routes, initially located within the lower Swansea Valley road network every hour or more frequently if this proves necessary. It is the intention to expand the forecast area in future years to cover the majority of the authorities' area. The model will have an interface with variable message signs and will broadcast specific messages to specific signs in an attempt to manage the traffic flows.

## **Data Requirements – A Brief Overview**

In order to operate, the Nowcaster model requires the construction of an emissions database. This database is in the process of construction and will identify and classify every road within the City & County of Swansea. Details of road width, pavement width and the distance and height of buildings on each road section will be input into the emissions database. All industrial, point and area sources will be defined and included onto the database. Emission factors will then be determined for each source.

A major data input into the Nowcaster model is detailed information of traffic flows. In the first phase of this project 23 GPRS (General Packet Radio Service) Automatic Traffic Counters (ATC's) have been installed within the road network to the lower Swansea Valley area. The second phase commenced in June 2004 and has seen the addition of a further 7 GPRS ATC mainly within the Fforestfach, Cockett and Sketty areas of Swansea. The ATC's have been

configured to produce a vehicle by vehicle classification to the EUR6 standard shown below,

Class	Description
0	Unclassified
1	Motorcycle
2	Car or Light Van
3	Car or Light Van with Trailer
4	Heavy Van, Mini Bus, LGV, MGV or HGV
5	Articulated Lorry, HGV and Trailer
6	Bus

EUR6 – Vehicle Classification

the speed of the vehicle and direction of the vehicle. Vehicle by vehicle data is transmitted via the GPRS network to dedicated FTP servers located within the authority, in blocks of 5 minute data. The data path taken from the ATC via the Vodafone GPRS network can be seen in diagram 1 below. For security purposes the data passes through a secure IPSEC Tunnel and is terminated via a Cisco Pix device at the FTP site. Please note that all IP addresses given in diagram 1 are false for security considerations, and are intended for illustration purposes only.

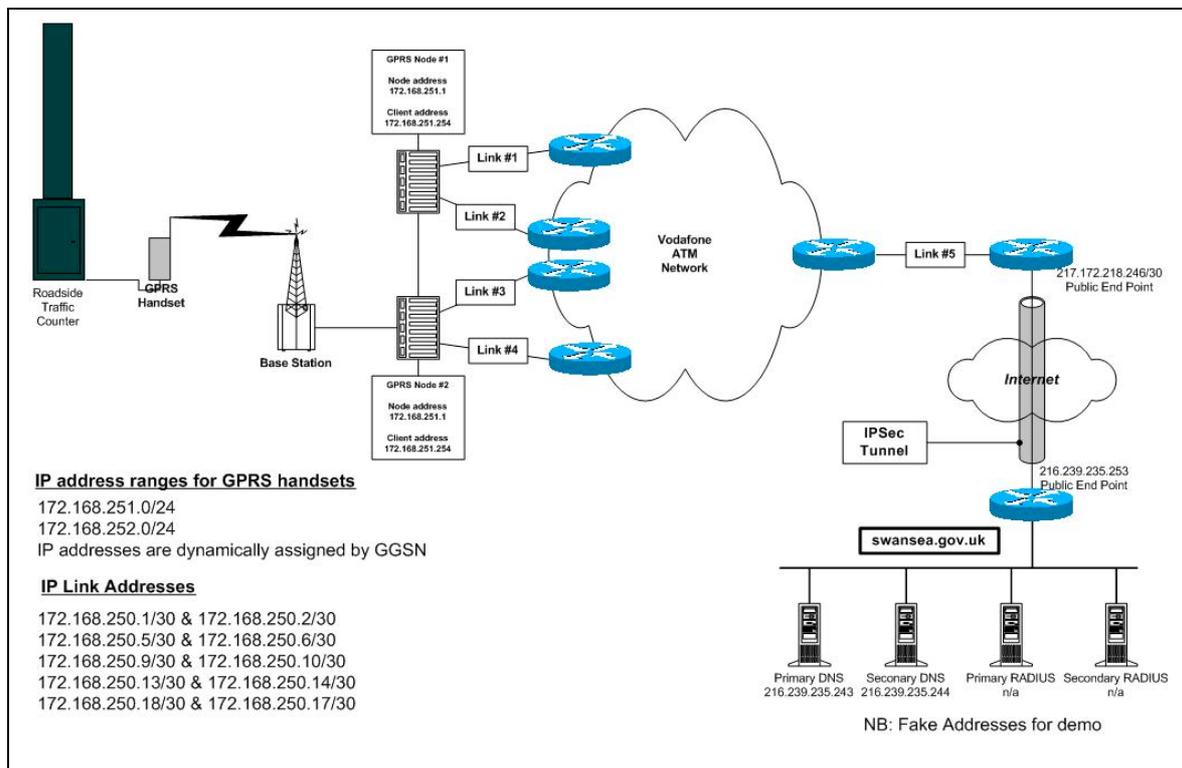


Diagram 1 – Schematic of GPRS data system and path

Meteorological data will be received via FTP from the Danish Met Office. The forecast will span three days as hourly time series. The forecasts will be updated four times every day, initialised at 00, 06, 12 and 18 UTC. The weather forecasts include the following parameters: Wind speed (10 m, 80 m and 800 m), wind direction (10 m, 80m and 800m), temperature (2 m, 80 m and 800 m), mean sea level pressure, precipitation (convective, stratisform and snow), boundary layer height, friction velocity, surface heat flux, relative humidity, and cloud cover (low and high).

Real-time air quality data will be processed from the four automatic monitoring sites at the Swansea AURN, Morfa Groundhog , Morriston Groundhog and the Hafod Differential Optical Absorption Spectroscopy (DOAS) monitoring station.

A vital requirement of this project is to validate the output of the Nowcaster model. This can best be achieved by validation of the predicted output of the model by measurement of real-time air quality data along a typical congested street. Neath Road has been chosen as the validation point. An OPSIS DOAS open path light source will measure the pollutants Nitric Oxide, Nitrogen Dioxide, Ozone and Benzene along a 250-metre section of Neath Road. These measurements will take place at first floor level - a height of approximately 3 - 4 metres. The DOAS transmitter will be fixed externally to the front wall of a terraced dwelling that fronts onto Neath Road at one end of the open path measurement, with the receiver module being located on the front wall of another dwelling that also fronts onto Neath Road at the other end of the open path length. The monitoring location will allow measurements' running parallel to the carriageway to be made of the above pollutants, as the carriageway of

Neath Road is approximately 2 metres away from the front façade of these terraced dwellings. These data will have a resolution of 3 minutes and will be used to determine and evaluate the atmospheric chemistry responsible for the formation of NO<sub>2</sub> (and O<sub>3</sub>) within the street, as well as the validation of the predictive output from Nowcaster. As part of the validation process, vertical and horizontal wind speed and wind direction measurements will be taken at first floor level at Hafod Post Office, Neath Road. Horizontal wind speed and wind direction will also be recorded from above roof ridge level. Global radiation, ambient air temperature and relative humidity will be measured at first floor level at the Hafod Post Office site. These measurements will have a resolution of 1 minute and will aid the definition of the vertices and mixing capacity of the street “canyon” – vital information if the model is to be properly validated.

The Nowcaster model will have the OPSIS EnviMet server module running in the background, compiling climatological datasets from the three meteorological stations located at the Guildhall (OPSIS Met), Morfa Groundhog and Morryston Groundhog and the station at Hafod Post Office. Nowcaster will receive input parameters from all generated climatological datasets to enable an accurate forecast to be made.

A brief schematic diagram representing the major data input parameter's and predictive output of the Nowcaster model can be see below in diagram 2.

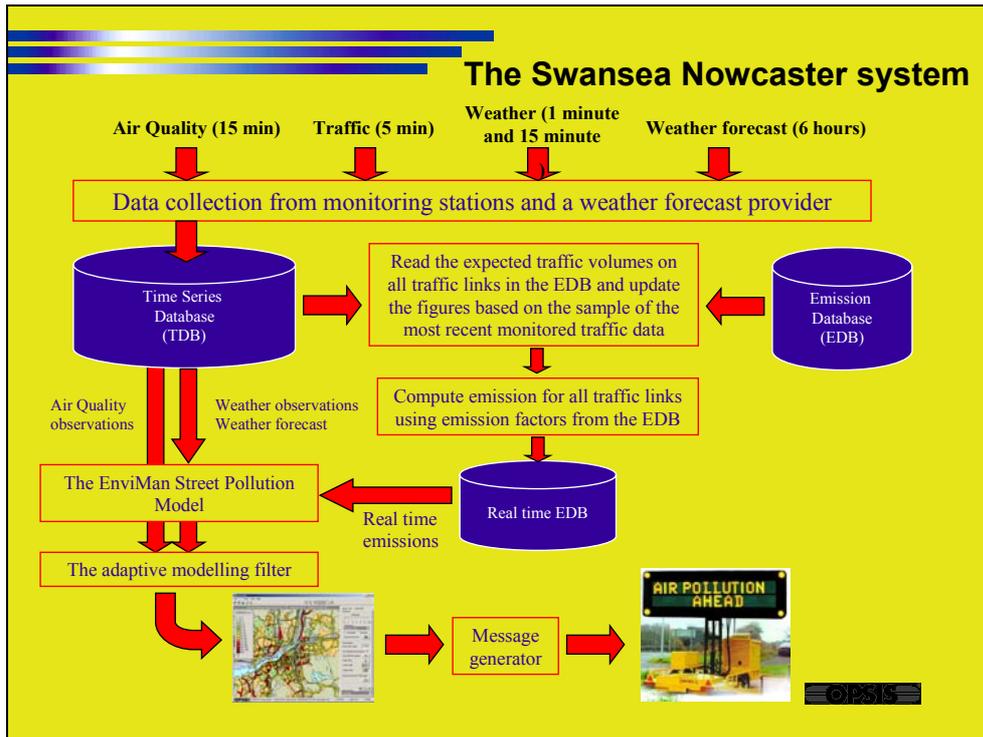


Diagram 2 – Nowcaster data parameter inputs and predicted output.

## Predictive Output

Nowcaster will perform several tasks in predicting hourly pollution levels within each road link. Firstly, output will be in a colour coded graphical form on a pre-defined digital map. Pollution loadings for the various pollutants will be graded according to a colour scale. These maps will be uploaded to web pages every hour and will give a visual indication of existing pollution levels together with hourly predictions for up to 8 hours into the future.

It is intended to link the model Nowcaster with the Variable Message Signs interface TRAMS. Nowcaster will send status signals to TRAMS for those section(s) of road links that are/may exceed predefined levels. Variable Message Signs will be sited strategically on the road infrastructure, initially within the Lower Swansea Valley area. Subsequent years of this project will see this provision expanded to other areas. TRAMS will have been pre-programmed

with a set of logical instructions to determine which sign receives which message for the existing/predicted conditions, as not all signs will receive the same message. This ability to forecast conditions ahead, allows an opportunity for management of the traffic flows in the lower valley area and for the traffic to be redirected away from area(s) identified as likely to experience pollution incidents. It is planned to incorporate information relating to available parking spaces within the City Centre and at the authorities Park and Ride sites. This additional information will enable the motorist to make an informed decision regarding their final destination. Information will also be transmitted to the Variable Message Signs as a result of traffic speed/flow information received from the ATC's i.e. congestion/slow moving traffic ahead etc, as the system will be able to determine in which direction slow moving traffic is being detected.

The Action Plan will also include details on existing strategies (Park & Ride) and consultation (Integrated Hafod Transport Study) as well as promoting the increased use of alternative methods of transport i.e. cycling. Policy developments are also included and cover topics such as bus corridor enhancements, enhancement of bus and rail stations, bus priority routes, safe routes to school etc.

It is planned to make available on-line the Action Plan when its formulation is complete.