Il sistema sperimentale per la misurazione in mobilità di traffico e inquinamento dell'aria.

3nd INTEGREEN workshop

26/02/2015

Outline

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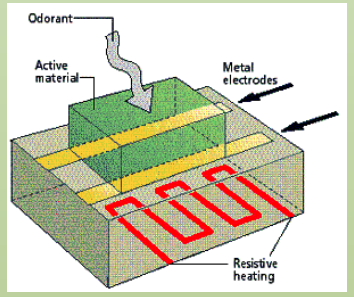
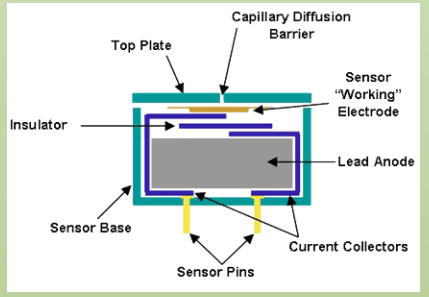
Traffic and environmental monitoring systems

Evaluation of mobile air pollution sensing techniques:

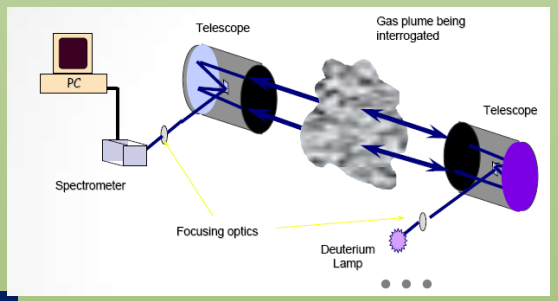
- **Chemo-resistive MOX**: based on variations of sensor resistivity
- **Electrochemical sensors**: active measurement principle (gas oxidation / reduction)
- **Optical gas sensors**: measurement of the impact that gas have on light absorption



Souce: University of Siena



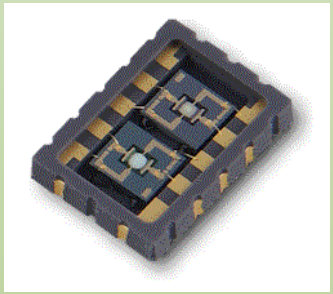
Souce: equipcoservices.com



Souce: DUVAS

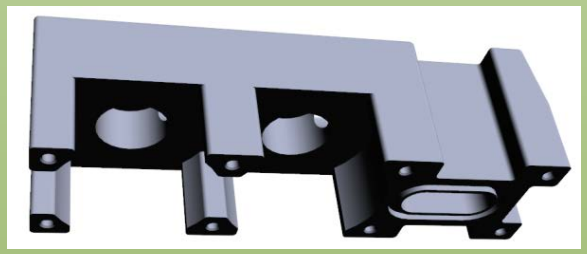
Evaluation based on different specifications, in particular: response time, non-linearity, zero drift and cross-sensitivity

Traffic and environmental monitoring systems



Air pollution sensor selection

- **Nitroge dioxide** (NO_2): electrochemical and MOX sensor
- **Ozone** (O_3): electrochemical sensor
- **Carbon monoxide** (CO): MOX sensor
- **Analog-to-digital converter** (for analogue sensors)
- **Temperature and humidity** sensors
- **Sensor Control Unit** (data reading and communication with on-board telematic unit)
- **GPS receiver**
- **Ad-hoc air guide**



Traffic and environmental monitoring systems

- Most of the design choices replicated for the on-board traffic unit as well.
- Integration and selection of precise **accelerometers**: this will allow to make specific measurement campaign on the correlation between fuel consumption and driving parameters.
- An interface is available with the **CAN-Bus network** in order to collect the available vehicular data as well.

Traffic and environmental monitoring systems

- The core «engine» of the mobile system:
  - ❑ Receives the data from the monitoring units
  - ❑ **Pre-processing** of the raw measurements
  - ❑ Remote **data transmission** to the vehicle front-end
- Detailed design activities:
  - ❑ Car-PC selection
  - ❑ **Real-time** interface to the on-board sensors
  - ❑ Local **data management** and communication system

Powerful unit that supports advanced telematic applications

Traffic and environmental monitoring systems

- HMIs :
  - **Fixed mounted Graphical Display**
  - **Handheld Tablet**

Traffic and environmental monitoring systems

- **On-board system prototypes**
  - ❑ Electronic design in house
  - ❑ PCB layout design and production

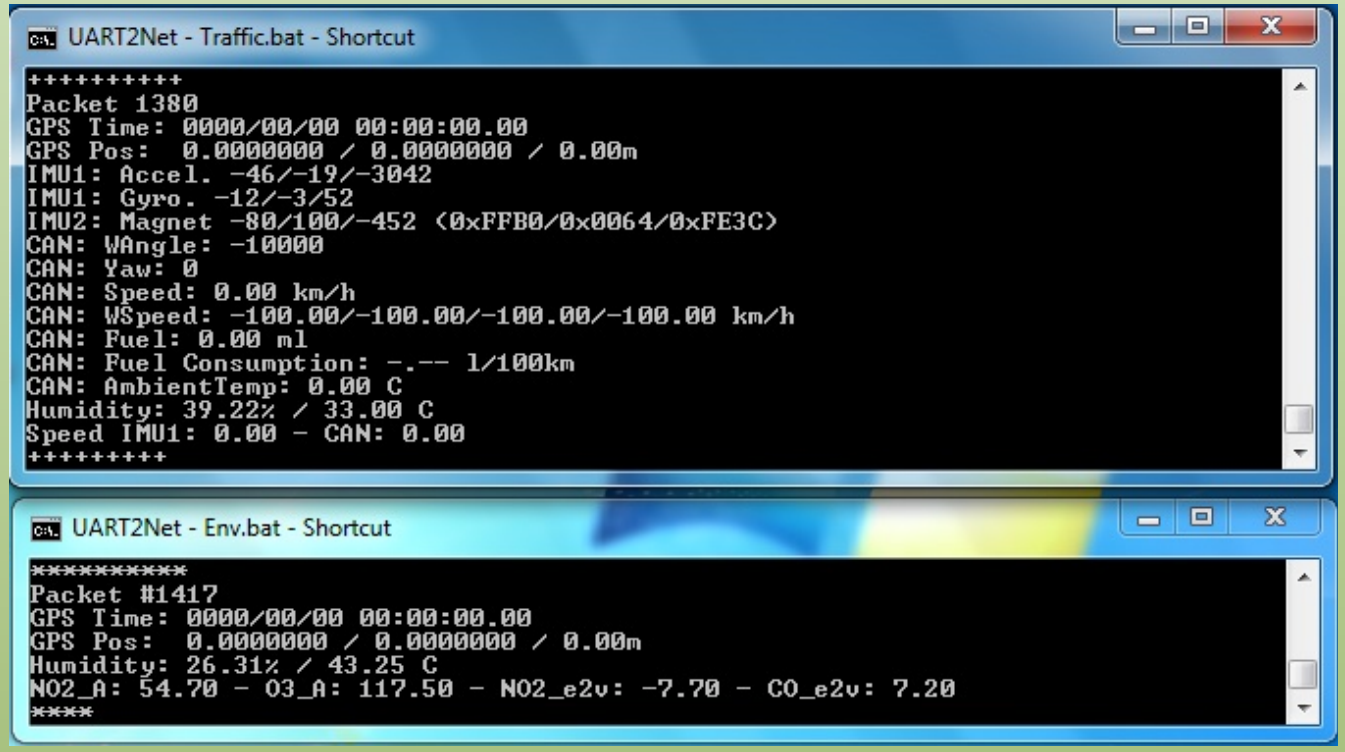
On-board traffic monitoring unit

On-board environmental unit

Tests and calibration

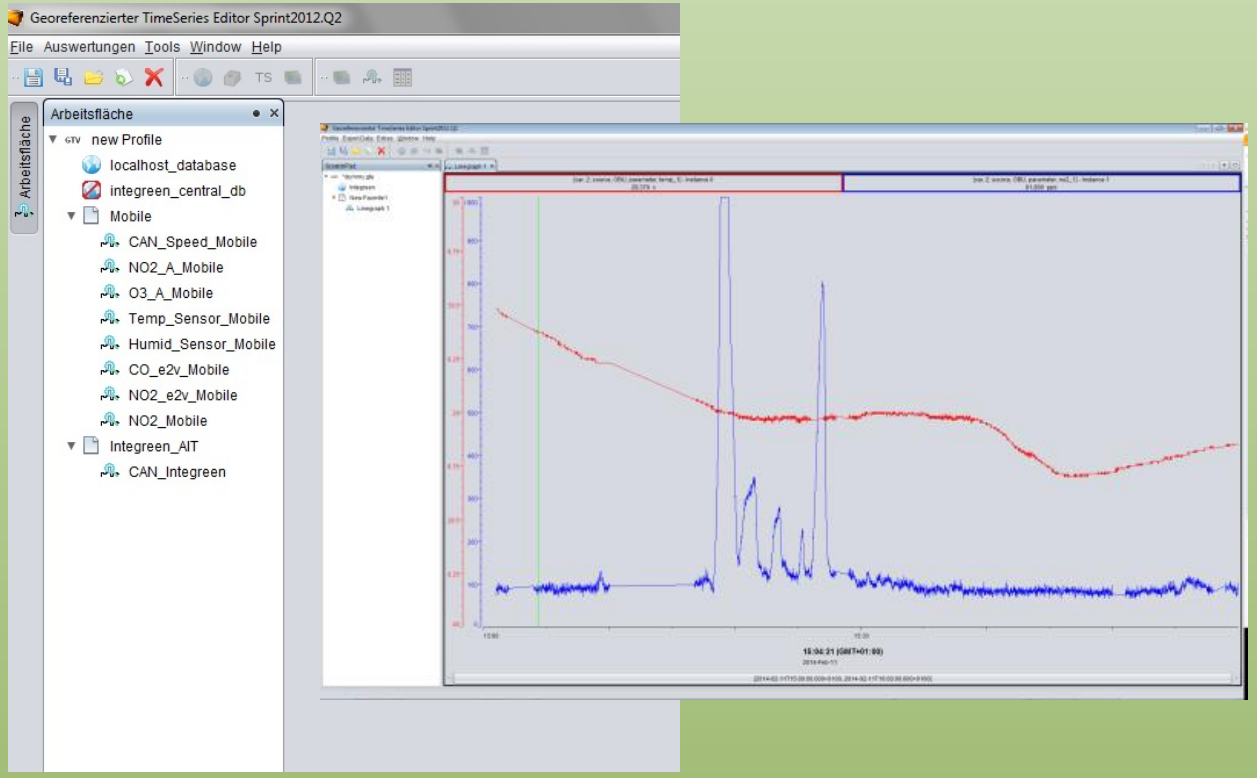
- **On-board HMI**

Detailed evaluation of the real-time measurements gathered by the on-board monitoring units



Tests and calibration

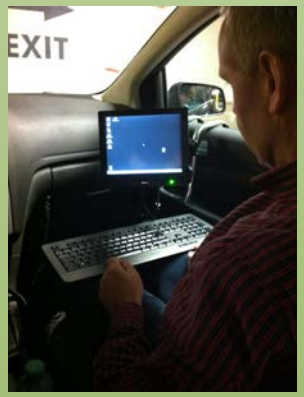
- **On-board HMI**



Graphical visualization of the measurement trends, immediate assessment of the mobile system performance

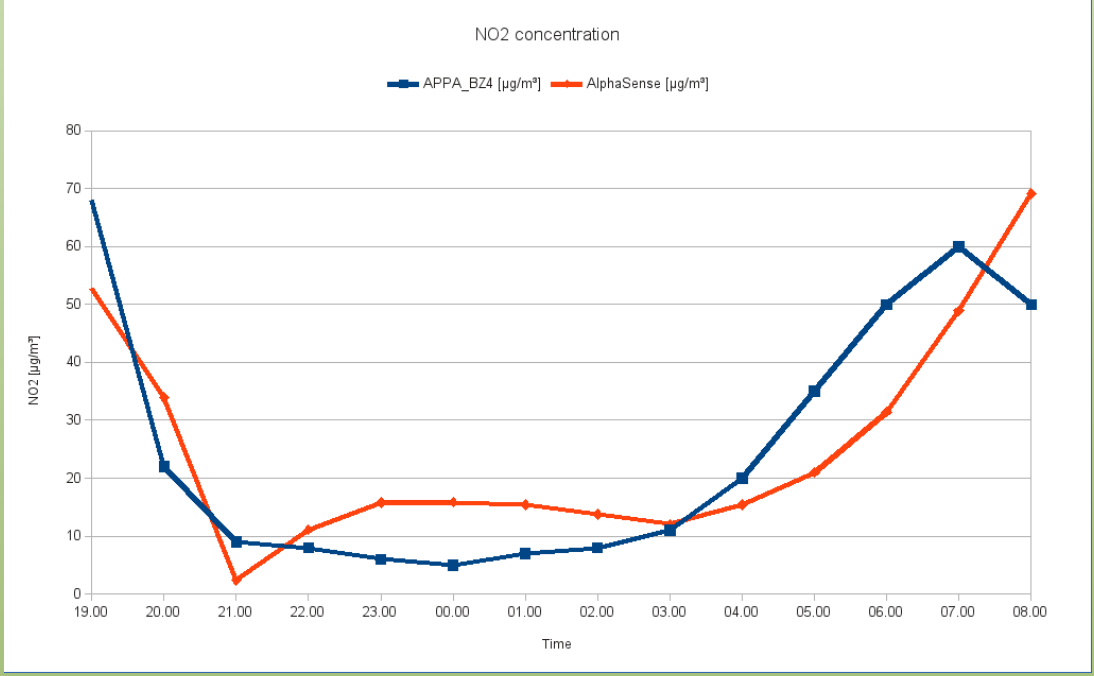
Tests and calibration

- **Joint component test session**
  - ❑ **Static measurements** near official air quality stations
  - ❑ **Different use cases** analyzed: mobile measurements on the reference test route and in harsh environments, including the A22 highway.



Tests and calibration

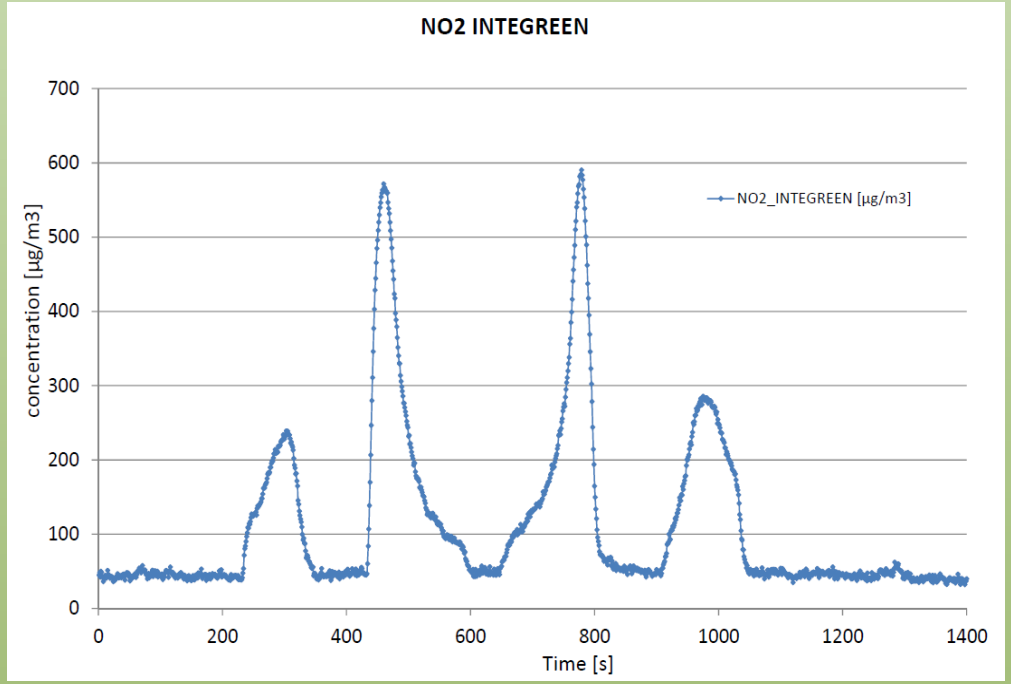
- **Calibration with static measurement station**



- Compairable behavior in **static conditions**, if compared to reference air pollution stations.
- More tests to improve the compromise between **fast and accurate measurements capability**

Tests and calibration

- **Calibration: time response**



- Tests in tunnels
- Measurement in both directions give the same result

Tests and calibration

- **Comparison of 2 systems**
  - ❑ TIS-System and AIT-System: output of the first goes the input of second system
  - ❑ Measurement results are very similar

Deployment in car sharing, SASA bus, AIT test vehicle

- **AIT test vehicle**
  - ❑ Verification of the entire communication chain
  - ❑ Verification of the performance of the mobile system (and XFCD data analyzer)

Deployment in car sharing, SASA bus, AIT test vehicle

- **New compact Mobile INTEGREEN System**

Deployment in car sharing, SASA bus, AIT test vehicle

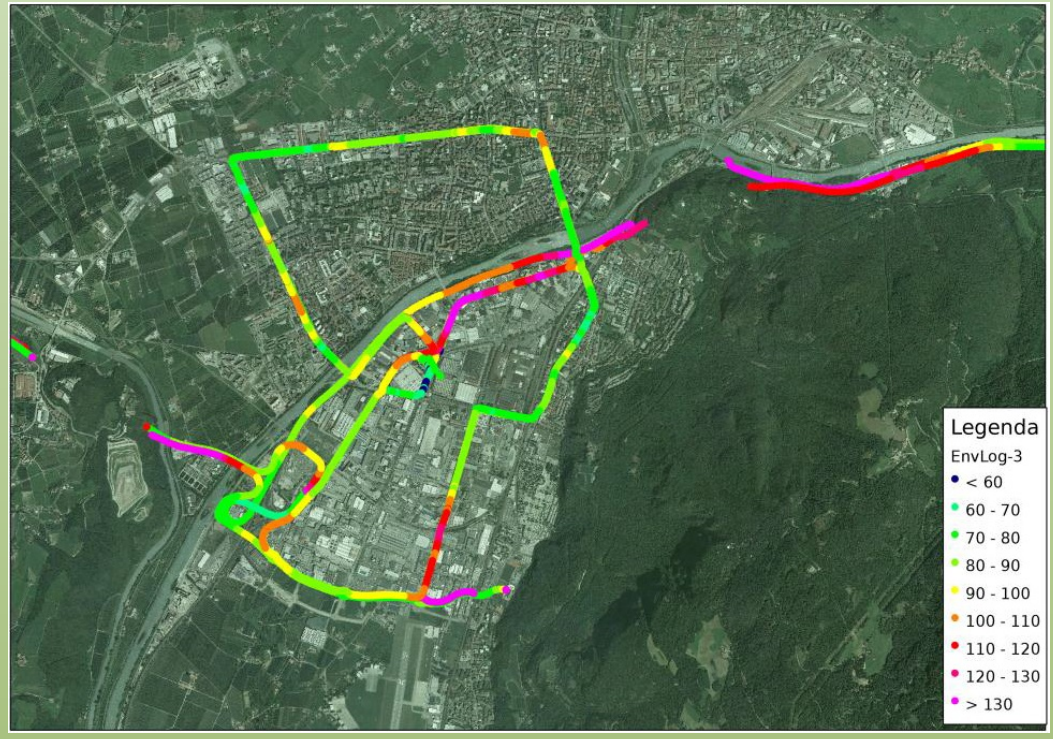
- **Mounting on the Bolzano car sharing test vehicle**

Deployment in car sharing, SASA bus, AIT test vehicle

- **SASA H_2 powered Fuel Cell bus of EU funded CHIC-Project**
  - ❑ Automatic start and stop
  - ❑ Hidden mounting

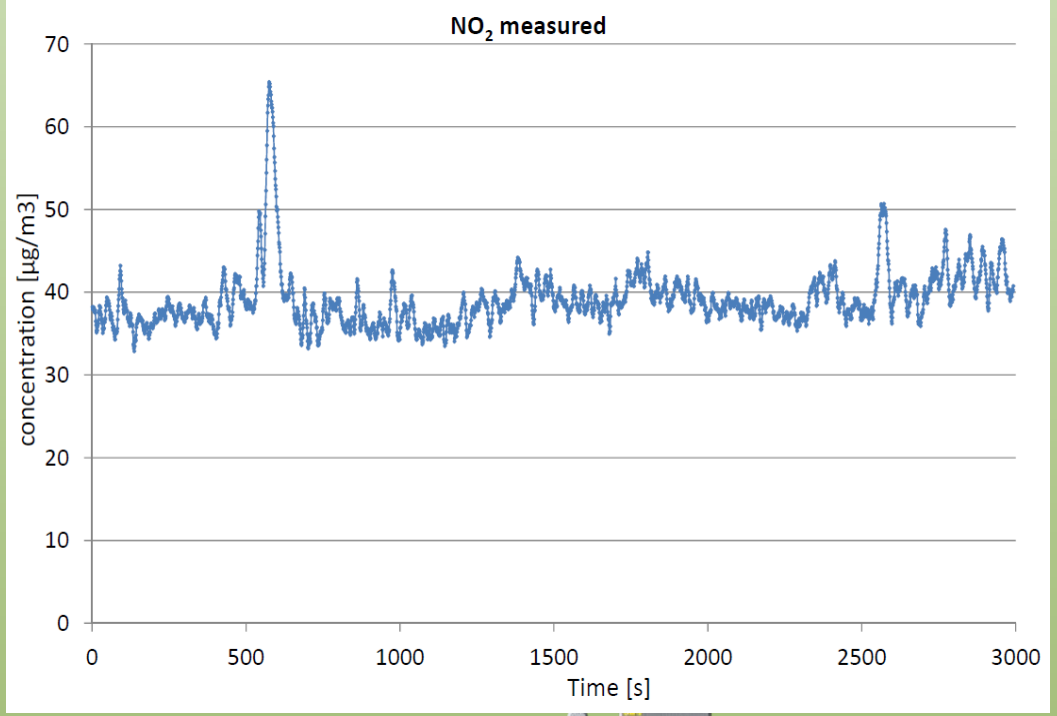
Field measurement

- **Joint component test session**
  - ❑ **Results:** air pollution togheter with position stamps
  - ❑ Red areas: traffic jam (stop and go), motorway



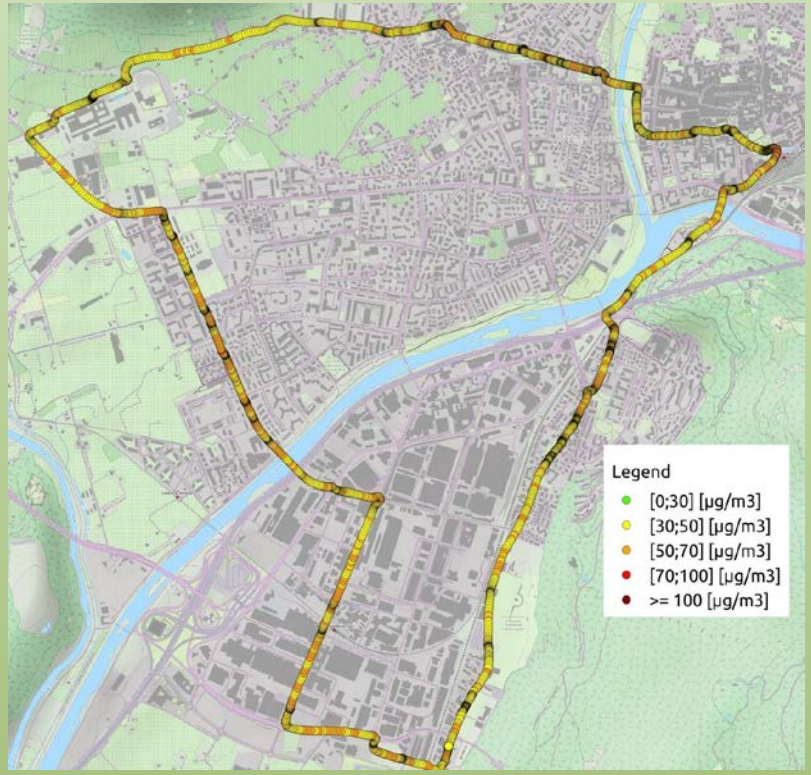
Field measurement

- **Test on urban road**
  - ❑ Measurement result in **time graph**
  - ❑ **High temporal** and geographical resolution



Field measurement

- **Test on urban road**
  - ❑ **Druso** and **Galilei Street**
  - ❑ Tipical increase on **crossroads**



Future applications

- **Future applications**
  - ❑ **Private** vehicle
  - ❑ **Public** vehicle
  - ❑ **Handheld** mobile device
  - ❑ **Automotiv** industrie
  - ❑ **Air pollution measurement agencies**
  - ❑ Research in **pollution distribution**
  - ❑ **…**

Further research activities

- **New EU-project submission DIANA**
  - ❑ **Low emission zone**
  - ❑ Further **miniaturisation** and **industrialisation** of Mobile System**, low price**
  - ❑ Cooperation and deployment in **other european cities**

Summary

Summary

- Ad-hoc design of traffic and environmental monitoring unit
- Air-guide and air-flow control, fast measurement
- Real-time data transmission to INTEGREEN server
- Portable test system for generic and special vehicle use
- Deployment on AIT test vehicle, car sharing vehicle, SASA bus
- Substantial field tests (Bolzano and Vienna)
- Industrial applications
- Further research activities